

# Introduction to the Modelling and Decision Support Framework (MDSF)

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## **INTRODUCTION TO THE MODELLING AND DECISION SUPPORT FRAMEWORK (MDSF)**

### **1. Content**

It is relevant to make clear that the Modelling and Decision Support Framework (MDSF) does not do any modelling nor does it make any decisions. It does, however, provide a structured framework to support decision-making. The framework anticipates the use of modelling results, generated externally then imported into the MDSF, in the calculation and presentation of information to aid the decision process.

The MDSF comprises:

- The **Software**, being a customised GIS tool (not a new GIS), developed to work with ArcView Version 3.2a
- A Software **User Guide** giving specific instructions for use of the customised GIS tool
- **Procedures**, explaining the software functions so users have an understanding of the results produced and their provenance, notably the influence of “built in” operations on the results. The Procedures also advise on the appropriate use of the MDSF.

### **2. MDSF Functionality**

The MDSF Software provides the functionality listed below.

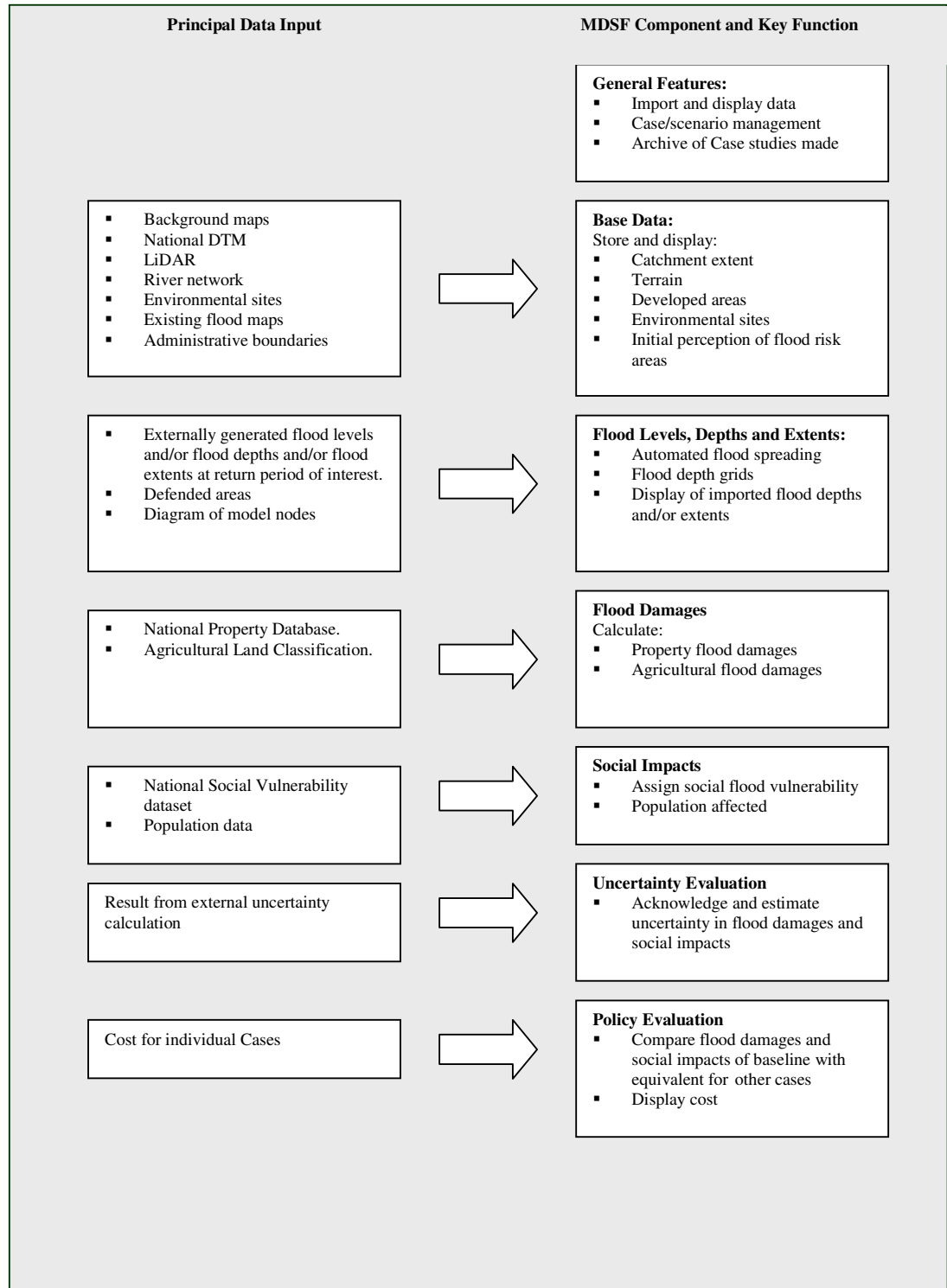
- Assessment of flood extent and depth
- Calculation of economic damages due to flooding
- Calculation of social impacts due to flooding including population in flood risk area and their social vulnerability
- Presentation of results for a range of Cases to assist the user in the selection of the preferred policy. Each Case is a combination of climate scenario, land use scenario and flood risk management option
- Procedure for estimating uncertainty in the results for each Case
- Framework for comparing flood damages and social impacts as an aid to policy evaluation
- Archiving of Cases.

A diagram illustrating the MDSF Software functionality is given as Figure 1.

### **3. Credibility Checks**

Throughout the use of the MDSF it is important to apply reasoned judgement in verifying that the data being used is adequate and that the results are sufficiently credible for the resulting policy decisions to be sound. Users must remember that the MDSF is a tool, it is not a substitute for clear thinking.

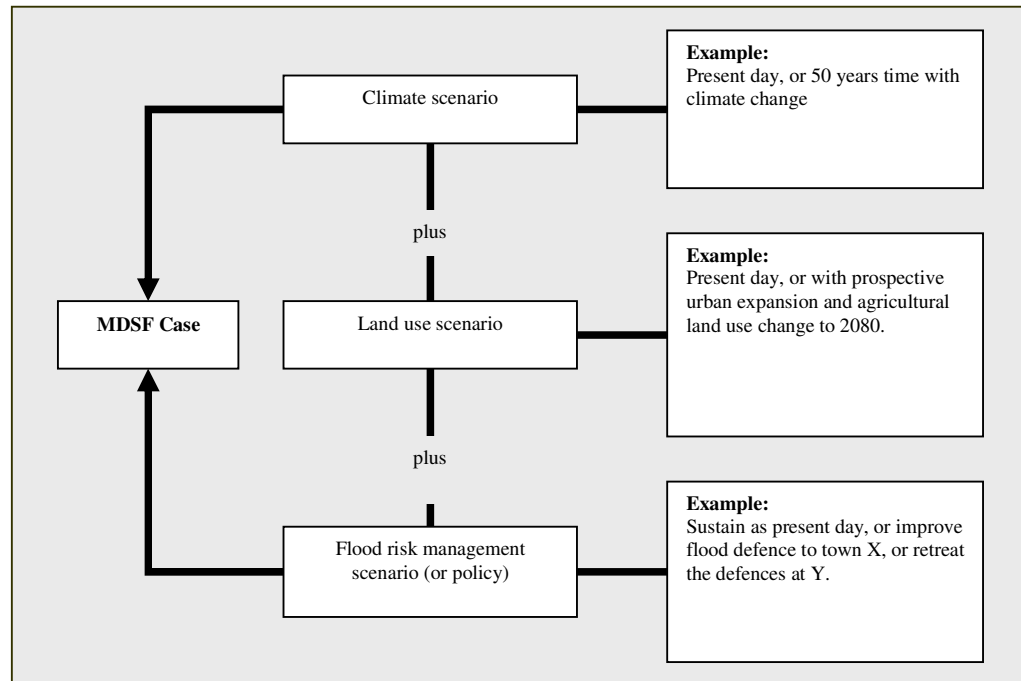
**Figure 1 MDSF Overview**



#### 4. *Cases and Scenarios*

The MDSF Software displays data, makes calculations and archives on the basis of “Cases”. A Case is a combination of three “scenarios”: climate, land use and flood risk management. This is illustrated in Figure 2.

**Figure 2 MDSF Case Construction**



The user assigns the relevant input to each Case. It is usual to set up the Baseline Case of existing conditions first, taking time to verify that the MDSF results are sufficiently credible for the Baseline Case before proceeding to examine other Cases for comparison.

The flood risk management scenario estimated cost can be added as an attribute for storage with the Case data, but is not used in any MDSF calculation.

Although the MDSF is a convenient tool for displaying data and performing some key calculations, it does require an amount of data preparation externally and manipulation internally. It will be economical, therefore, to manage the examination of Cases so this is done in an efficient manner.

## **5. *Data and Data Management***

Supplied with the MDSF software are:

- Property depth/damage values
- Agricultural damage values related to land class
- Population and Social Flood Vulnerability Index for census Enumeration Districts.

Other data sets are imported into the MDSF as appropriate to meet individual needs. They include:

- Standard or “core” national data sets which can be provided by the Environment Agency
- Data sets provided by the local Agency offices
- Specialist data sets, provided from national sources other than from the Agency
- Other local sources, such as planning authorities.

The user is cautioned against data overload and is advised to concentrate on the data that is important for the task in hand. The user is reminded that broad scale appraisal does not need the best data, only data that is good enough.

The MDSF provides facilities for overlaying key data sets and inspection of data. All data must be in a suitable format for import into the MDSF Customised GIS based on ArcView Version 3.2a.

## **6. *Flood Levels, Depths and Extents***

### **6.1 *Data Used***

For display of the flood risk areas, and subsequent linking of this information to the calculation of flood damages and social impacts, the MDSF uses:

- A DTM (the National DTM, LiDAR or other as available)
- Background mapping (to aid the screen display)
- River centre lines
- Flood levels, generated externally, and/or
- Flood depths as a grid, generated externally, and/or
- Flood extents, generated externally (for example as calculated from earlier detailed studies, or from flood mapping)
- The delineation of defended areas, user defined.

The two key features being sought are flood extent, to show the flood risk area, and flood depth, this being an important criterion in the MDSF flood damages calculation.

### **6.2 *MDSF Automated Flood Spreading***

The MDSF provides an automated process for calculating flood extents and depths based on the following:

- DTM, the river centre-lines, and flood levels.

All flood levels must be generated externally to the MDSF. The MDSF has no process for creating flood levels.

Flood levels at prediction points are imported into the MDSF. Flood levels between prediction points are linearly interpolated by the MDSF at user-specified intervals along the river centre-line. The process projects the river centre-line flood level across the floodplain to the intersection of that level with the ground level as given by the DTM. The user lays out individual flood mapping-section lines from the river flood level points so the projection across the floodplain is in the right direction.

The automated flood spreading process is valid where the water level at the river centre-line is representative of the flood water level over the adjacent floodplain. It is possible to add “dummy” river lines, for example to represent known flood levels along a floodplain where these are different to levels along the adjacent river centre-line because of the presence of flood defence embankments between the floodplain and the river.

### 6.3 *User Generated Flood Spreading*

Alternatively, users can use imported flood depth grids and/or extents directly. User defined flood depths can be used instead of the MDSF generation of depth from flood level or flood extent and the DTM. This approach may be particularly helpful where the user wishes to use flood depths generated outside the MDSF for complex areas.

Where imported flood extents are used, the MDSF will create flood depths by linking the extent to the DTM. Users should be aware that the depths may not now match those associated with the original flood extents since the terrain data may be different.

### 6.4 *Defended Areas*

The system permits the exclusion of defended areas for floods which are at or below the defence level or designated defence standard (flood return period). This is vital for the flood damage calculation.

## 7. **Flood Damages**

The MDSF provides an automated process of calculating economic flood damages.

The calculation of property damage is based the National Property Database (NPD). Property definition is linked to depth/damage curves in a manner generalised from procedures developed by the Middlesex University Flood Hazard Research Centre and adopted by Defra for use in project appraisal.

The damage calculation made by the MDSF involves combining flood depths with depth damage data for each property for five specific return periods (5, 10, 25, 100, 200 years) and aggregating the data to provide an overall assessment of Annual Average Damages. Damages can also be calculated for a specified return period, for example the residual damages in an extreme event of 0.1% annual probability.

Agricultural damages are included in the MDSF software, based on annual crop losses and the Agricultural Land Classification maps.

The MDSF flood damage component only considers property and agricultural flood damages. Separate consideration, outside MDSF, would be need for other related aspects such as:

- Benefit of flood warning

- Economic damage due to the flooding of roads, railways and similar infrastructure
- Indirect damages
- Environmental and intangible damages.

## **8. Social Impacts**

The MDSF provides an automated process of calculating social impacts due to flooding.

The social impact is based on assessing the population at risk together with an index of social vulnerability. The calculation is made on the basis of census Enumeration Districts, as data are available on this basis. The number of people at risk of flooding in each Enumeration District is based on the proportion of properties in each District in the flood risk area.

## **9. Uncertainty Calculation**

The MDSF procedures provide a method for assessing uncertainty in consideration of each Case examined using the MDSF. The assessment is implemented in the Software by using screen forms for uncertainty in:

- Flood depth
- Flood damages
- Social impacts

The uncertainty procedure allows consideration of likely bounds on the values calculated using the MDSF. The bounds are shown in the Software as “upper” and “lower” values. However, the procedure allows for bounds to be set at any degree of confidence the user considers to be appropriate.

## **10. Policy Evaluation**

In order to assist the user in selection of the preferred option, the MDSF Software provides a form for summarising and comparing the results from the MDSF of Cases tested. The form compares the results from the calculations of:

- Property damages
- Agricultural damages
- Population affected by flooding.

This is the limit of the Policy Evaluation facility. Full evaluation of the flood risk management scenario would be undertaken outside the MDSF, taking into account the full range of issues involved.

## **11. Support Service**

The Environment Agency have established a support service for use of the MDSF on legitimate Agency business. The primary contact address for user support is the email address [support@mdsf.co.uk](mailto:support@mdsf.co.uk). The project website [www.mdsf.co.uk](http://www.mdsf.co.uk) includes support details and features a Frequently Asked Questions list and open discussion forum.