Flood Defence Levels of Service - Stage 2

Annex E: Asset Assessment

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R&D Note 127

NRA
National Rivers Authority

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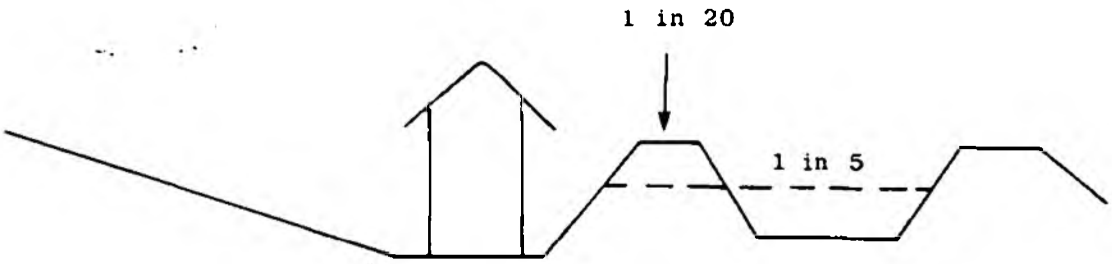
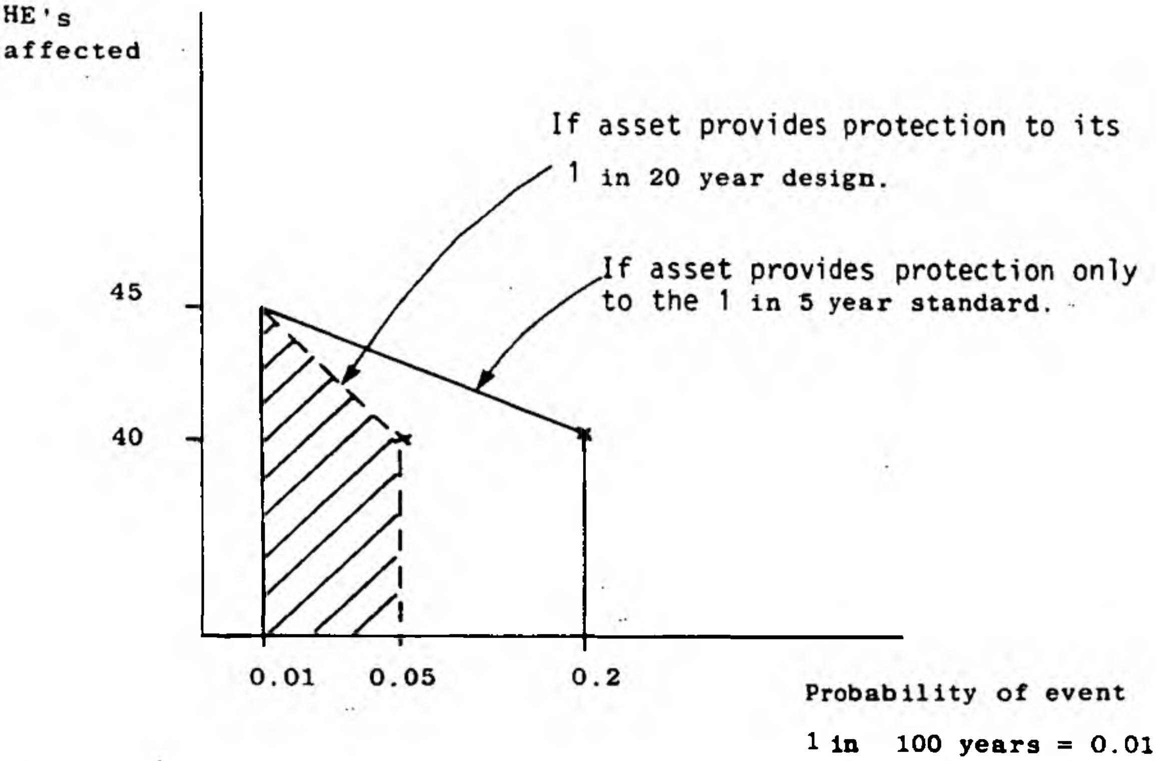
1. INTRODUCTION

This Annex is one of five Annexes which, together, provide a description of a method of applying a flood defence levels of service strategy. The overall system is described in the main report which contains references to the other Annexes where appropriate.

This particular annex deals with the method devised for assessing adequacy of service provision of flood defence assets. Two methods have been considered, the more complex of these is not recommended at this stage. It's extensive data requirement involves subjectivity judgments to identify a number of conditions for each asset. A number of R & D initiatives to develop methods to reduce this subjectivity are underway and until such time as they are completed, estimated at 1994, it is believed inappropriate to proceed this methodology further. For reference the approach is described in detail in appendix 1 of this annex. For the interim it is recognised that a simple and low resource requirement system is required to ensure the asset condition is considered. The method devised to incorporate this aspect in to the levels of service system is detailed in this annex.

Figure E1.





The area under the graph equals the HE's likely to be affected per year by flooding. This must be expressed on a per km basis to allow comparison. Assume reach length = 4km.

A) Assuming Asset performs to 1 in 20 year design standard.

Area under graph = 1.7 HE/YEAR

= 0.425 HE/km/YEAR

This would be the score used in the predictive assessment as described in Annex C.

B) Assuming Asset fails at events exceeding 1 in 5 year magnitude.

Area under graph = 8.075 HE/YEAR

= 2.02 HE/km/YEAR

2. ASSET ASSESSMENT - INTERIM METHOD (See Annex C)

2.1 INTRODUCTION

For the short term the method developed to assess the contribution to service provision due to the condition of a flood defence asset is an extension of the predictive flood assessment method as detailed in Annex C and the final report. By assessing the average number of House equivalents affected per year after allowing for the condition of the asset, a comparison can be made with both standard values and the average HE's affected when asset condition is ignored. The particular contribution of the asset can be ascertained and consideration given to remedial action where necessary.

2.2 DATA COLLECTION AND ANALYSIS

The key source of data for this assessment will be the considered judgment of relevant operations personnel. Their judgment is likely to form a large part of the information gathered for the predictive assessment of likely flood incidence. Data on return periods of flood incidence in the predictive aspect is based on an assumption that any assets present will perform to their design standard. However it is probable that some assets will fail when subjected to flood levels below the theoretical design level. The advice of local operations personnel will be used to define the maximum retention level (in terms of flood return period) that assets will provide adequate protection to.

The total number of House Equivalents affected per km by flooding for each of a range of flood return periods is identified for each LOS reach. This can be assessed from data from the predictive assessment and the perception of standards of protection afforded by assets rather than their theoretical design standard.

As with the predictive flood assessment a graph can be plotted of probability of event against HE's affected by the event. The area under the graph then equals the HE's per km that are likely to be affected per year in the reach as modified by the condition of any assets present.

For example.

The embankments of a highland carrier provide a theoretical standard of protection to a 1 in 20 year return period event. The particular reach being considered has both agricultural and urban interests present. All the urban interests are affected as soon as overtopping commences with thereafter agricultural interests progressively affected upto the maximum known extent, for this example taken as a 1 in 100 year event.

However the embankment has degenerated over it's life such that operations staff believe that it may breach if an event exceeding a 1 in 5 year return period is experienced. At such an event, the urban interests would all be affected as soon as overtopping occurred and the agricultural interests progressively affected thereafter.

Figure E1 opposite illustrates this situation in terms of HE's affected at different probabilities of event.

In contrast the example illustrated in figure E1 may indicate that the poor asset condition is the main cause of inappropriate service provision.

From figure E1.

Predictive score based on theoretical design standard	= 0.425 HE/KM/YEAR
Additional contribution from poor asset condition	= 1.595 HE/KM/YEAR
Total score	= 2.02 HE/KM/YEAR

Target range= 0.5 to 1.0 HE/KM/YEAR

Before the asset condition is taken into account the predictive score indicates aninappropriately high standard of service is being provided, the high contribution from the asset condition however means that overall the standard is inappropriately low. Improvements to the condition of the asset should be considered to reduce it's contribution and result in provision of an acceptable level of service.

Further examples of this interpretation are included in the summary report accompanying these annexes.

2.3 INTERPRETATION OF RESULTS

The implications of any perceived reduction in the standard of protection afforded by a flood defence asset are assessed by comparison of the following scores:-

i) the predictive score based on the theoretical design standard of protection from an asset and as modified by other river maintenance works.

ii) the additional contribution to the predictive score as a result of the perceived reduction in standard of protection from the asset.

iii) the target range of acceptable flooding per year in terms of HE's per km per year. As detailed in the final report.

The first comparison made is between the total score from i) and ii) above, ie score at B in figure B in figure E1, with the target score appropriate for the current land use band identified for the reach. This identifies whether the overall effect on flooding of poor asset condition combined with the in intrinsic flooding characteristics is unacceptable.

It may be that the asset was initially over designed or was designed in anticipation of an intensification of land use which has not occurred, with the result that the sum of i) and ii) is within or below the acceptable range of scores. In such a case the poorer condition of the asset than it's design would not be inappropriate for the land use and there would be no requirement to improve the assets condition to the theoretical design.

In other situations the combination of scores from i) and ii) will result in the target range being exceeded. In such cases improvements to either the assets condition, it's actual design standard of protection or current river maintenance regimes may be necessary. The balance of scores may indicate which of these, or combination of these, may be most appropriate.

For example.

Predictive score based on theoretical design standard	= 0.97 HE/KM/YEAR
additional contribution from poor asset condition	= 0.12 HE/KM/YEAR
Total score	= <u>1.09</u> HE/KM/YEAR
Target acceptable range of flood scores	= 0.5 to 10.0 HE/KM/YEAR

In this example the likely incidence of flooding will on average be unacceptably high. From the particular scores given, the largest contribution to this inadequacy of service provision is from the predictive score based on theoretical design standard of protection, with only a relatively small contribution from perceived reduction in asset condition. Whilst every option to improve the service provision must be considered to find the most resource efficient, it is probable that the greatest effect may be due to an inappropriate river maintenance regime or a lower than appropriate theoretical design standard of protection rather than merely a perceived reduction in asset condition.

In contrast the example illustrated in figure E1 may indicate that the poor asset condition is the main cause of inappropriate service provision.

From figure E1.

Predictive score based on theoretical design standard	= 0.425 HE/KM/YEAR
Additional contribution from poor asset condition	= 1.595 HE/KM/YEAR
Total score	= 2.02 HE/KM/YEAR
Target range=	0.5 to 1.0 HE/KM/YEAR

Before the asset condition is taken into account the predictive score indicates an inappropriately high standard of service is being provided, the high contribution from the asset condition however means that overall the standard is inappropriately low. Improvements to the condition of the asset should be considered to reduce it's contribution and result in provision of an acceptable level of service.

Further examples of this interpretation are included in the summary report accompanying these annexes.

APPENDIX 1

Asset Assessment - Probability Approach

1. DATA COLLECTION

1. INTRODUCTION

A number of data collection pro-formas were developed to allow standardisation of the data gathering process and also to ease the subsequent analysis of the data. The forms have been developed following a study of existing draft pro-formas and instructions devised by Mr C Flanders of NRA Anglian Region in March 1989, and also by Thames Water, Essex Water and other Authorities. The forms have been designed to be compatible with data held under the Anglian Sea Defence Management Study.

1.2 PRO-FORMAS

The pro-formas that have been devised are as follows.

1A Summary of present assets - fluvial rivers/tidal rivers.

1B Data collection sheets for 1A on flood banks and/or flood diversion channels.

1C Data collection sheets for 1A on control structures or drainage pumping stations.

2A Summary of present assets - estuary/sea defences.

2B Data collection sheets for 2A.

Blank copies of these forms are included at the end of this text.

The output from these forms will be an assessment of the factors contributing to the adequacy of service provision given by the asset. These factors are:

1. Structural condition.
2. Beach or river bank/bed condition.
3. Overtopping frequency.

1.2.1 Structural Condition

The assets should be assessed using the following "Condition of Assets Category".

Structural	General	Further Explanation
Good	No problem	Acceptable structural condition
Fair	Only minor problems	Deterioration causing minimal influence on Level of Service
Average	Some problems	Deterioration beginning to be reflected in deteriorating Levels of Service and/or increased operating costs. Asset replacement/renovation required within 10 years
Poor	Significant problems	Asset nearing end of useful life, further deterioration likely requiring substantial replacement within 2-5 years
Bad	Substantial problems	Asset substantially derelict requiring urgent replacement/renovation

Within each fluvial reach, tidal river/estuary, or coastal unit; the condition of assets such as weirs, tidal barriers, groynes, and other structures should be described by the first letter of each condition category.

1.2.2 Beach or River Bank/Bed Condition

The condition of the particular asset is assessed as one of five possible states:

i. Accreting
ii. Stable
iii. Volatile
iv. Eroding Slowly
v. Rapid Erosion.

1.2.3 Overtopping Condition

The frequency of overtopping of the asset is assessed as one of the following: Note that the identification should be based on the return period ranges only. The descriptors are for ease of form completion only.

i. Extremely Rarely	50 years plus return period
ii. Very Rare	20 to 49 year return period
iii. Rare	10 to 19 year return period
iv. Frequent	1 to 9 year return period
v. Often	greater than every year

1.2.4 In addition to these three components it is also necessary to make a judgment on the likely residual life of the structure or asset. The likelihood of occurrence of the event causing failure, diminishes the shorter the residual life of the structure and so must be considered when comparing the relative performance of assets and particularly when considering which should be replaced or refurbished with greater priority.

1.3 DATA COLLECTION TECHNIQUES

A formalised procedure was developed to gather relevant information for the study. This would involve a preliminary visit to NRA offices to gather details of the presence and general nature of structures or flood defence assets. Details of design standards are gathered at this time. Once the general location of assets is ascertained site visits are undertaken to identify their condition. This is done on the basis of the classification explained earlier with data recorded on forms included at the end of this appendix. This information can then be collated and processed as described at Section 3.2.

This approach of determining some preliminary information before undertaking site visit would be applicable to an extensive data collection exercise on all flood defence assets.

The categorisations defined for each aspect of the assets condition appear to be readily applicable, however care must be exercised when instructing assessors to ensure that individual interpretation and thus bias of the results is minimised.

Table 3.1 : Proposed Probabilities that the Asset will Fail to Protect Against the Design Event because of its Condition

The actual values cited are a <u>first approximation</u> and will need to be reviewed following some initial trials and validation.

Structure Condition	P(d/S)	Beach Condition	P(b/S)	Overtopping Condition	P(q/S)
Good	0.01	Accreting	0	Extremely Rarely	0
Fair	0.05	Stable	0	Very Rare	0.01
Moderate	0.1	Volatile	0.1	Rare	0.1
Poor	0.3	Eroding Slow	0.2	Frequent	0.2
Bad	0.5	Eroding Rapid	0.3	Often	0.3

Note

Each of the categories specified in the above table represents a range of standards assessed against the design standard. The design standard is assumed to provide the correct level of service. For example for structure condition the good category would be applied to structures ranging from almost new to those which may be several years old but for which degradation was not causing a significant reduction in performance.

2. ASSESSMENT OF ADEQUACY OF CONDITION OF FLOOD DEFENCE ASSETS

2.1 INTRODUCTION

The survey of flood defence assets provides various data sets on the different components contributing to the individual asset's overall adequacy. It is proposed to combine these into a single measure of the level of service provided by the asset. This is achieved by assigning probabilities that the asset will fail to protect against the design event because of structural condition, beach or river bank/bed condition or because of overtopping. Table 3.1 opposite shows proposals for probabilities to be assigned to each of the descriptive categories.

By applying statistical techniques it is possible to combine the individual probabilities to give an overall probability to the adequacy of the asset. The equations are derived as follows.

2.2 DERIVATION OF EQUATIONS TO ASSESS ADEQUACY OF ASSET CONDITION

Definitions

P(E) - probability of a flood event
P(S) - probability of the design storm event
P(F/S) - The probability of a flood event given that the design storm event occurs.
P(K/S) - The probability of structural failure/given that the design storm event occurs.
P(Q/S) - The probability of overtopping failure/given that the design storm event occurs.
P(d/S) - The probability of damage due to condition of structure/given that the design storm event occurs.
P(b/S) - The probability of damage on overtopping due to condition of beach/given that the design storm event occurs.
P(q/S) - The probability of overtopping based on reported performance/given that the design storm event occurs.

We can then define

$$P(K/S) = P(d/S \cup b/S)$$
$$= P(d/S) + P(b/S) - P(d/S \cap b/S)$$

which assuming d/S and b/S can be treated as independent events may be written as

$$P(K/S) = P(d/S) + P(b/S) - P(d/S)P(b/S) \qquad \underline{1}$$

Similarly we can write

$$P(Q/S) = P(q/S) + P(b/S) - P(q/S)P(b/S) \qquad \underline{2}$$

Eqns. 1 and 2 are then combined using similar arguments, whence

$$P(F/S) = P(K/S) + P(Q/S) - P(K/S)P(Q/S) \qquad \underline{3}$$

The relative performance of the flood defence asset given the occurrence of the design storm event can be determined as a percentage from:

$$RP = [1 - P(F/S)] \times 100\% \qquad \underline{4}$$

Alternatively the probability of a flood event is obtained from

$$P(F) = \frac{P(S)P(F/S)}{P(S/F)}$$

If we state that the only cause of failure is the design storm or greater, then:

$$P(S/F) = 1$$

$$P(F) = P(S)\,P(F/S) \qquad \underline{5}$$

This can be related to the target P(F) using equations 1 - 3 to determine the design value of P(F/S)

If we consider the probability of a flood event in <u>any one year</u>, then $P(S) = P(S)_D$ and we can write

$$RP^D = \frac{1 - P(F/S)}{1 - P(F/S)_D} \times 100\% \qquad \underline{6}$$

which is the performance relative to the design performance expressed as a percentage

Alternatively we could consider the performance taking due account of the remaining life of the structure. This reflects the fact that the probability of a flood is a function of exposure duration being considered. (To some extent this will provide compensation for the inevitable and <u>planned</u> degradation of the structure over its design life).

If the design storm has a return period Rp, then:

$$P(S) = 1 - \left(1 - \frac{1}{Rp}\right)^{LR} \qquad \underline{7a}$$

and $$P(S)_D = 1 - \left(1 - \frac{1}{Rp}\right)^{LD} \qquad \underline{7b}$$

where L_R = remaining life

L_D = design life

Note: remaining life is time to replacement which is not always residual life.

whence the life dependent performance of the structure relative to the design is:

$$RP^L_D = \frac{1 - P(S)P(F/S)}{1 - P(S)_D P(F/S)_D} \times 100\% \qquad \underline{8}$$

In order to use the above we define the nominal descriptions for each condition statement as a probability as shown in Table 3.1 repeated below.

Table 3.1 : Proposed Probabilities that the Asset will Fail to Protect Against the Design Event because of its Condition

Structure Condition	P(d/S)	River bank/bed Condition	P(b/S)	Overtopping Condition	P(q/S)
Good	0.01	Accreting	0	Extremely Rarely	0
Fair	0.05	Stable	0	Very Rare	0.01
Moderate	0.1	Volatile	0.1	Rare	0.1
Poor	0.3	Eroding Slow	0.2	Frequent	0.2
Bad	0.5	Rapid Erosion	0.3	Often	0.3

It is assumed that any failure causes complete failure of the structure and the whole floodplain area is affected. The level of service is then simply a function of the asset performance set against the design or target performance, ie: equations 6 or 8 depending whether the time to replacement is to be taken into account.

2.3 WORKED EXAMPLES

2.3.1 Worked Example 1

Flood Bank at Bungay Meander Embankment.

Original Design Life = 50 years
Estimated Residual Life = 35 years
Condition of Asset = Fair = P(d/S) = 0.05
River Bank/Bed Condition = Stable = P(b/S) = 0.0
Overtopping Frequency = Frequent = P(q/S) = 0.2
Designed to protect against the 5 year flood.

	Design	Present
Rp (return period of design event)	5	5
LD (design life)	50	50
LR (residual life)	*	35
P(d/S) (probability of failure due to structure condition)	0.01 (G)	0.05 (F)
P(b/S) (probability of failure due to bank/bed condition)	0.0 (S)	0.0 (S)
P(q/S) (probability of failure due to overtopping frequency)	0.2 (F)	0.2 (F)

* For the design condition it is assumed that residual life equals design life.

P(S)	0.99	0.99
P(F/S)	0.208	0.24

Equation 6 $RP^D = \left(\frac{1 - P(F/S)}{1 - P(F/S)_D}\right) \times 100\%$

$= \left(\frac{1 - 0.24}{1 - 0.208}\right) \times 100\%$

$= 96\%$

Equation 8 $RP^L_D = \left(\frac{1 - P(S)P(F/S)}{1 - P(S)_D\, P(F/S)_D}\right) = 100\%$

$= \left(\frac{1 - 0.99 \times 0.24}{1 - 0.99 \times 0.208}\right) \times 100\%$

$= \left(\frac{0.762}{0.794}\right) \times 100\%$

$= 96\%$

Both equations indicate that the particular structure is performing to a standard relatively close to its design conditions.

2.3.2 Worked Example 2 : A Structure Known to be in Poor Condition

	Design	Present
Rp	100	100
L_D	50	50
L_R	*	10
P(d/S)	0.01 (G)	0.5 (B)
P(b/S)	0 (S)	0.3 (R)
P(q/S)	0.01 (VR)	0.3 (O)
P(S)	0.395	0.096
P(F/S)	0.0199	0.829

* Residual life equal design life for the design condition.

Equation 6 $RP_D = \left(\frac{1 - 0.829}{1 - 0.0199}\right) \times 100 = 17.5\%$

Equation 8 $RP^L_D = \left(\frac{1 - 0.096 \times 0.829}{1 - 0.395 \times 0.0199}\right) \times 100 = 92.7\%$ with 10 years residual life

In contrast with a 40 year life to replacement equation 8 gives the following result.

Equation 8 $RP^L_D = \frac{1 - 0.33 \times 0.829}{1 - 0.395 \times 0.0199} \times 100 = 73\%$

That is the greater length of time until replacement, the more likely it is that the asset will fail to provide it's design performance level.

In this second example, equation 6 indicates the very poor performance of the particular asset confirming the perceived view that this structure is in a very poor condition. The two examples of equation 8 illustrate the difference in values when different residual lives of the structure are considered. If it is already planned to replace this asset in 10 years time a more efficient use of resources may be to replace other poor assets as evidenced by equation 6 but which have a longer time to replacement and thus greater likelihood of failure before replacement.

2.4 INTERPRETATION OF RESULTS

2.4.1 The two equations 6 and 8 described at 3.2 allow the current condition of assets to be compared with the design condition both on the basis of the absolute standard of protection it affords and also taking account of the time to replacement of the asset.

Equation 6 shown in Section 3.2 reflects the present performance of the asset relative to its design performance the range of results is indicated below in Table 3.2.

Table 3.2 : Range of Results provided by Condition Equation 6

	> 100% ↑	Asset providing relatively better performance than design. Lower probability of failure than design standard
Design Performance	100%	Present Performance
	↓ < 100%	Asset providing relatively poorer performance than design. Greater probability of failure than design standard

Equation 8 from Section 3.2 is a further development of equation 6 taking into account the time before replacement of the assets to identify those most likely to fail over their remaining life. Table 3.3 indicates the range of results produced by equation 8.

Table 3.3 : Range of Results Provided by Condition Equation 8

Design Performance	100%	Probability of asset failing during remaining life equals probability of failure of original asset over its whole life
Actual Performance	↓ < 100%	Probability of asset failing during remaining life is greater than the probability of failure of the original asset over its whole life

2.4.2 The scoring systems for assessing the occurrence of flooding as detailed in Annex C define the overall occurrence for each LOS reach as either Adequate, Inadequate or Excessive in relation to the range of scores suggested as acceptable.

At this stage it is considered inappropriate to define the performance of the asset against the design standard in similar terms. Not only is the availability of data on a range of structures limited but also such a ranking may be inappropriate. It is perhaps more applicable simply to rank the assets in order rather than define a level at which the condition relative to the design is appropriate or otherwise.

Pro-formas for data collection - Rivers

1A	**Summary of Present Assets - Fluvial Rivers/Tidal Rivers**
1B	**Data Collection Sheet for 1A - Flood Banks and/or Flood Diversion Channels**
1C	**Data Collection Sheets for 1A - Control Structures or Drainage Pumping Stations**

PRO-FORMA 1A

SUMMARY OF PRESENT ASSETS
FLOOD DEFENCE - LEVELS OF SERVICE
CLASSIFICATION OF PILOT STUDY - FLUVIAL RIVER/TIDAL RIVER *

NRA ____________ REGION
____________ AREA
____________ DISTRICT
____________ RIVER

LOS REACH - From (d/s) : ____________ NGR : ____________
To (u/s) : ____________ NGR : ____________
Approximate Reach Length ____________ km

A. ASSET DATA

Asset	Local Name	Length Area or Number	Unit	NGRs **	Year of Construction	Original Design Life		Condition of Asset ***		River Bank/Bed Conditions at Structure *****	Overtopping of Crest ******		Estimated Residual Life		Comments on Asset Extent and Effectiveness
						Civil	M/E	Civil	M/E		Civil	M/E	Civil	M/E	
Flood Banks/Flood Walls (Left Bank)			km												
Flood Banks/Flood Walls (Right Bank)			km												
Flood Diversion Channels			km												
Tidal Sluice/Barrier			No												
Tidal Floodgate			No												
Tidal Penstocks/Boards			No												
Weir/Sluice Complex			No												
Flood Storage Reservoir			km^2												
Spillway/Other			No												
Drainage - Pumping Station ****			No												

B. Source and Reliability of Data (Brief Summary)
C. Effective Level of Protection Against Flooding/Handling Internal Drainage (Brief Summary)

Problems anticipated to commence (year) [ ]

Completed by: ....

Date: ....

Notes :
* Delete and specify as required
** Specify in comments if more than one structure
*** Specify Good/Fair/Moderate/Poor/Bad
**** Specify whether operated by AWA or others (IDB)
***** Specify Accreting, Stable, Volatile, Eroding Slowly, Eroding Rapidly
****** Specify Extremely Rarely (50 year plus return period)/Very Rarely (20-49 year return period)/Rarely (10-19 year return period)/Frequent (1-9 year return period)/Often (Greater than every year)

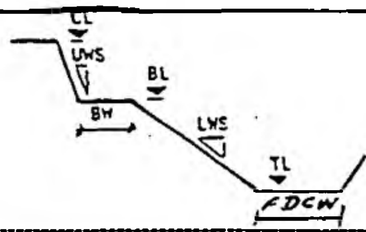
SUMMARY OF PRESENT ASSETS — PRO FORMAS 1B

FLOOD DEFENCE - LEVELS OF SERVICE
FLUVIAL RIVER/TIDAL RIVER* CLASSIFICATION
DATA COLLECTION SHEETS FOR FLOOD BANKS AND/OR FLOOD DIVERSION CHANNELS*

NRA.................. REGION
.... AREA REACH - From (d/s) ____________ NGR: ______
.... DISTRICT
.... RIVER To (u/s) ____________ NGR: ______

POSITION	PURPOSE	DESCRIPTION	MATERIAL	STRUCTURE
Left/Right	Flood Protection	Vertical	Concrete	Wall
River Bank	Erosion Protection	Sloping	Timber	Revetment
Left/Right	Retired	Bermed	Rock/stone	Embankment
Flood Plain	Protection of Control	Stepped	Steel/Sheet Pile	Toe/Apron
	Structure or Bridge	Capping	Gabions Mattress	Other
	Marina/Quay	Reveted	Grass/Earth	
			Other	

SKETCH PLAN



Toe Level (TL) : ----------------- AND IF PRESENT

Crest Width (CW) : ----------------- Berm Width (BM) : -----------------

Crest Level (CL) : ----------------- Berm Level (BL) : -----------------

Lower Wall Slope (LWS), 1 : ------------- Upper Wall Slope (UWS), 1 : -------------

Flood Diversion Channel Width (FDCW) : -------------

Year of Construction : ------------- Design Life : -------------

Value of Works : ------------- Residual Life : -------------

CONDITION OF ASSET	RIVER BANK/BED CONDITIONS AT STRUCTURE	OVERTOPPING	POTENTIAL FAILURE MODES
Good	Accreting	Extremely Rarely (50 yrs plus)	Undermining
Fair	Stable	Very Rarely (20-49 years)	Structural
Moderate	Volatile	Rarely (10-19 years)	Wash Out
Poor	Eroding Slowly	Frequent (1-9 years)	Excessive Seepage
Bad	Eroding Rapidly	Often (Greater than every year)	Settlement

Foot Note: * Delete and specify as required
General Notes on asset extent and effective level of protection against flooding/handling internal drainage.

Completed by: Date: Additional Sketch (PTO)

SUMMARY OF PRESENT ASSETS — PRO FORMA 1C

FLOOD DEFENCE - LEVELS OF SERVICE
FLUVIAL RIVER/TIDAL RIVER* CLASSIFICATION
DATA COLLECTION SHEETS FOR CONTROL STRUCTURES AND/OR DRAINAGE PUMPING STATIONS*

NRA.................. REGION
.... AREA
.... DISTRICT
.... RIVER

REACH - From (d/s) ____________ NGR: __________

To (u/s) ____________ NRG: __________

NAME OF STRUCTURE COMPLEX

POSITION	PURPOSE	DESCRIPTION OF TYPE OF SLUICE OR DRAINAGE PUMPING STATION	CONTROL METHOD
Main River	Flood Control	Tidal Sluice/Barrier	Gates
Flood Diversion	Ponding	Tidal Floodgates	Ungated
Channel Drainage	Drainage	Tidal Penstocks/Boards	Manual
Outlet	Flow Measurement	Weir Sluice Complex	Electrical
		Flood Storage Reservoir	Seasonal Use
		Spillway	Normally Closed
		Drainage Pumping Station	Other
		Other	

SKETCH PLAN

HYDRAULIC CONTROL DETAILS

Maximum Ponding Level of Sluice : ________

Lowest Crest Level : ________

Weir Width (Ungated) : ________

Weir Width (Gated) : ________

Maximum Flow of Drainage Pumps : ________

Upstream Drainage Channel Level : ________

Downstream Drainage Channel Level : ________

GENERAL DETAILS

Year of Construction : Civil________ M&E________

Year of Remodelling : ________

Design Life : Civil________ M&E________

Residual Life : ________ M&E________

Value of Works : ________

Owner/Operator : ________

CONDITION OF ASSET (Civil)	(M & E)	RIVER BANK/BED CONDITION AT u/s	d/s	OVERTOPPING OF ADJACENT EMBANKMENTS	POTENTIAL FAILURE MODES
Good	Good	Accreting	Accreting	Extremely Rarely (50 yrs plus)	Undermining
Fair	Fair	Stable	Stable	Very Rarely (20-49 years)	Structural
Moderate	Moderate	Volatile	Volatile	Frequent (1-9 years)	Wash Out
Poor	Poor	Eroding Slowly	Eroding Slowly	Often (Greater than every year)	
Bad	Bad	Eroding Rapidly	Eroding Rapidly		

Foot Notes: * Delete and specify as required

General Notes on asset extent and effective level of protection against flooding/handling internal drainage.

Completed by: Date: Additional Sketch (PTO)

Pro-formas for data collection - Estuary/sea defences

2A **Summary of Present Assets -**
Estuary/Sea Defences

2B **Data Collection Sheet for 2A -**

PRO-FORMA 2A

SUMMARY OF PRESENT ASSETS
FLOOD DEFENCE - LEVELS OF SERVICE
CLASSIFICATION OF PILOT STUDY - ESTUARY/SEA DEFENCE *

NRA ____________ REGION
____________ AREA
____________ DISTRICT
____________ RIVER

LOS REACH - From (d/s) : ____________ NGR : ____________
To (u/s) : ____________ NGR : ____________
Approximate Reach Length ____________ km

A. ASSET DATA

Asset	Local Name	Length Area or Number	Unit	NGRs **	Year of Construction	Original Design Life	Condition of Asset ***	Condition of Beach at Toe of Wall ****	Overtopping of Crest *****	Estimated Residual Life	Comments on Asset Extent and Effectiveness
Groynes											
Breastwork											
Embankment											
Revetment											
Wall											
Other											
Drainage Gravity Outfall											
Drainage Pumping Station											

B. Source and Reliability of Data (Brief Summary)

C. Effective Level of Protection Against Flooding/Handling Internal Drainage (Brief Summary)

Problems anticipated to commence (year) [ ]

Notes :
* Delete and specify as required
** Specify in comments if more than one structure
*** Specify Good/Fair/Moderate/Poor/Bad
**** Specify Accreting, Stable, Volatile, Eroding Slowly, Eroding Rapidly
***** Specify Extremely Rarely (50 year plus return period)/Very Rarely (20-49 year return period)/Rarely (10-19 year return period)/Frequent (1-9 year return period)/Often (Greater than every year)

Completed by: ....

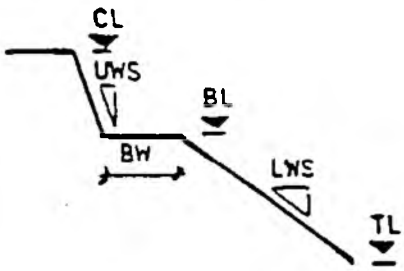
Date: ....

COASTAL WORKS CLASSIFICATION

Location: ____________ NRA Ref No: ____________ Coastal Works ID: ____________

Owner: ____________

POSITION	PURPOSE	DESCRIPTOR	MATERIAL	STRUCTURE
Hinterland	Flood Protection	Vertical	Concrete	Wall
Backshore	Erosion Protection	Sloping	Timber	Revetment
Foreshore	Beach Retention	Bermed	Rock/stone	Embankment
Nearshore	Dune Retention	Stepped	Steel Sheet Pile	Breastwork
Offshore	Other	Capping	Gabions Mattress	Toe/Apron
		Reveted	Grass	Groyne
		Armour	Sand/Shingle	Breakwater
		Zig Zag	Other	Fencing
		Box		Ridge/Dune
		Fillet		Other
		Fishtail		
		Offshore		



Toe Level (TL) : ____________

Crest Width (CW) : ____________

Crest Level (CL) : ____________

Lower Wall Slope (LWS), 1 : ____________

Year of Construction : ____________

Value of Works : ____________

AND IF PRESENT

Berm Width (BM) : ____________

Berm Level (BL) : ____________

Upper Wall Slope (UWS), 1 : ____________

Design Life : ____________

Residual Life : ____________

CONDITION	BEACH CONDITION AT STRUCTURE	OVERTOPPING	POTENTIAL FAILURE MODES
Good	Accreting	Extremely Rarely (50 yrs plus)	Undermining
Fair	Stable	Very Rarely (20-49 years)	Structural
Moderate	Volatile	Rarely (10-19 years)	Wash Out
Poor	Eroding Slowly	Frequent (1-9 years)	
Bad	Eroding Rapidly	Often (Greater than every year)	

NOTES:

Completed by: Date: Sketch (PTO)