Council Study Working Paper
Comparing the Current DRIFT Version for the Council Study from the IBFM Predictive Tool (Early Version of DRIFT)
Prepared on January 2015

This comparison addresses the comments raised by MRC/Halcrow (2009) review of the IBFM Predictive Tool. The review was conducted as part of the Basin-wide Modelling Support and Capacity Building for the MRC (Contract: # 056 – 2008 - Work Package 006; MRC/Halcrow 2009). The IBFM Predictive Tool based on a much earlier version of DRIFT was applied in 2004/2005 to provide a spreadsheet-based tool for recording expert evaluations of biophysical, ecological, and socio-economic impacts associated with development scenarios in the LMB as illustrated in Figure 1.

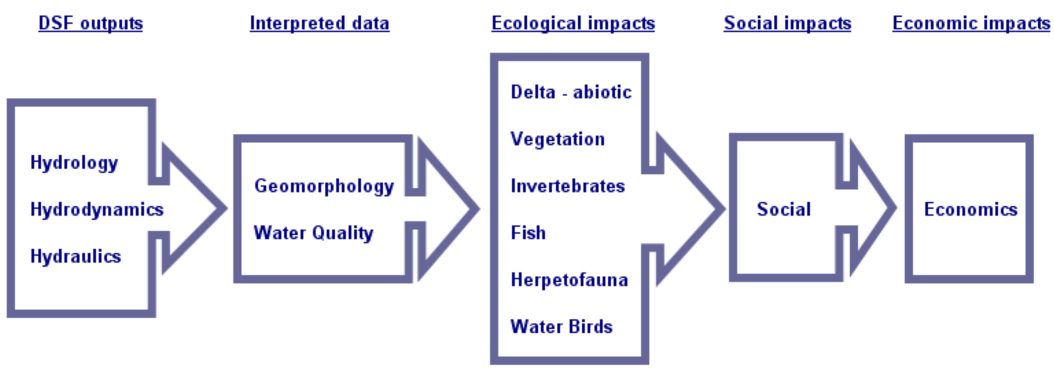

Figure 1 Assessment process encapsulated in IBFM predictive tool (MRC Halcrow 2009)

1 DRIFT (Current Version) vs. IBFM Predictive Tool (Early DRIFT version)

As stated in MRC/Halcrow (2009), the IBFM Predictive Tool was based on an early version of the DRIFT Decision Support System (DSS), the tool that has been approved for use in the Biological Resources Assessment (BioRA), which is an integral part of the Council Study. DRIFT has been applied widely, and improved considerably, in the decade between the IBFM study and the Council Study, and the current version of DRIFT differs from the 2004/5 version in several important ways.

The most relevant similarities are:

- Use of indicators. The preliminary list of indicators will be developed In February/March 2015. Due consideration will be taken of the indictaors used in IBFM.
- Use of expert opinion. This is unlikely to change in the near future as the relationships are so numerous and complex that it is likely that getting empirical data for the relationships (and feed-back loops) will take many, many years of directed research.
- Use of severity and integrity scores.
- Use of biophysical condition scores.
- Use of river zones.

The most relevant differences are:

- Adoption of a time series approach.
- The inclusion of response curves.
- Expansion of the number and type of flow indicators.
- Inclusion of a connectiviy module.DRIFT is no longer an Excel-based database, and is a now Delphi-coded purpose built software program – the DRIFT DSS.
- Inclusion of external indicators, which allows data from calibrated hydraulic, sediment and water quality models to be imported directly into the DRIFT DSS.

The differences are discussed in more detail below. Additional detail is available in Brown et al. (2013) and King et al. (2014).

1.1 Time-series approach

The 2014 DRIFT DSS uses a time-series approach. After completion of the Response curves (Section 1.2), the response of each indicator is available for every season or every year of the hydrological record under consideration (see Response curves in) rather than, as was the case with the IBFM tool, for the whole of the hydrological record.

A time-series approach to the evaluation of the consequence of flow change in an aquatic ecosystem has several advantages over the approach used in IBFM:

- A time-series approach gives the specialist an easier task: to consider a response to a condition for a particular time-step rather than thinking of an averaged response over several years as in previous IBFA DSSs such as DRIFT. Furthermore, specialists may know of conditions in, or have data from, a particular year or season, which can be used to calibrate time-series responses;

- It allows for the incorporation of individual discipline models, such as sediment transport or bank erosion model, where these are available.
- It alllows for consideration of temporal changes, such as changes in the onset or duration of seasons.
- It facilitates more dynamic outputs, such as time-series of abundance of indicator species.
- It is more suited to none linear aquatic systems, such as estuaries, wetlands, floodplains and lakes.

1.2 Response curves

Response curves depict the relationship between a biophysical or socio-economic indicator and a driving variable (e.g., flow; Figure). As such, they have replaced the expert rating of the overall, integrated effect on an indicator over the course of the hydrological record. Thus, instead of relying on mental integration (by an expert) of the various responses of an indicator to change in an ecological flow category, each individual response to flow (or other relevant ecosystem change) is clearly depicted and evidence provided therefor.

Once the response curves have been developed by the experts, a series of calculations is used to derive a time series of responses as follows:

- Seasonal responses: the average of the responses in a season;
- End-of-season response: previous season's response plus the seasonal response
- End-of year response: equals the end-of-season response for the last season of the year.

A number of 'modifiers' have also been included in the DSS, which can be applied at the expert's discretion. These are related to:

- dependency on the previous years' result;
- lags in the response;
- density dependence effects.

The use of response curves has several advantages over the approach used in IBFM:

- the assumptions and relationships underlying the integrated predicted response to flow change are transparent.
- It makes use of traditional ecological research outputs, such as tolerance to water quality variables, and does not rely solely on flow to trigger a prediction of change.
- It is easier to identify which relationships are driving the assessment and those where the data suport in the relationshp are in short supply.

- It allows for the evaluation of numerous scenarios without the need to reassemble experts to regenerate the individual assessments.

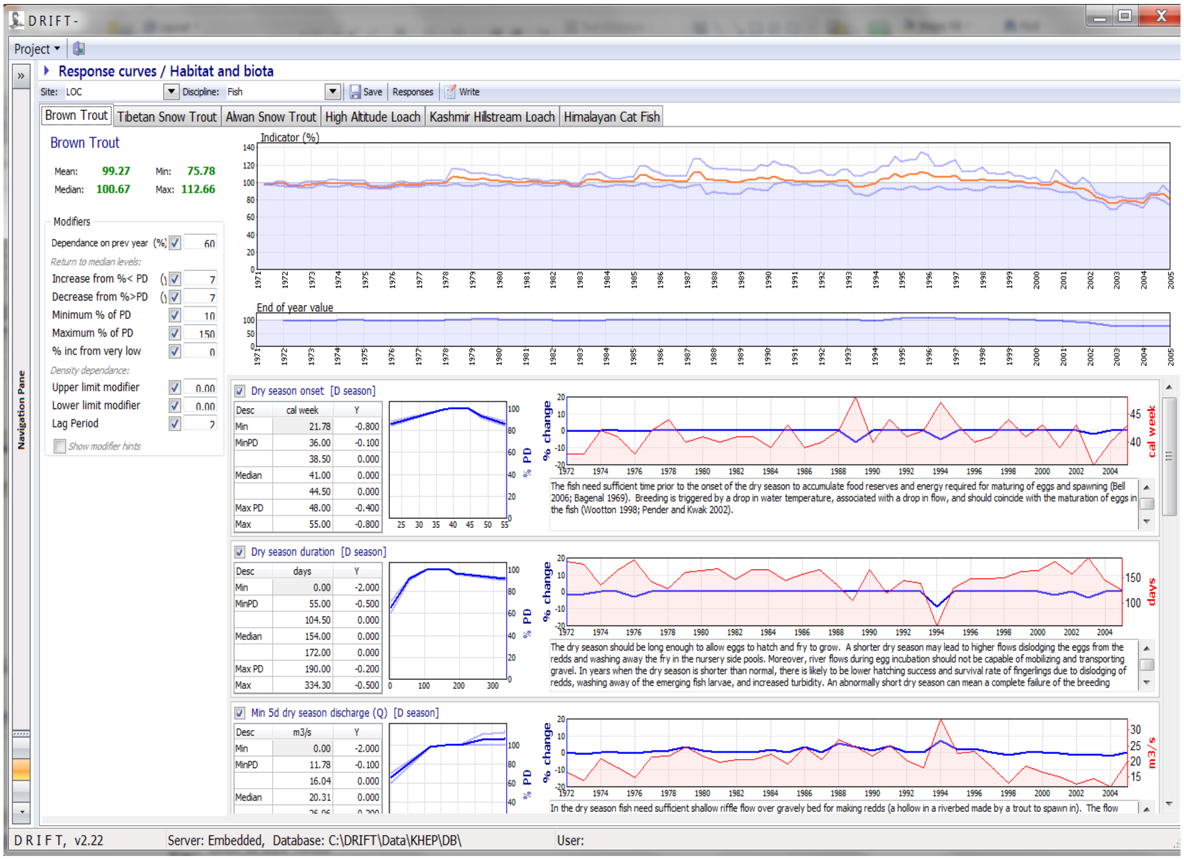

Figure 2 Example of the Habitat and Biota response-curve data entry sheet in the DRIFT DSS

1.3 Expansion of the number and type of flow indicators

In the Council Study, the DRIFT DSS, will be used to predict the response of the aquatic ecosystems to changes in hydrology, hydraulics, sediment dynamics and water quality as a result of the development scenarios. For the driving time series, the DRIFT DSS automatically calculates over 70 ecologically-relevant summary statistics. Examples of these ecologically-relevant summary statistics for flow (known as flow indicators) are shown in Table 1.

The expansion of the number and type of flow indicators has several advantages over the approach used in IBFM:

- More flexibility in responding to scenarios.
- Consideration of sub-daily operational impacts, such as hydropeaking.
- Applicability to a wider range of ecosystems. For instance, changes in floodplain condition may be related to changes in the hydrualics, e.g., depth, time and duration of inundation, rather than to changes in the hydrology per se.

Table 1 Examples of flow indicators calculated in the DSS.

Season	Type	Name	Units	Abbr
Whole year	Hydrological	Mean Annual Runoff	m^3/s	MAR
Dry season	Hydrological	Dry season onset	cal week	Do
		Dry season relative onset	weeks	DoR
		Dry season duration	days	Dd
		Min 5d dry season discharge (Q)	m^3/s	Dq
		Dry season ave daily volume	Mm^3/d	Ddv
	Hydrological (subdaily)	Dry season min instantaneous discharge (Q)	m^3/s	DQmni
		Dry season max instantaneous discharge (Q)	m^3/s	DQmxi
		Dry season max rate of change	$m^3/s/min$	DRmxi
	Hydraulic	Min 5d dry season velocity	m/s	DqV
		Min 5d dry season WetPerim	m	DqW
		Min 5d dry season Stage	m	DQH
Transitional season 1	Hydrological	T1 ave daily volume	Mm^3/d	T1dv
	Hydrological (subdaily)	T1 min instantaneous discharge (Q)	m^3/s	T1Qmni
		T1 max instantaneous discharge (Q)	m^3/s	T1Qmxi
		T1 max rate of change	$m^3/s/min$	T1Rmxi
Wet season	Hydrological	Wet season onset	cal week	Fo
		Wet season relative onset	weeks	FoR
		Max 5d flood season discharge (Q)	m^3/s	Fq
		Flood volume	Mm^3	Fv
		Flood type		F_Type
		Wet season duration	days	Fd
	Hydrological (subdaily)	Wet season min instantaneous discharge (Q)	m^3/s	FQmni
		Wet season max instantaneous discharge (Q)	m^3/s	FQmxi
		Wet season max rate of change	$m^3/s/min$	FRmxi
	Hydraulic	Min 5d flood season Stage	m	FminQH
		Max 5d flood season velocity	m/s	FqV
		Max 5d flood season WetPerim	m	FqW
		Max 5d flood season Stage	m	FqH
		Min 5d flood season velocity	m/s	FminQV
		Min 5d flood season WetPerim	m	FminQW
		Wet season ave daily volume	Mm^3/d	Fdv
Transitional season 2	Hydrological	T2 recession slope	$m^3/s/d$	T2s
		T2 ave daily volume	Mm^3/d	T2dv
	Hydrological (subdaily)	T2 min instantaneous discharge (Q)	m^3/s	T2Qmni
		T2 max instantaneous discharge (Q)	m^3/s	T2Qmxi
		T2 max rate of change	$m^3/s/min$	T2Rmxi

1.4 Connectivity module

The connectivity module allows for the qualitative assessment of the effects of in-channel obstructions, such as where a dam and impoundment, or an area where extreme abstraction, results in a barrier to longitudinal biotic connectivity and thus reduces the degree of connectivity between the EF sites. This is particularly important in the Mekong River where many animals migrate up and downstream to feed or breed.

1.5 Inclusion of external indicators

This feature ensures that where money and time have been spent on setting up and calibrating models, their outputs can be incorporated directly into the DRIFT analyses. In the case of the Mekong River, this applies in particular to the suite of hydraulic, sediment and water quality models run by IKMP. Simply put, this means that were calibrated models are available, then they can be used, and where they are not DRIFT can be used to fill the gaps.

2 Replicability

Comments in the review (MRC/Halcrow 2009) on replicability, plus how these relate to the DRIFT DSS for the Council Study are listed in Table 2.

Table 2 Comments on replicability, and how these relate to the DRIFT DSS for the Council Study

Comment on IBFM Predictive Tool	DRIFT DSS for the Council Study
Some adaptation of the spreadsheet to accommodate the increase in number of scenarios from the three that the current tool allows for	The DRIFT DSS can be used to assess an almost unlimited number of scenarios
Assembly of a group of experts to regenerate the individual assessments of each of the 136 indicators for each of the five zones is onerous	Once the DRIFT DSS has been populated additional scenarios can be assessed without having to reconvene the expert team

3 User friendliness and future utility of the IBFM tool

Suggestions in the review (MRC/Halcrow 2009) for improving the user friendliness and future utility of the IBFM tool and how these relate to the DRIFT DSS for the Council Study are listed in Table 3.

Table 3 Suggestions for improving the user friendliness of the IBFM predictive tool and how these relate to the DRIFT DSS for the Council Study

Comment on IBFM Predictive Tool	DRIFT DSS for the Council Study
The structure could usefully be revisited to be set up for one scenario per spreadsheet with a reporting function to a separate "results" sheet	The DRIFT DSS has been completely overhauled and reorganized.
The layout of individual indicator sheets could be much improved	The DRIFT DSS has a Habitat and Biota Module with a separate sheet for each indicator, and where its linked indicators and all explanations are clearly visible.
The structure of the sheet could allow space for these relationships to be documented and wherever possible the relationships should actually be embedded in the sheet	This has been done in the Habitat and Biota Module, and in the Social Module
There appears to be need for greater clarity on what outputs are really required (and how these might be interpreted by decision takers)	The results can be presented in many, many different ways. The outputs that are really required (and how these might be interpreted by decision takers) will be a point of discussion during the course of the Council Study.

4 Summary

In Summary:

Like the IBFM predictive tool, the DRIFT DSS used in the Council Study will rely heavily on expert opinion to make the assessments. However, unlike the IBFM Predictive Tool, once the DRIFT DSS has been populated it can be used to assess an almost unlimited number of scenarios without having to reconvene the expert team.

Unlike the IBFM predictive tool, DRIFT DSS is a replicable assessment process. Each scenario will be evaluated using exactly the same set of criteria as all of the other scenarios.

All of the suggestions in the review for improved user-friendliness of IBFM predictive tool have been addressed in the DRIFT DSS software.

The DRIFT process can (and will) be used to identify the driving relationships between basin development and ecosystem condition. This is a first step towards identifying which relationships to prioritise, which assests are most critical to protect and what needs to be understood to ensure a rational approach to protection is adopted (*sensu* M. Wallace).