Appendix C

Structures Lifecycle Plan

Introduction

1. The background to lifecycle plans, and the format of each, is described in Section 5 of the HAMP. This lifecycle plan covers highway structures owned and maintained by the Council.

2. The highway structures covered under this appendix are bridges, culverts, retaining walls, sign gantries and subways.

3. A significant number of bridges on the highway network are the responsibility of other owners, such as the Highways Agency and Network Rail, and so are not included in this plan.

Levels of Service

4. The desirable levels of service for this asset category are set out in Table 1 below and Table 2 overleaf.

Table 1

Attribute	Service Level	Measure
Safety	Provide adequate containment for vehicles, pedestrians and livestock.	Principal (alternates with General Inspections) Inspections – every 6 years. General and superficial inspections – every 2 years. Special/safety – as required.
Availability	Provide adequate load-carrying capacity (which may include weight limits in lieu of strengthening at appropriate locations), width and headroom.	All bridges will be capable of carrying European standard 40/44T vehicles (except where weight limits have been imposed).
Serviceability	Maintain appropriate appearance, including removal of:- • offensive graffiti • debris in watercourse beneath bridges	Complaints. NHT Survey. Council surveys. ELM Reports.
Condition	At a level consistent with achieving minimum whole-life cost, that is SCICRIT for all bridges to be above 75.	Bridge Condition Indices (SCICRIT and SSCICRIT) monitored on an annual basis. (See Table 2)

Table 2 - Condition Related Service Levels

Service Level	Condition Index	Service Level
Target 1	SCICRIT	No bridge spans will have a SCICRIT value below 75
Target 2	SSCICRIT	The bridge stock will have a minimum SSCICRIT value of 86
Target 3	Strength Assessment	All bridges will be capable of carrying European standard 40/44T vehicles (except where weight limits have been imposed)
Target 4	Bridge Inspections	All bridges will be inspected on a 2-year cycle

5. Later sections of this life cycle plan show how different levels of available funding will influence the extent to which the desirable levels of service can be achieved.

6. Failure to respond adequately to any of these four levels of service will produce risk to the authority. Table 3 below, which details the main risks, underlines the importance of responding properly to each:-

Table 3

Risk Type	Description Example
Physical	Accidents caused by asset defects
Business	Legal proceedings for failure in duty of care
Financial	Reduction in the net book value of the asset and increase in eventual maintenance costs arising from lack of timely repairs
Corporate Image	Poor condition reflects on the overall image of the Council.
Environmental	Increased risk of flooding if watercourses beneath structures are not properly maintained.
Network	Increased disruption to highway users caused by emergency unplanned maintenance arising from suboptimal maintenance

Asset Base and Characteristics

7. The highway bridge stock comprises many different types of structures including masonry arches, concrete, and steel. They carry a wide range of highways from A Roads to Public Footpaths. The council holds information and data about the highway bridges and other highway structures is held on the WDM computerised structures asset management system. The WDM system is also able to interrogate the data held.

Highway Structures Inventory.

8. The Council's structures inventory is summarised in Table 4 below.

Table 4

Structure Type	Number of Structures
Bridges	209 No.
Footbridges	192 No.
Culverts	97 No.
Subways	11 No.

Asset Condition and Assessment

9. To asses the extent to which the desirable levels of service are met requires measurements covering the four dimensions of safety, availability, serviceability and condition. There are as yet no measures for serviceability and these will be considered further in the second edition of the HAMP.

10. Highway structures are subject to periodic inspection to determine their condition and to record any defects present. The regime is shown in Table 5 below.

Table 5

Type	Frequency	Assets Inspected
General Inspections	2 years	All bridges
Principal Inspections	6 years	All bridges except minor footbridges
Diving Inspections	Ad hoc	Bridges which have substructures in deep, often fast-flowing, watercourses
Special Inspections	Ad hoc	All structures as necessary
Superficial Inspections	2 years	Privately owned bridges

11 A Structure Condition Index (SCI) is determined for each individual structure, based on its condition at the time of the inspection. The SCI system is a nationally developed method, endorsed by ADEPT, with two SCI values calculated for each bridge:-

SCICRIT the value when only the critical load-carrying elements are considered

SCIAV the value when every element of the bridge is considered

12. How the SCI value relates to condition is shown in Table 6 below.

Table 6

SCI Range	Condition
100 – 95	Very Good condition
94 – 85	Good condition
84 – 65	Fair condition
64 – 40	Poor condition
39 – 0	Very Poor condition

13. An average value for the whole bridge stock, known as the Structure Stock Condition Index (SSCICRIT), is also calculated based on the individual SCICRIT values, and is weighted by area.

14. Bridge condition deteriorates at different rates according to the construction type, exposure conditions, traffic flows and maintenance regime adopted. It is a complex interaction of variables which makes forecasting trends very difficult.

15. Condition values monitored over time are shown in Table 7 below.

Table 7

Date	SSCIAV	SSCICRIT	% below SCICRIT 75
2009	93.79	90.75	12.80
2010	93.01	87.92	17.55
2011	92.77	87.79	16.81

16. In addition highway bridges are assessed to establish their ability to carry the loads which are imposed upon them. The assessment provides valuable information for managing the safety and serviceability of highway bridges. The road bridges in West Berkshire were last assessed under a national programme of assessment undertaken in the mid 1980s.

17. In accordance with current guidance bridges will be re-assessed at the following intervals:-

- a minimum of 12 years, to coincide with principal inspections;
- whenever there is a significant change in the bridge condition.

Asset Valuation

18. The background to Asset Valuation is described in Section 4 and Appendix E. The interim value of the highway bridge stock, based on the Gross Replacement Cost (GRC), is estimated to be approximately £ 75,351,000

19. This valuation has been developed from an unrefined method which will eventually be updated in line with the Guidance Document for Highway Infrastructure Asset Valuation once published.

Treatment Options and Costs

20. Treatment options and costs are summaries in Table 8 below.

Table 8

	Maintenance Activity	**Treatment Option**
Reactive	Emergency and non-programmed essential maintenance.	Ad-hoc emergency repairs. Graffiti removal.
Regular	Routine and cyclic maintenance.	Vegetation removal. Re-pointing of brickwork. Re-painting of metalwork. Drainage cleansing.
	Management of sub-standard structures.	Weight restriction.
Programmed	Preventative maintenance.	Concrete repairs. Re-painting of metalwork.
	Component renewal/upgrading.	Waterproofing. Parapets. Joints. Bearings.
	Replacement.	Replacement of Structure Replacement of deck Replacement of brick arches with precast concrete box culverts.

21. Table 9 below shows the expected service life for the different bridge types and treatments with their respective estimated replacement costs.

Table 9

Structure	Work	Interval	Cost (£000s)
Masonry arch (span range 1.5m – 12.0m, average span – 4.6m, average area – 131m2)			
	Brickwork repairs	10 years	15
	Complete replacement(with modern equivalent)	120 years	249
Concrete bridge (span range 1.5m – 33.5m, average span – 5.0m, average area – 103m2)			
	Drainage/bearing shelf cleaning	5 years	0.5
	Parapet painting	15 years	7.5
	Deck re-waterproofing	20 years	25
	Expansion joint renewal	20 years	15
	Concrete repairs	30 years	15
	Bearing renewal	30 years	60
	Complete replacement	120 years	196
Steel bridge (span range 3.0m – 39.0m, average span – 8.6m, average area – 265m2)			
	Drainage/bearing shelf cleaning	5 years	0.5
	Structural metalwork painting	12 years	10
	Parapet painting	15 years	7.5
	Deck re-waterproofing	20 years	30
	Expansion joint renewal	20 years	15
	Bearing renewal	30 years	60
	Complete replacement	120 years	665

22. It should be noted that not all bridges will require each of the treatments shown.

Management Strategy for Minimising Whole-Life Costs

23. When considering whole life costs, account needs to be taken of the direct and indirect costs associated with the asset group, including works, design and supervision, and inspection. With bridges, which have a long life but are very expensive to replace at the end of that life, it is essential to plan preventative maintenance works in a timely manner, since delays will increase the whole life cost of the structure.

24. Currently, our work programme is determined using the data in the bridge management system, and priority is given to the following:-

- structures with low SCICRIT values, i.e. those with structural defects which have a direct impact on their load-carrying capacity;
- structures with safety-related defects;
- structures with defects which, if not remedied, are likely to lead to more serious problems, for example failed waterproofing systems which will permit water ingress into decks, leading to corrosion of steel reinforcement.

25. The available funding is allocated to each of the above work-types on an annual basis to suit the importance or criticality of the works identified. This strategy is intended to deliver the identified levels of service.

26. Precedence is given to bridges on higher category roads and on roads carrying higher volumes of traffic.

27. Currently, maintenance works are identified in an annual programme, although major schemes are planned up to two years ahead.

Options and Targets within the Management Strategy

28. The analysis which follows looks at levels of maintenance spending against predicted outcomes for structures condition. The impact of spending on condition and service levels will continue to be developed over the course of HAMP.

Maintenance Budgets

29. The bridge maintenance budget is funded from Capital and Revenue budgets. Table 10 below shows the total level of funding over the last 3 years and how this funding has affected the condition of the bridge stock and service levels respectively.

Table 10 - Funding

Date	Total Funding (Capital and Revenue)	SSCIAV	SSCICRIT	% below SCICRIT 75
2009	£862,790	93.79	90.75	12.80
2010	£938,000	93.01	87.92	17.55
2011	£708.000	92.77	87.79	16.81

30. From the data collected to date, it has been established that the maintenance funding over the last three years has kept the condition of the bridge stock more or less stable. However, with reference to the set condition based service levels, Service Level 1 has not been met. Further development will take place over the course of this HAMP to refine the budget/service level relationship to enable us to set appropriate service levels for different budget allocations.

31. The Service Level Targets 2, 3 and 4 are all currently being achieved and there is a reasonable level of confidence that, with the same level of future funding, these service level will continue to be maintained.

32. Based on evidence currently available, minimum whole life cost is obtained if individual bridges have a SCICRIT value of 75 or above, i.e. in the 'fair condition' range. Reduced performance, that is lower SCICRIT values, will therefore lead to increased costs in the longer term. To achieve a level of condition which reflects minimum whole-life cost we need to reach a point where 100% of bridges meet this criteria. To achieve this may require some increased spending, though this can not be confirmed until more data is available to identify the correlation between maintenance spending and bridge condition.

Risks

33. The risks involved in implementing the lifecycle plan have been assessed against a standard grid of likelihood versus impact as shown in Tables 10 and 11 below, with an outline of the mitigation to be planned. The 'red' risks are listed in Section 7 of the main HAMP document.

Table 10

Impact				
	Extreme Impact - Rarely 4	**Extreme Impact - Moderate** 8	**Extreme Impact - Likely** 12	**Extreme Impact - Almost certain** 16
	High Impact - Rarely 3	**High Impact - Moderate** 6	**High Impact - Likely** 9	**High Impact - Almost certain** 12
	Medium Impact - Rarely 2	**Medium Impact - Moderate** 4	**Medium Impact - Likely** 6	**Medium Impact - Almost certain** 8
	Low Impact - Rarely 1	**Low Impact - Moderate** 2	**Low Impact - Likely** 3	**Low Impact - Almost certain** 4

Likelihood

Table 11

Risk	Level	Mitigation	Responsible
1. Insufficient staff resources.	8	Highlight in Service Plan Present Business Case for additional support	Head of Service Service Managers
2. Insufficient national guidance and support	2		
4. Materials/ labour/ plant/ staff costs	6	Ensure value for money is being achieved	Project Managers Contractors
5. Reduced capital funding	12	Prioritise key assets to minimise overall deterioration whilst maintaining safety	
6. Reduced revenue funding	12	Prioritise key assets to minimise overall deterioration whilst maintaining safety	