

MOUSE LTS

User Guide



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PART I

INTRODUCTION TO MOUSE LTS





1 ABOUT MOUSE LTS MODULE

1.1 Key Features and Application Domain

The MOUSE LTS (Long Term Statistics) Module allows that a MOUSE network with intermittent hydrological inputs can be set up for a long-term simulation, covering a long, continuous historical period. The system automatically selects the periods for dynamic pipe flow simulations during wet weather. This reduces the simulation time significantly, while preserving the accuracy in the simulation of relevant dynamic effects in the system - CSOs, surcharges, etc. For example, by running successive MOUSE LTS simulations with the existing drainage system configuration and the planned upgrade, impacts of the planned investments (e.g. new sewers, retention tanks, RTC schemes) on the system performance can be reliably tested and evaluated. This allows the user to develop the optimal rehabilitation / upgrade strategy, e.g. for satisfying the requirements of environmental regulations.

The MOUSE LTS module features an easy way to convert a usual MOUSE simulation covering a long historical period into a discontinuous series of relevant events feasible for the simulation, and to define various event-based and annual statistics for the selected parameters.

The simulation results can be presented in MIKE View, both in the form of time series and as a range of statistical parameters for the selected variables.

1.2 Software Implementation

MOUSE LTS is an add-on module to MOUSE HD Pipe Flow Model. The MOUSE LTS capabilities can be accessed only after the MOUSE license has been extended to include MOUSE LTS. For details about the DHI copy protection system and the license update procedure, please refer to the 'MOUSE Installation and Update Guide'.

MOUSE LTS utilizes the standard MOUSE Windows interface with on-line HELP facility, which has been extended to accommodate some specific actions related to MOUSE LTS. This implies that the MOUSE on-line HELP system and documentation related to the standard versions of MOUSE are essential as a support for work with this model (ref./1/ and /2/).





2 ABOUT MOUSE LTS USER GUIDE

This manual provides information related to the principles and techniques for running discontinuous MOUSE LTS simulations. It is assumed throughout this manual that the user is well acquainted with the standard MOUSE system.

Usage of MOUSE and its other add-on modules is described in respective User Guides & Tutorials.

This manual is divided into two units:

- **Part I: Introduction**
Some general information about MOUSE LTS and about this document.
- **Part II: MOUSE LTS User Guide**
Basic information about MOUSE LTS principles and techniques.





3 MOUSE LTS USER SUPPORT

3.1 Product Support

If you have questions or problems concerning MOUSE LTS, please consult the documentation (Installation and Update Guide and MOUSE LTS User Guide) first. Secondly, look in the README files that came with your installation. If you have access to the Internet, you may also have a look under 'Frequently Asked Questions' or 'Problems & Work-arounds' on the MOUSE Home Page. The MOUSE Home Page is located at <http://www.dhisoftware.com/mouse>.

If you cannot find the answer to your queries, please contact your local agent.

In countries where no local agent is present, you may contact DHI directly by mail, phone, fax or e-mail:

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When you contact your local agent or DHI, you should prepare the following information:

The version number of MOUSE that you are using.

- The type of hardware you are using including available memory.
- The exact wording of any messages that appeared on the screen.
- A description of what happened and what you were doing when the problem occurred.
- A description of how you tried to solve the problem.

3.2 DHI Training Courses

DHI software is often used to solve complex and complicated problems, which requires a good perception of modelling techniques and the capabilities of the software.

Therefore DHI provides training courses in the use of our products. A list of standard courses is offered to our clients, ranging from introduction courses to courses for more advanced users. The courses are advertised via DHI Software News and via DHI home page on the Internet (<http://www.dhi.dk>).

DHI can adapt training courses to very specific subjects and personal wishes. DHI can also assist you in your effort to build models applying the MOUSE software.

If you have any questions regarding DHI training courses do not hesitate to contact us.

3.3 Comments and Suggestions

Success in perception of the information presented in this document, together with the user's general knowledge of urban sewer systems and experience in numerical modelling, is essential for getting a maximum benefit from MOUSE LTS. This implies that the quality of the



documentation, in terms of presentation style, completeness and scientific competence, constitutes an important aspect of the software product quality. DHI will, therefore, appreciate any suggestion in that respect, hoping that future editions will contribute to the improved overall quality of MOUSE LTS.

Please submit your contribution via e-mail, fax or letter.



PART II

MOUSE LTS USER GUIDE





1 BACKGROUND

Statistics on maximum water levels, discharges from weirs, etc., generated by simulating long loading series (e.g. historical rainfall records), is a specific form of results from numerical simulation models that is particularly useful for the evaluation of the simulated system functionality. Statistics can be used to compare the effects of various mitigation measures in the planned rehabilitation process, the performance of various RTC strategies, the cost-benefit efficiency of the planned investments, as well as to determine whether the functionality of the sewer system is satisfactory compared with legislative requirements.

Functionality of urban drainage systems is often subject to requirements like:

- Flooding on terrain must not happen more than once every T years.
- Flooding of basements must not happen more than once every T years.
- Discharge from CSO weirs to receiving waters must not happen more than n times per year.
- Total volume from CSOs must not exceed a certain threshold amount per year.
- Etc.

MOUSE LTS is able to answer these kinds of questions and thereby appears as an essential simulation tool for a reliable assessment of system performance.

Statistics on some operational parameters are only reliable if the simulated number of more or less independent events is sufficiently large, i.e. if the simulated historical period is sufficiently long. This, in turn, may imply very long simulation times (if 'normal' computing hardware is applied) and thereby spoil the feasibility of the analysis.

However, use of dynamic simulation for the hydraulic and pollution transport analysis of drainage networks is only beneficial in periods of high-flow dynamics. Otherwise, simpler and much faster simulation tools can be used with a similar level of accuracy. Since high-flow dynamics in urban drainage networks are normally associated with rainfall events, the dynamically simulated periods can be reduced to the wet periods, i.e. to only a few percent of the certain historical period.

The fundamental principle behind the MOUSE LTS concept is therefore the ability to reduce the simulation time without losing significant information. MOUSE LTS is able, based on the user-specified criteria, to eliminate the irrelevant periods from the simulated series, and to limit the dynamic simulations to a series of disconnected events, instead of the entire simulation period.





2 DATA INPUT

2.1 Job List

For the purpose of isolating the intervals relevant for dynamic simulation, MOUSE LTS generates a job list on the basis of system information and knowledge of time series for dry weather flow (i.e. wastewater), rainfall and other loads. Initially, the generated job list contains the simulation jobs which cover those intervals in the total simulation period that would be simulated if no additional criteria were specified. Namely, some additional criteria (so-called 'runtime criteria') may optionally be specified, which would extend the simulations beyond the time intervals defined in the job list. Since the 'runtime criteria' are evaluated during the simulation, it is not possible to determine the exact duration of the dynamic simulation in advance.

The job list can be edited, so that the actual start time and date and the estimated stop time for the individual jobs may be modified according to specific requirements.

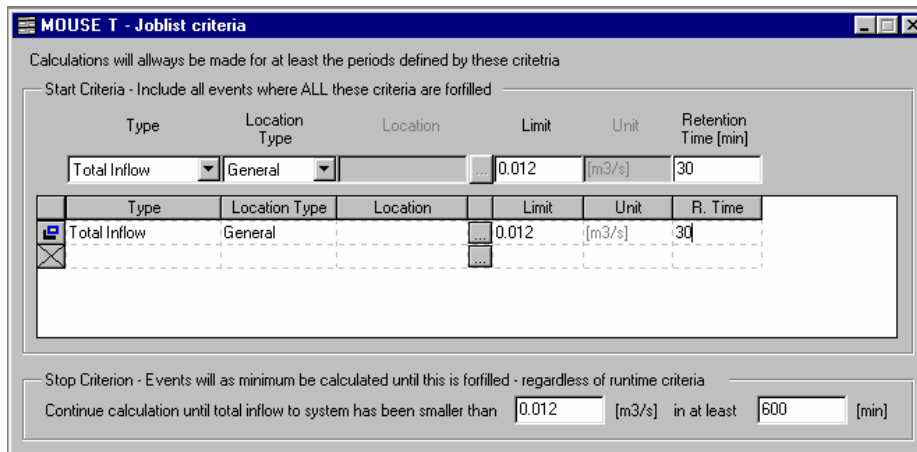
2.1.1 Job List Criteria ("*LTS* | Job List Criteria")

Job list criteria are used to select the intervals which (at least) should be calculated with the hydrodynamic model during a computation with MOUSE LTS.

The job list criteria represent actually various thresholds for the system loading, which are used to evaluate if the state of the system is within or outside the "dynamic" conditions. There are separate START criteria, which determine the start dates and times for the dynamic simulations, and a single STOP criterion, which is used for the estimation of the ending dates and times for dynamic simulations.

The START criteria are evaluated against the loading time series - dry weather flow, rainfall events, etc., for the system as a whole, for a part of the system, or for an individual sub-catchment. A number of START criteria can be defined, and if at least one of them is fulfilled, a certain "event" will be included into the job list.

The STOP criterion includes a threshold for the total load for the entire system, and an additional time condition which extends the simulation for the specified time after the loading has fallen below the threshold. The objective of the STOP criterion is to delimit the dynamic simulation, but without a potential loss of important information due to the time offset between the loads and effects in the sewer network.



Type	Location Type	Location	Limit	Unit	Retention Time [min]
Total Inflow	General		0.012	[m3/s]	30

Type	Location Type	Location	Limit	Unit	R. Time
Total Inflow	General		0.012	[m3/s]	30

Stop Criterion - Events will as minimum be calculated until this is fulfilled - regardless of runtime criteria

Continue calculation until total inflow to system has been smaller than [m3/s] in at least [min]

Figure 2.1 Dialog for input of job list criteria.

Start Criteria - Type

Controls the type of criterion to be specified – in this version only “Total Inflow” can be selected.

Start Criteria - Location Type

For the criteria of type 'Total Inflow', it must be specified for which part of the system the inflow must be evaluated. 'Location type' can be either 'General' (the whole system), 'List' (a group of nodes) or 'Individual' (a single node).

Start Criteria - Location

For the types 'List' and 'Individual', additional information must be specified in the 'Location' field. For the 'List', a node selection file (*.NSE) must be specified. For the 'Individual', a single node name must be typed or selected from the node list.

Start Criteria - Threshold

Defines the threshold that should be exceeded in order to evaluate the criterion as true. The unit of the parameter is automatically changed according to the selected type of criteria (not applicable in the current release).

Start Criteria - Duration

Criteria of type 'total inflow' can optionally be extended by specifying the duration of a continuous period in which the threshold should be exceeded in order to evaluate the criterion as true. The default duration is zero.

The specified job list criteria are saved into a MOUSE LTS file (*.MTF).

2.1.2 Initial Conditions for Simulated Events ("LTS | Initial Conditions")

Correct initial conditions for hydrodynamic simulations in MOUSE LTS are essential for achievement of realistic simulation results. Therefore, MOUSE LTS provides a system to define appropriate initial conditions for each simulated event. The initial conditions can either be specified as an empty pipe system for each job in the job list (MOUSE default), or a set of hotstart files can be specified to be used for individual events, depending on the actual inflow at the start time for the event.

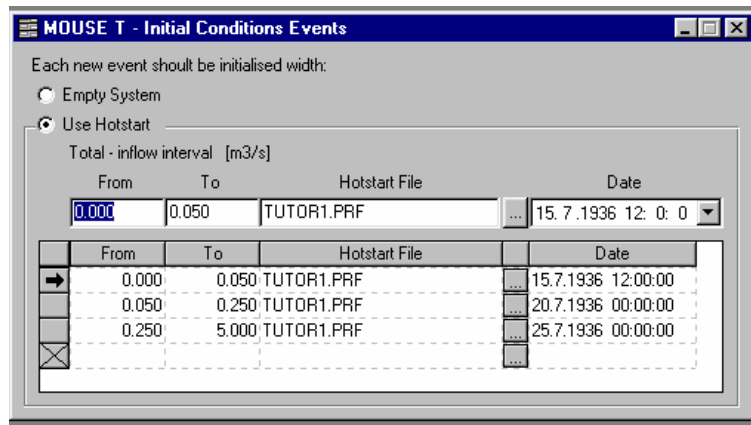


Figure 2.2 Dialog for input of initial conditions.

Empty system

At the beginning of each event in the job list, the system is initialized with an empty system. This approach is valid only for storm drainage systems where there is no water in the network during dry periods. Use of this option in any other situation is not recommended.

Use hotstart - Total inflow (without DWF)

At the beginning of each event in the job list, the system is initialized according to the specified hotstart information - hotstart filename and hotstart date. The hotstart file for an actual event is selected according to the total inflow (from *.CRF and *.BSF), excluding dry weather inflows, at the start time of the event.



If the actual inflow is outside all specified intervals, the job will start with an empty system.

Any hotstart file must cover at least 24 hours. The hotstart date is user-specified, but the hotstart time is automatically set equal to the event start time.

The hotstart files for the MOUSE LTS job list are selected according to the specified range of inflows. This implies that all inflows other than DWF are constant over the entire length of the hotstart file. In order to reproduce a cyclic pattern of diurnal DWF variation, care must be taken to eliminate the filling phase in the beginning of the hotstart file. This is achieved by running the initial simulation over two or more days, and specifying a corresponding date as a hotstart date.

A drawback of this principle is that weekly and seasonal variation of wastewater loads cannot be taken into account.

Total inflow interval (From - To)

Defines intervals for total inflow (excluding DWF) which is used at the start of each job in the job list to evaluate what hotstart parameters to use.



Hotstart file

Specifies a hotstart file to be used for the system initialization in association with the specified range of total inflows (excluding DWF) detected at the beginning of certain job.

Date

Specifies the date in the hotstart file to be used in the search for the hotstart conditions associated with the specified range of total inflows (excluding DWF) detected at the beginning of certain job.

The hotstart specification is saved in the MOUSE LTS file (*.MTF).

2.1.3 Generating Job List

On the basis of user-specified Job List criteria, the simulation input files, the simulation period (specified in the Start Computation dialog), and optionally the initiation hotstart files, a job list is automatically created.

The simulation periods for individual events represent the minimum simulation time, which may be extended in run-time according to the fulfillment of run-time criteria.

The job list (*.MJL) is written into an ASCII file ('PFS' format), which contains all relevant information about input files for the simulation, definition of the time periods to be simulated (for the individual jobs), and optionally information about the hotstart files and hotstart date/time. An example of a job list file is presented in Figure 2.3.

```
// Created      : 2000-08-12 11:34:4
// DLL id       : C:\WINDOWS\SYSTEM\PFS2000.DLL
// PFS version  : Mar 17 2000 12:07:29

[MOUSE_JOB_LIST]
[MOUSE_COMPUTATION]

  [INPUT_FILES]
    SWF_file = 'GEN1126.SWF'
    PWF_file = 'GEN1107.PWF'
    CRF_file = '2GRAINS.RRF'
    BSP_file = 'RIVER-FF.BSF'
    RTC_file = 'OPEN.RTC'
  EndSect // INPUT_FILES

  [SIMULATION_EVENT]
    Simulation_start = '1990-01-01 21:22:26'
    Simulation_end   = '1990-01-02 04:00:00'
    Hotstart_file    = 'HOT1'
    Hotstart_time    = '1990-01-01 00:00:00'
  EndSect // SIMULATION_EVENT

  [SIMULATION_EVENT]
    Simulation_start = '1990-01-03 15:36:16'
    Simulation_end   = '1990-01-04 04:00:00'
    Hotstart_file    = 'HOT1'
    Hotstart_time    = '1990-01-01 00:00:00'
  EndSect // SIMULATION_EVENT

  [SIMULATION_EVENT]
    Simulation_start = '1990-01-05 00:05:19'
    Simulation_end   = '1990-01-05 08:16:57'
    Hotstart_file    = 'HOT1'
    Hotstart_time    = '1990-01-01 00:00:00'
  EndSect // SIMULATION_EVENT

EndSect // MOUSE_COMPUTATION

EndSect // MOUSE_JOB_LIST
```

Figure 2.3 Example of a MOUSE LTS Job List file (*.MJL).



2.1.4 **Edit Job List**

Optionally, the job list file can be edited before starting the calculation. There is no dedicated dialog for editing the job list in MOUSE. Instead, MOUSE uses Windows Notepad. Alternatively, any ASCII editor can be used. When editing the joblist before starting the computation it is also possible to change the minimum and maximum default time step for each job. Default is that each job will have the same minimum and maximum time step. The values can be changed by editing the values for Dt_MaxSec and Dt_MinSec (see below).

```
[SIMULATION_EVENT]
```

```
Simulation_start = '1937-06-08 01:19:00'
```

```
Simulation_end = '1937-06-08 04:33:00'
```

```
Dt_MaxSec = 60
```

```
Dt_MinSec = 10
```

```
EndSect // SIMULATION_EVENT
```

2.2 **Runtime Stop Criteria ("*LTS / Runtime Criteria*")**

Runtime Stop Criteria are evaluated during discontinuous computations in order to determine the earliest time at which the simulation can be stopped without losing important information, i.e. in the closing phase of the simulated event. The evaluation of runtime stop criteria for the currently simulated event starts immediately after the preliminary event end (determined according to the job list) has been reached. The simulation continues as long as the runtime stop conditions are not fulfilled.

A number of independent Stop Criteria can be specified. They are evaluated through an Evaluation matrix.

MOUSE T - Runtime criteria

Fast Query

Name	Type	Location Type	Location	Limit	Unit	Retention Time [min]

Stop Criteria - definitions

Name	Type	Location Type	Location	Limit	Unit	Retention Time [min]
outlet_B1300	Outflow	Individual	B4.1300	0.010	[m3/s]	30

Name	Type	Location Type	Location	Limit	Unit	R. Time
volume	Total Volume			50.000	[m3]	0
outlet_B1300	Outflow	Individual	B4.1300	0.010	[m3/s]	30

Stop Criteria - evaluation matrix: Calculation continues until all criteria in one of the lines are fulfilled

Name	Location Type	Location	Limit	Unit	Retention Time [min]
volume	outlet_B1300				

Figure 2.4 Dialog for input of runtime stop criteria.

Stop Criteria - Name

Each criterion is identified with a unique name, which is used as a reference in the evaluation matrix.

Stop Criteria - Type

Controls the type of criterion to be specified – either total outflow, difference in inflow and outflow, total volume stored in the system, or filling degree in the system.

Stop Criteria - Location/Location Type

For criteria of type 'total outflow', it must be specified for which part of the system the inflow should be evaluated. Specification type can be either 'General' (the whole system), 'List' (a number of nodes specified in an NSE file), or 'Individual' (one node name). If 'List' or 'Individual' is selected, the supplementary information of selection file name or node name should be specified.

Threshold

The residual value of the variable defined by the 'Type' that must be achieved in order to evaluate the criterion as true. The unit of the parameter is automatically changed according to the selected type of criterion.

Duration

A period in which the parameter value must be below the threshold in order to evaluate the criterion as true.



Evaluation Matrix

At every time step during computation (but only after the end time in the job list!), each criterion is subject to logical evaluation as an element of an evaluation matrix. The evaluation matrix consists of an arbitrary number of lines, each containing up to five individual criteria. Each line of the evaluation matrix represents a combination of criteria which have to be fulfilled simultaneously (i.e. criteria are linked with the logical operator AND) if the combination is to be evaluated as TRUE and the simulation stopped.

If one line has been evaluated as FALSE, the evaluation algorithm jumps to the next line. This means that the successive lines are connected by the logical operator OR. The process continues until one line has been evaluated as TRUE (the simulation stops).

If none of the lines has been evaluated as TRUE, the simulation continues for one time step. Then, a new evaluation cycle is initiated and the entire evaluation repeats.

If no evaluation matrix is specified, periods specified in the job list will be simulated exactly, i.e. no runtime criteria will be evaluated.

The specified runtime criteria are saved in the MOUSE LTS (*.MTF) file.

3 MOUSE LTS COMPUTATIONS

3.1 General

Running a discontinuous MOUSE LTS computation (based on a job list) is usually beneficial if the total simulation period is long and the model is heavy. This has a potential of speeding up the simulation significantly, without the loss of vital information.

A MOUSE LTS discontinuous computation is started from the usual 'Pipe Flow Computation' dialog and will be performed if the calculation mode is set to 'Discontinuous'.

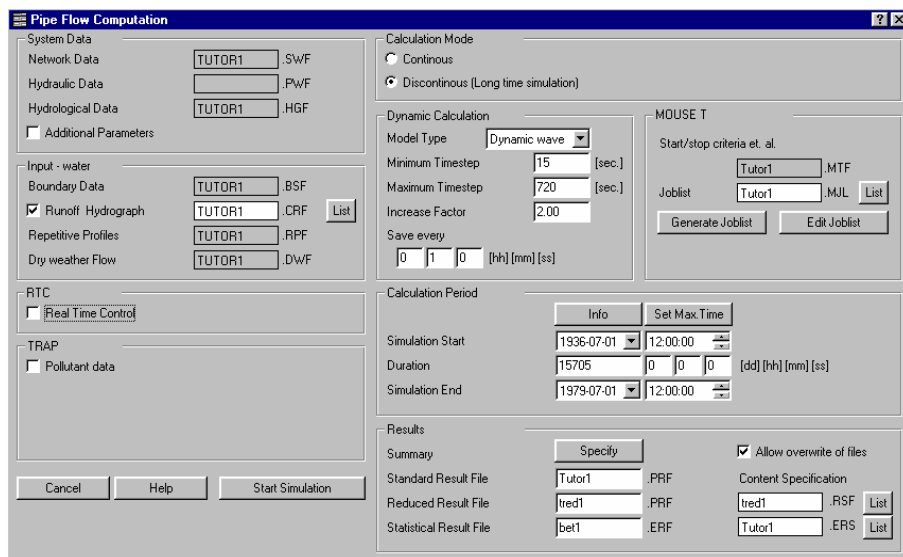


Figure 3.1 Pipe Flow computation dialog with 'Discontinuous' simulation mode selected

Switching the calculation mode to 'Discontinuous' opens a new part of the dialog, including fields for selecting a MOUSE LTS input file (*.MTF) and buttons for generating and editing a job list file.

Prior to the computation, a job list must be generated. Several different job lists can be generated and the appropriate one selected from the list.

While generating a job list, MOUSE scans the boundary files (*.DWF, *.BSF, and *.CRF), and evaluates the job list start criteria in order to identify the events to be simulated. Each event is preliminarily delimited by the evaluation of the stop criterion.

Simultaneously, total loads (excluding DWF) at the simulation start for each event are determined, and the appropriate initialization file is selected.

When using a job list in a MOUSE LTS simulation, the specified simulation period may include the entire job list or only a small fraction - ultimately only a single event. This feature opens the possibility to use the same job list through different phases of the project - initially using only individual events for test simulations (or in the calibration process), and later extending the



simulation to the entire job list. The advantage of using the job list instead of an "ordinary" continuous mode simulation is access to useful statistics available only with MOUSE LTS.

3.2 **Result Files**

Discontinuous MOUSE LTS generates the same types of result files as a normal MOUSE simulation ('standard' and 'reduced'). However, due to usually very long simulation periods, attention must be paid to keeping the size of the result files within reasonable limits. The standard MOUSE result file (*.PRF), where most of the computed time series are saved, becomes practically too large in long-term simulations, if the saving frequency is high. On the other hand, too small a time resolution in a result file might make the saved results useless. Consequently, for simulations covering long periods, a reduced result file will usually be of major interest.

3.2.1 **Reduced Result File**

The reduced result file contains only selected time series of particular interest. This makes it especially practical for keeping the long-term results sufficiently resolved, and the standard result file may often be completely abandoned.



It must be noted that reduced result files cannot be presented in MIKE View independently of some complete result file generated by the same model setup. The file must be 'Added'.

A description of specifying the contents of a reduced result file is provided in the MOUSE User Guide.

3.2.2 **Statistics Result File**

When running any simulation over a longer period, focus of interest is usually turned to the operational statistics rather than to the raw time series. Therefore, MOUSE LTS provides an option to save an additional result file (*.ERF) containing various statistics (event-based and annual) over the individual computed time series and the system performance as the whole.

The statistics are computed according to the specification given in the configuration file. MIKE View provides extensive viewing and reporting facilities for the computed statistics.

The technical background for statistical computations and the process of specifying which statistical results to save are further described below.

3.3 **Specification of Statistical Result File ("LTS | Statistics File Specification")**

MOUSE LTS provides the possibility to generate a series of useful statistical results - events, annual and system statistics - related to the simulated period. Such statistical results are stored in an optional statistical result file (*.ERF). Contents of the statistical result file must be specified prior to a MOUSE LTS simulation. Configuration of the statistics is enabled through the Statistical File Specification dialog.

MOUSE T - Result File Specification

Select result types - Nodes

Result Type	Location Type	Location	Maximal no. of events to save [#]
Total Dis. Chronologica	General		-1
Max. Level	General		250
Total Discharge	General		250
Total Dis. Chronologica	General		-1

Event definitions

dT to separate events [min]

Max(H) 120
Max(Q,V) 120
Discharge(Q,T,n) 120

Select result types - Links

Result Type	Location Type	Location	Save Type	Maximal no. of events to save [#]
Max. Level	General		All Points	250
Max. Level	General		All Points	250
Max. Flow	List	Nort1500.LSE	UpStr Point	250
Max. Velocity	General		UpStr Point	250
Total Discharge	All Weirs		All Points	250
Duration Discharge	General		All Points	250

Figure 3.2 Dialog for the configuration of the statistical result file.

Event definitions

The computation of statistics can be controlled by specifying the minimum time intervals between the two occurrences (dT) in order to consider these as independent. In this sense, statistics on peak values and statistics on accumulated values (discharge, duration) can be distinguished.

The peak values statistic operates with instantaneous peak values separated by at least dT. If for instance in peak value statistics a continuous series of water levels includes 2 peaks within an interval shorter than that specified for Max(H) events, only the larger of the two values will be counted in the peaks statistics.

Accumulated discharge and duration statistics is associated with discontinuous variables like pump or weir discharges (i.e. volumes). The statistics are performed on the events delimited with zero flows. Thus, two successive weir or pump flows are considered as independent only if they are separated by an inactive interval (i.e. with zero flow) of at least the specified length dT. On the contrary, if the two flow occurrences are close to each other, the statistical parameters will be computed from the sum of the two.

For the continuous flow variables (e.g. pipe flow), which in principle never drop to zero within the simulation period, it means practically that the accumulated discharge and duration statistics are calculated for the entire length of the simulated event.

Both for peak statistics and for accumulated flow statistics, two events are always considered as independent if the computation has been stopped in between by the specified stop criteria. Thus, specification of a very long dT - longer than any individual event to be simulated, would result in the number of peak values and the number of accumulated discharges and duration corresponding exactly to the number of simulated events.

Result Type in nodes

For nodes, three types of results can be selected:



Max levels:

Saves peak water levels in nodes – instantaneous values.

Total discharge:

Saves total event discharges for weirs, pumps and outlets.

Total discharge annual:

Saves total yearly discharge for weirs, pumps and outlets.

Result Type in links

For links, six types of results can be selected:

Max levels:

Saves peak water levels in links – instantaneous values.

Max flow:

Saves peak flows in links – instantaneous values.

Max velocity:

Saves peak flow velocity in links – instantaneous values.

Total discharge:

Saves total event discharge in links.

Total duration:

Saves event duration for discharge in links.

Total discharge annual:

Saves total yearly discharge in links.

Location

For all result types it must be specified for which location(s) the desired results are to be saved. Location type can be either 'General' (the whole system), 'List' (a number of nodes/links specified on NSE/LSE-file), or 'Individual' (one node/link name). If 'List' or 'Individual' is selected, the supplementary information of selection file name or node name should be specified.

Additionally, some pre-defined groups can be specified for nodes by selecting type 'All Weirs', 'All Pumps', or 'All Outlets'.

Save Type

For links, it must be specified where in the link data should be saved. There are four saving possibilities:

Upstream grid point,

Downstream grid point,

Both upstream and downstream grid points,

All grid points.



Max number of events to save

For some statistics parameters, the number of events during a long MOUSE LTS computation can be very high and the statistics result file size can grow rapidly. Therefore, the statistical computation can be limited to a specified number of highest events, i.e. only the limited number of most significant events is included into the calculation. This is possible if the purpose of statistical calculation is to focus on extreme events only. In such a case, all insignificant events may be eliminated from the statistics as “irrelevant”.

The maximum number of events must be specified within the range 1-5000.

3.4 Specification of Statistical Results for MOUSE AD

It is possible to combine the MOUSE LTS simulations with MOUSE TRAP applying the Advection-Dispersion module. In this way it is possible to estimate loads of pollutants annually or on an event based level. The additional functionality is depicted in figure 3.3.

As seen in figure 3.3 there are several options for statistical results from the MOUSE AD module. The obtainable results are all connected to the nodes, pumps, weirs and outlets. Multiple AD components are supported.

Max. Concentrations

This will give a ranked list of the highest concentrations reached during the individual events.

Events Loads

Will yield the total mass flux at the chosen locations for each event in ranked order.

Annual Loads

Furthermore, for individual locations it is possible to get a histogram of annual loads from the simulated period.

Result Type	Location Type	Location	Maximal no. of events to save [#]
Annual discharges	General		10
Max. Level	Location Type	Location	Limit
Events Discharge	General		10
Duration Discharge	General		10
Annual discharges	General		10
Max. Concentrations			
Events Load			
Annual Loads			

Result Type	Location Type	Location	Save Type	Maximal no. of events to save [#]

Event definitions

dT to separate events [min]

Max(H) 120

Max(Q,V) 120

Discharge(Q,T,n) 120

Figure 3.3 Dialog for the configuration of the statistical result file – TRAP issues.



Figure 3.3 also shows a checkbox named “Discharges and Emissions out of the sewer system”, and it is possible to chose to have the statistic compiled as a monthly or as an annual histogram. The results from this computation are placed in a table with columns as shown in table 3.1.

Table 3.1 Discharges and emissions out of sewer system.

Column	Description
Year	Year for the data in the line.
Month	Month for the data in the line.
Qpump	Total discharged flow from all pumps pumping out of the system.
Qweir	Total discharged flow from all weirs discharging out of the system.
Qoutlet	Total discharged flow from all outlets.
Qtotal	Sum of Qpump, Qweir, and Qoutlet.
LoadPumpNH4	Accumulated mass flux through pumps pumping out of the sewer system for a component named “NH4”.
LoadWeirNH4	Accumulated mass flux over weirs discharging out of the sewer system for a component named “NH4”.
LoadOutletNH4	Accumulated mass flux through all outlets for a component named “NH4”.
LoadTotalNH4	Sum of LoadPump, LoadWeir, and LoadOutlet
LoadPump...	Value for next component.
LoadWeir...	Value for next component.
LoadOutlet...	Value for next component.
LoadTotal...	Value for next component.

3.5 Results from Mouse AD

Results from the MOUSE AD simulation run together with the LTS module comes in two forms. The time series can be stored in a regular result file from the AD module (*.TRF), whereas the statistical results are located in the specified *.ERF file together with hydraulic results.

3.5.1 Reduced AD result file

There are two ways of reducing the contents of the TRF file. These two ways can be combined. The first way is to alter entries in the DHIapp.ini file. The possible items are:

```
[MouseTRAP]
PRINT_WEIR_AD=1
PRINT_PUMP_AD=1
PRINT_NODE_AD=1
PRINT_GRID_AD=1
PRINT_GRID_MASS_AD=1
PRINT_MASS_BALANCE_AD=1
```

If the value is changed into 0 then the item will not be written in the result file. The other way is to specify a reduced hydraulic result file through the menu entry named “Network | Result Selection...” If this is done the AD results for all components will be printed only in those locations where one or more hydraulic parameters are chosen to be saved in the reduced PRF file.



3.5.2 Statistical results from MOUSE AD

The results are found in the *.ERF file. In MOUSE 2002 MIKE View does not support displaying and plotting of these data. Therefore, it is necessary to evaluate the tables manually. The ERF file is an ASCII file, which can be loaded into e.g. Microsoft Excel. The file is opened as a delimited text file with comma and “=” as delimiter. Then the file can be nicely formatted resulting in the examples shown below.

[Max_Concentration_Ranked]				
[Outlet]				
Event_definition	120			10
Geometry_data		'A0.0327'		
Component_ID		'NH4'		
Cmax	1	'1965-07-21 15:50:10'		0,422
Cmax	2	'1959-08-15 13:29:40'		0,412
Cmax	3	'1961-08-22 06:41:10'		0,400
Cmax	4	'1974-07-12 07:28:40'		0,374
Cmax	5	'1970-07-02 15:31:20'		0,357
Cmax	6	'1941-08-21 13:32:30'		0,350
Cmax	7	'1963-06-10 14:34:40'		0,317
Cmax	8	'1961-06-13 15:46:30'		0,301
Cmax	9	'1954-06-20 15:07:50'		0,275
Cmax	10	'1961-09-25 00:55:30'		0,265
EndSect // Outlet				

This example shows maximum concentrations found at an outlet. The values in the right hand side of the table are the maximum concentrations. The Keyword “Cmax” shows that it is a maximum concentration. The keyword “Ctotal” denotes event based loads in kilogrammes.

“Cyear” shows a histogram of loads as seen below (some of the years has been deleted).

[Load_Yearly_Chronological]				
[Node]				
Event_definition	120			-1
Geometry_data		'B4.1480'		
Component_ID		'NH4'		
Cyear	1936	1	4.81	0.0457
Cyear	1937	3	15.95	0.1805
Cyear	1938	2	8.39	0.0820
Cyear	1939	3	8.23	0.1358
Cyear	1940	1	1.50	0.0331
EndSect // Node				
EndSect // Load_Yearly_Chronological				

For each line the keyword “Cyear” is stated. Then follows the year, the number of events that year, the total duration in hours, and the total accumulated mass in kg.

The final table in the ERF file is the table with total emissions out of the sewer system.



The statistics results configuration is saved into an ASCII file (.ERS) which can be reused in successive MOUSE LTS simulations.*



4 RESULT PRESENTATION

MOUSE LTS makes it possible to create a range of new types of results, which unlike the 'usual' results are not presented as time series but as event- and annual statistics on graphs and in tables. All these results can be presented in MOUSE's result presentation tool, MIKE View.

MIKE View is a map-based presentation tool, which requires that the results are geographically determined. Since the network geometry information is not included in the statistics result file, such a file must therefore be added to a MIKE View session where some 'ordinary' result file (*.PRF) has already been opened.

Adding a statistical result file is done from the MIKE View Main Menu option "FileLoad MOUSE LTS results".

Viewing facilities for the MOUSE LTS statistics results can be accessed from the MIKE View Main Menu option "PlotMOUSE LTS ". Additionally, extreme values Hmax and Qmax as functions of return period can be presented on the Horizontal plot and on the Longitudinal profile plot.

4.1 Extreme Statistics –Single Parameters

Extreme statistics are based on a list with ranked results for the specified parameter.

For example, peak water levels in specified nodes can be saved for all events covered by the simulation. Ranking of the peak values is done only on the basis of these results, i.e. there is no direct link between ranking of the rain inputs and the ranking of the parameter.

The results are plotted as a function of return period – the highest value is given rank one, the next highest in the series gets the rank two, and so on. The 'return period' for a certain event is calculated by dividing the complete observation period (i.e. the period covered by the simulation) with the rank of the event. If for example the observation period is 10 years, the event with rank 1 gets assigned a return period of 10 years, number two gets a return period of 5 years, number 3 gets a return period of 3.33 years, and so on.

Assuming that the simulated events and the computed values are independent and that the number of simulated events is large enough, the computed 'return periods' for the events with low and medium rank may be considered as sufficiently correct for practical considerations. However, for the highest 5-10 values the computed 'return periods' might be significantly different than if the observed sample of events is subject to an appropriate statistical distribution. Therefore, 'return periods' for these extreme events must be used with due care.

4.2 Annual Statistics

Annual statistics are only relevant for some parameters, e.g. discharge at weirs, pumps and outlets. The total discharge is calculated for each year in the simulation period, and values are plotted as bars for each year.

In this way, it is possible to see the total discharge in different years, which is of course highly dependent on the actual sum of rain each year. In the presented example, the first and last year are actually only 'halfs', and there is a period of 10 years in the middle of the simulation period where no rain load has been simulated – the values presented are therefore dry weather flow. It

should be noted that the years with dry weather load only would only be calculated in continuous calculation mode.

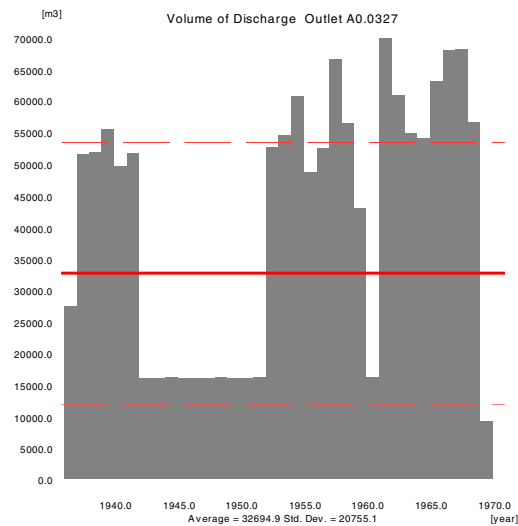


Figure 4.1 Example of annual statistics for an outlet

4.3 Spatial Statistics – Extreme Statistics for Entire System

If for example MaxH has been saved for all nodes in the system, it is possible to generate a plot where the number of elements (nodes or grid points) for which the critical levels are exceeded is drawn as a function of the return period.

This indicates how problems in the system grow (expressed as the number of 'problematic' locations) as a function of return period. Ideally, the system should be without problematic locations for the design return period.

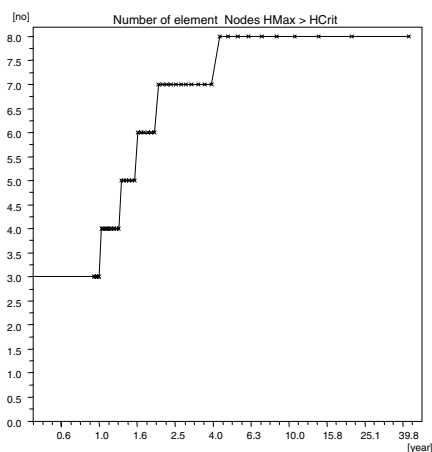


Figure 4.2 Example of the spatial statistics presentation



4.4 Horizontal Plot and Longitudinal Profiles

The return period for exceedence of the critical levels in the system can be shown in the horizontal plot. This can give a very good overview of the locations where e.g. water levels are exceeded more frequently than prescribed by the design or by legislation.

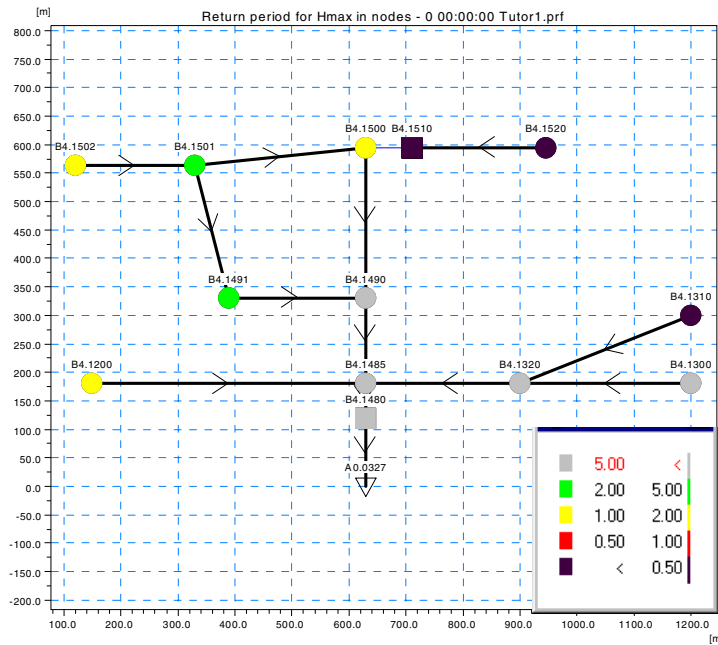


Figure 4.3 Horizontal plan with return periods for the exceedence of critical water levels in nodes.

Another way to illustrate how serious the problems might be in parts of the system – and maybe even why – is the longitudinal plot, where a number of lines can be specified to show how high the water will get for different return periods.

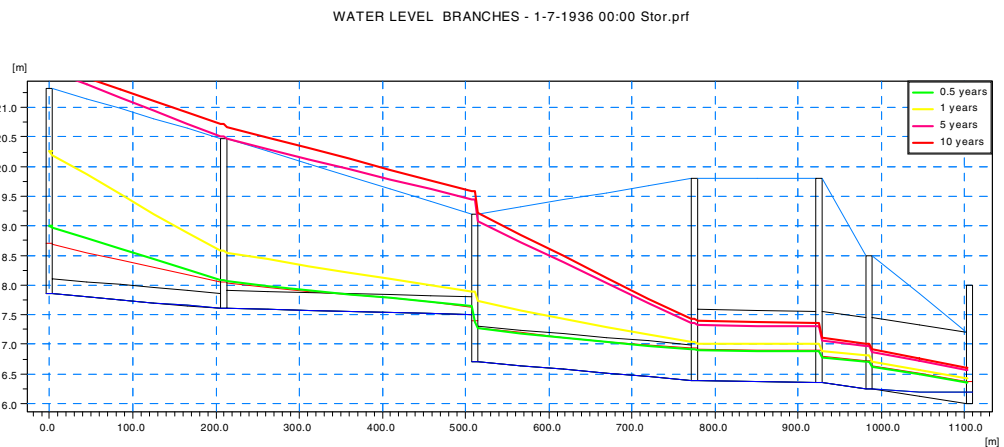


Figure 4.4 Longitudinal profile plot with return periods for water levels.



4.5 Tabular Reports

Mike View generates a series of tabular reports on the basis of the computed statistics:

Extreme Statistics Report,

Annual Statistic Report,

Number of Events,

General Report.

Any report can be generated either in ASCII or in HTML format, and as such can be viewed or edited by any software which supports some of these formats.



5 REFERENCES

- /1/ DHI (2000): MOUSE - Short Introduction and Tutorial (Version 2000), DHI, Hørsholm, Denmark.
- /2/ DHI (2000): MOUSE - User Guide (Version 2000), DHI, Hørsholm, Denmark.