Minerals Planning Policy (Wales)

Minerals Technical Advice Note (Wales)

1: AGGREGATES

Llywodraeth Cynulliad Cymru
Welsh Assembly Government

March 2004

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Cathays Park
Cardiff
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ISBN 0 7504 3314 0
March
Designed by Graphics Unit G/497/03-04
Typeset by Text Processing Services

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MINERALS TECHNICAL ADVICE NOTE 1 (Wales): AGGREGATES

Introduction

1. This Minerals Technical Advice Note (Wales) sets out detailed advice on the mechanisms for delivering the policy for aggregates extraction by mineral planning authorities and the aggregates industry. It should be read in conjunction with Minerals Planning Policy Wales[1] which sets out the general policies for all mineral development.

2. Minerals Planning Policy Wales, Minerals Technical Advice Notes and circulars should be taken into account by mineral planning authorities in Wales in the preparation of development plans. They will usually be material to decisions on individual planning applications and mineral review applications and will be taken into account by the Welsh Assembly Government and Planning Inspectors in the determination of called-in planning applications and appeals. Sections of text are highlighted in this Minerals Technical Advice Note to emphasise their importance.

3. This technical advice note relates only to land-based development. Welsh Assembly Government policy for dredging aggregates in the Bristol Channel and Severn Estuary will be provided in a separate document: Marine Aggregates Dredging Policy.

4. Government policies and planning guidance on the provision of aggregates have previously been set out in Mineral Planning Guidance Note 6 (MPG6) published in 1989 for England and Wales and revised for England only in 1994. This Minerals Technical Advice Note supersedes Mineral Planning Guidance Note 6 (1989) which is hereby cancelled. This Minerals Technical Advice Note supersedes Minerals Planning Guidance Note 7 (MPG7): The Reclamation of Mineral Workings (1989) and paragraphs 31 to 42 of Minerals Planning Guidance Note 11(MPG11): The Control of Noise at Surface Mineral Workings (1993) in relation to aggregates planning, both of which are hereby cancelled only in respect of aggregates related development.

[1]Minerals Planning Policy Wales, December 2000, National Assembly for Wales

Background

5. Aggregates are the basic constituents used in construction. For the purposes of this note they are placed into three categories:

   - primary aggregates - naturally occurring bulk materials - rock, sand and gravel - which are extracted directly from land or marine sources for use in construction;

   - mineral waste - material arising as a by-product of mineral extraction that is capable of use, either with or without further treatment, as a primary aggregate substitute, for example crushed rock fines and slate waste; and,

   - secondary/recycled aggregates – previously used materials that are capable of substituting for primary aggregates. These include waste material from construction operations; the demolition of buildings or structures; the by-products of industrial processes such as steel slag or pulverised fuel ash from power stations.

6. It is essential to the economic and social well being of the country that the construction industry is provided with an adequate supply of the materials it needs[2] but not to the unacceptable detriment of the environment or amenity. The Sustainable Development Scheme adopted by the National Assembly in November 2000 acknowledges that our environment is Wales' greatest asset, that there is an inextricable inter-dependency between our economy and our environment, both having an impact on our communities and our way of life. A thriving and competitive economy where finite resources are used prudently must be compatible with a cleaner and protected environment that includes the natural, social, cultural and historic environment.

7. The overarching objective in planning for aggregates provision therefore is **to ensure supply is managed in a sustainable way so that the best balance between environmental, economic and social considerations is struck, while making sure that the environmental and amenity impacts of any necessary extraction are kept to a level that avoids causing demonstrable harm to interests of acknowledged importance**. This acceptable minimum may not be possible in all instances, and where that is the case, extraction should not take place, or where extraction is currently taking place, local planning authorities and the aggregates industry should consider alternative working practices or locations for future working to secure a standard considered appropriate to mineral working in the 21st Century. This task must be carried out by mineral planning authorities within the framework of the Assembly's planning policy and technical advice.

8. The following sections A to E are structured to reflect the five key principles in Minerals Planning Policy Wales.

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[2]Minerals Planning Policy Wales, December 2000, National Assembly for Wales

A. To provide aggregate resources in a sustainable way to meet society's needs for construction materials in line with the following objectives:

- **maximising the use of secondary and recycled materials and mineral waste where practicable;**
- **ensuring planning permissions for future primary extraction are essential and properly planned for in accord with the Regional Technical Statement;**
- **eliminating over the next 5 years any likelihood of future primary aggregate extraction at historically obsolete and long dormant sites.**

Current Aggregates Production

9. Information on current production and permitted reserves of aggregates in each local authority in England and Wales is collected and monitored by the Regional Aggregates Working Parties (RAWPs).

10. **Regional Aggregates Working Parties** were established in the 1970s as technical groups to monitor and assess the supply of aggregates. There are two RAWPs in Wales for North and South Wales. The RAWPs collectively advise their parent body, the National Co-ordinating Group (NCG) which provides a national (GB) forum for discussion of the RAWP work. A Technical Sub-Group (TSG) of the NCG provides detailed technical guidance on specific issues. The membership and work undertaken by the RAWPs in monitoring aggregates is explained in Annex A.

11. In addition to the regular monitoring reports, in 1995 the two Welsh RAWPs published their own guidelines to provide up-to-date advice on the provision of aggregates in Wales; to consider what provision should be made in each region to meet aggregates needs up to 2006, and to apportion the estimated demand between the former counties.

12. **Primary aggregates production** in England and Wales has declined from a peak of 250 million tonnes in 1989[3] to 193 million tonnes in 2001. In Wales total sales declined from 26 to just under 20 million tonnes[4] in 2001 or 10% of total production in England and Wales. Primary aggregates production in Wales is dominated by crushed rock (86%); of this, limestone (including dolomite) makes up 73%; sandstone 15% (only produced in South Wales); and, igneous rock 12%. Land based sand and gravel extraction is far more developed in North Wales than in South Wales where marine-won sources provide most of this material. Overall, land based sand and gravel extraction is far less significant in Wales than in England and marine dredged materials more important. Table 1 shows the pattern of primary aggregates production in Wales from 1993 to 2001.

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[3]Minerals Planning Guidance Note 6 (MPG6): Guidelines for Aggregates Provision in England - Monitoring Report 1994-1995, DETR, 1997

[4]Collation of the Results of the 2001 Aggregates Minerals Survey for England and Wales, ODPM (BGS), 2003

Table 1
PRIMARY AGGREGATES PRODUCTION IN WALES (million tonnes)

	1993 SW	1993 NW	1993 WALES	1997 SW	1997 NW	1997 WALES	2001 SW	2001 NW	2001 WALES
CRUSHED ROCK	14.74	8.04	22.78	12.91	7.55	20.46	10.02	7.20	17.22
SAND&GRAVEL LAND WON	0,27	1.66	1.93	0.30	1.34	1.65	0.12	1.34	1.46
MARINE	1.55	0.07	1.62	1.71	0.05	1.75	1.17	0.05	1.22
TOTAL S&G	1.82	1.73	3.55	2.01	1.39	3.40	1.29	1.39	2.68
ALL PRIMARY AGGREGATES	16.56	9.77	26.33	14.92	8.94	23.86	11.31	8.59	19.90

13. Mineral wastes –

i. Crushed rock fines – hard rock quarries produce "fines" from the crushing and screening process and much of the material is used as fine aggregate in concrete, asphalt and for other purposes. The amount produced and current level of usage is unknown although annual arisings of around 3.8 million tonnes in South Wales have been estimated. Manufactured sands from hard rock quarrying are already partially replacing naturally-occurring sands and this trend is increasing. It is usually necessary for crushed rock fines (CRFs) to be blended with naturally-occurring sand to improve its particle size distribution and workability in concrete. In general, most CRFs produced by limestone quarries are re-used but not those from sandstone or igneous quarries because the excessive amounts of fines generated in the production of high specification aggregates[5] are much greater than the market demand for them. Recent research[6] has indicated that annual arisings from sandstone and igneous crushed rock production are about 1.6 million tonnes in Wales but the majority would require processing prior to use. Comprehensive information is not therefore available and the position will be kept under review as new information comes forward.

ii. Slate waste – research has been undertaken by the Assembly to investigate how this material could be re-used or recycled to provide a sustainable primary-won aggregate[7]. This study has estimated that there are 700 to 900 million tonnes of slate waste in Gwynedd alone, and over half is constrained by a range of environmental designations or by distance from any possible bulk transport options. However, the remaining 270 – 370 million tonnes in the Bethesda and Blaenau Ffestiniog areas are suitable for use as aggregates. Relatively small quantities of slate waste are currently used as aggregates generally to supply local needs although this has increased since the introduction of the Aggregates Levy was imposed on primary aggregates production. The study concludes that the provision of rail freight facilities would assist in enabling much greater quantities of slate waste to be used as aggregates in major markets in the North West and South East of England. Improvements to the rail infrastructure are currently being considered.

[5]Crushed Rock Sand in South Wales –A Reconnaissance Survey, National Assembly for Wales, (British Geological Survey), 2000

[6]Improving the Information Base on Secondary Minerals/C&D Waste for Use as Aggregates, Arup, January 2004

[7]North Wales Slate Tips – A Sustainable Source of Secondary Aggregates, National Assembly for Wales, (Arup), 2001

iii. **Other mineral wastes** – very little waste material tipped as a result of non-aggregate mineral extraction, such as coal, is currently being used as aggregates although such mineral waste has been used for aggregates in the past. Recent research[8] indicates that annual arisings of colliery spoil with potential for use as aggregates amounts to about 0.5 million tonnes in South Wales only. The re-working of reclaimed tips is likely to be unacceptable in most locations because of the significant public investment in reclamation works that has been undertaken to improve the amenity of local communities and in some cases the method of tip construction makes it unsuitable to re-use the material.

Secondary/Recycled Materials

14. **Industrial By-Products:** These are fairly homogenous wastes produced by certain industrial processes in large quantities such as slags from iron and steel manufacture and ash from coal fired power stations, however, significant volumes are only produced in South Wales. It was estimated[9] that over 1.3 million tonnes of slag and about 0.5 million tonnes of ash were produced in Wales in 2001 and most of the steel slag material was re-used, about half of total arisings were used as aggregates. Further research by Arup[8] has recently been undertaken to provide more detailed information on the potential of alternative materials to substitute for primary aggregates in Wales. This indicates that there are current arisings of about 1 million tonnes of steel slag and full usage is being achieved with about a third being used as aggregates. It is estimated that there are 3 million tonnes of slag in stockpiles. Annual arisings of power station ash are in the region of about 0.5 million tonnes per year, and there are between 5 and 8 million tonnes of accessible stockpiles. The high carbon content of the ash prevents further use for cementitious uses.

15. **Recycled Aggregates from construction and demolition waste** - Research projects[10 11] relating to the use of recycled materials as aggregates have concluded that the majority of arisings of construction and demolition waste in the UK is re-used or recycled. Table 2 shows the current rate of recycling (latest figures available for 2001) of construction and demolition waste and soil in Wales[12].

Table 2
RECYCLING OF CONSTRUCTION AND DEMOLITION WASTE AND SOIL IN WALES (2001) (million tonnes)

Used as Recycled Aggregates	Used as Recycled soil	Re-used for restoration and landfill	Used to backfill quarry	Spread on Exempt Sites	Disposed of at landfills	Total Arisings
1.55	0.24	0.66	0.94	1.28	0.35	5.02
31%	5%	13%	19%	25%	7%	100%

[8]Improving the Information Base on Secondary Minerals/C&D Waste for Use as Aggregates in Wales, Arup, January 2004

[9]Survey of Arisings and Use of Secondary Materials as Aggregates in England and Wales in 2001, ODPM (Symonds Group), September 2002

[10]Statistics on arisings and use of mineral and construction wastes as aggregates – information collection issues – Department of the Environment (Building Research Establishment) 1995

[11]Use of Waste and Recycled Materials as Aggregates, Department of the Environment (BRE), 1995

[12]Survey of Arisings and Use of Construction and Demolition Waste in England and Wales in 2001 – Office of the Deputy Prime Minister and National Assembly for Wales (Symonds), 2002

16. Of the 5.02 million tonnes of construction and demolition waste and soil arising in Wales in 2001, 31% were recycled for aggregates use, with a further 13% re-used at licensed landfill sites mostly for site engineering works, the remainder is used to backfill quarry voids, or tipped at landfill or exempt sites. The opportunities to maximise the use of such materials as alternatives to primary sources will be considered later in this advice. (See paragraph 34 and Section E)

Future Demand

17. **Demand Forecasts:** It has been long standing practice for the Government to commission econometric forecasts to provide projections of aggregates demand as a basis for decisions about future levels of supply. A Monitoring Report[13] published in 1997 for England concluded that the forecast projections for both crushed rock and sand and gravel were generally significantly higher than actual land won production over the period 1992 to 1995, which was between 200 and 220 million tonnes per annum in England and Wales. Inaccuracies in the forecasts are magnified if projections are made over anything more than a relatively short period[14].

18. The Welsh Assembly Government has decided that this approach to planning for the supply of aggregates does not tie in closely enough with the principles of sustainable development which are at the heart of government in Wales. In particular, it feels there are more relevant ways of determining how to meet society's needs without compromising the environment, amenity or future resource needs. The RAWPs provide a suitable forum for informed discussions on the provision of aggregates.

19. In recognition of this, Minerals Planning Policy Wales states that although there should be an adequate supply of aggregates (paragraph 67), natural resources should be conserved and the use of waste products maximised in line with sustainable objectives (paragraph 68). Therefore, while the planning system in Wales must ensure that supply is capable of meeting demand as it arises, the means of meeting that demand must be through a number of sources of supply, and not simply from primary extraction. This must be carefully planned for, beginning in earnest now, and is discussed later in paragraphs 29-50.

20. It is considered that the present level of total aggregates demand and consequent production (from both land-won, marine and secondary sources) of about 23 million tonnes in Wales will not increase significantly over the next 5 years (in 2001, 19.90 mt of primary aggregates were produced[15] and 2.9 mt of secondary materials[16]). Even taking into account the expected economic growth in Wales it is not anticipated that demand for aggregates will exceed 23-27 million tonnes per year by 2010. Until the Regional Technical Statement (paragraph 50) is completed this range should be used

[13]Minerals Planning Guidance Note 6 (MPG6): Guidelines for Aggregates Provision in England – Monitoring Report 1994-1995, DETR, 1997
[14]Planning for the Supply of Aggregates in England Consultation Paper, DETR, 2000
[15]Collation of the results of the 2001 Aggregates Minerals Survey for England and Wales (Table 1a) ODPM (BGS), 2003
[16]Improving the Information Base on Secondary Minerals/C&D Waste for Use as Aggregates in Wales, Arup, January 2004

for planning purposes. As an overall guideline for the foreseeable future, this broad level of supply should be sufficient to ensure adequate provision for the current road construction and repair programme and to supply the demands of the construction industry.

21. Demand for aggregates produced in Wales will be closely monitored annually at all-Wales and regional levels by the Assembly in conjunction with the RAWPs and reviewed in the Regional Technical Statements. Further advice will be issued if major changes are anticipated. The econometric forecasts of aggregate demand published by the Office of the Deputy Prime Minister (ODPM) as part of the review of MPG6 (England), have been considered and there is no indication of any significant increase in demand for aggregates in Wales in the near future. The extent of the permitted reserves in landbanks in Wales will allow for flexibility in meeting an increase in demand in aggregates, particularly in North Wales from where most of the demand from exports to England are met.

22. Demand for aggregates would be reduced if alternative materials were more widely used in construction, such as timber or plastics. Research[17] has been undertaken to recommend how changes could be introduced to current construction practices and thus reduce the demand for aggregates. There is little evidence that significant changes in construction design are likely to occur in the foreseeable future but there could well be a long-term trend towards using alternative materials in construction in place of primary aggregates.

23. **The Aggregates Levy** introduced in April 2002 has encouraged some substitution of primary materials as secondary and recycled materials are exempt from taxation. Research[18] has shown that overall demand for aggregates is relatively inelastic, that is, overall demand does not generally fluctuate according to price, as in order to function, the construction industry must have aggregates. A Sustainability Fund has been set up with the objective of using part of the revenues from the Levy to promote recycling and to provide environmental benefits to quarrying communities.

Table 3
REGIONAL PRIMARY AGGREGATES PRODUCTION
(million tonnes)

		1993[19]	1995[19]	1997[20]	2001[21]
South Wales	-	16.56	17.71	14.92	11.31
North Wales	-	9.77	10.20	8.94	8.59
Total production	-	26.33	27.91	23.86	19.90

[17]Building a better quality of life: a Strategy for more Sustainable Construction, DETR, 1999
[18]The environmental costs and benefits of the supply of aggregates, DETR, 1999 (London Economics)
[19]Annual Reports 1993 & 1995, South and North Wales Regional Aggregates Working Parties
[20]Collation of the results of the 1997 Aggregates Minerals Survey for England and Wales, DETR (BGS), 2000. (Table 2b Page 21)
[21]Collation of the results of the 2001 Aggregates Minerals Survey for England and Wales ODPM (BGS), 2003 (Table 1)

Regional Demand

24. The regional proportion of primary aggregates production in Wales had remained consistent for many years at 63% - South Wales, and 37% - North Wales, although the 2001 survey indicates that these proportions may be changing with North Wales accounting for an increasing proportion of Welsh production

25. The two Regional Aggregates Working Parties in Wales published guidelines for aggregates provision in 1995 to provide the necessary information to carry out an apportionment exercise of the forecasts of demand for the mineral planning authorities within their regions. The guidelines forecast primary aggregate demand in three five-year periods as follows:

Table 4
FORECASTS OF DEMAND - SOUTH AND NORTH WALES RAWP GUIDELINES 1995 (million tonnes)

	Crushed Rock		Sand & Gravel (land)	
	SW	**NW**	**SW**	**NW**
1992-1996	62	44	1	8
1996-2001	71	54	1	10
2002-2006	76	64	2	12
Marine dredged (1992-2006)			35	
Total Demand (1992-2006)	**207***	**162**	**39**	**30**

The 5-year periods do not add up to the total shown in the table

26. The South Wales RAWP[22] calculated that crushed rock sales from 1992 to 1996 had exceeded the 1995 RAWP forecast by nearly 10 million tonnes and the sales of sand and gravel were double the forecast figure of 1 million tonnes (the increased sand and gravel production was the result of a short term output from a borrow pit). In North Wales, sales of crushed rock were less than the forecasts but the same as the forecast for sand and gravel. The RAWP forecasts have proved, however, to be more reliable than the econometric forecasts used in UK forecasts and in MPG6 (England) 1994.

27. It will be necessary to monitor regional demand carefully and the RAWPs are well placed to carry out monitoring of aggregate demand. The Welsh Assembly Government considers it essential that the role of the RAWPs be enhanced to include not only assessments of regional changes in demand but also to explore the regional interpretation of the assessment of environmental capacity and environmental capital, and how these principles may be applied to ensure that the provision of aggregates is sustainable. Research[23] has been undertaken to establish the methodology to carry out this work and ensure the process adequately reflects these notions. The increased role of the RAWPs in monitoring demand and assessing regional supply is considered later in this advice note (paragraph 50) and is summarised in Annex A.

[22]Annual Reports 1996 and 1997, South Wales Regional Aggregates Working Party (1997)
[23]Establishing the Methodology for Assessing Aggregates Demand and Supply, Welsh Assembly Government, (Arup), 2003

28. As part of the monitoring process to examine regional demand, the RAWP Technical Secretaries should assess development plans for major proposals and future programmes in consultation with the aggregates industry that will be likely to increase the demand for aggregates. Examples include new road proposals and large-scale industrial, commercial or residential development. This will enable future demand to be anticipated at an early stage and allow for an assessment of the aggregates reserves to determine whether a review of advice on aggregates supply is necessary to meet that demand.

Future Supply of Aggregates

29. The planning system can influence aggregates supply patterns much more than overall demand which is generally market led. The current pattern of supply is largely a historic residual, and does not necessarily relate to what may be optimal in the 21st century. It will need to gradually change to reflect current notions of sustainability. This can be achieved by:

- examining very carefully existing reserves on a national and regional basis to see if they are adequate in the short, medium and long term;

- only granting permission for future extraction to take place in the most environmentally acceptable locations, in accord with development plans that are informed by the Regional Technical Statement which in turn is based on the environmental capacity assessment. In some local authority areas aggregate resources may not be available, or it may be inappropriate or unacceptable for them to contribute to regional supply. Proposals for aggregates extraction within areas that are subject to environmental designations and thus recognised as part of our natural heritage will require careful consideration in accord with their relative significance and the policies set out in Minerals Planning Policy Wales. The assessment of proposals adjacent or close to these areas which would be likely to adversely affect such sites must take into account the likely impact of the development on the environmental designation.

- actively reducing the proportion of primary aggregates used in relation to secondary, recycled or waste materials[24];
- minimising the transportation of aggregates by road;
- seeking self-sufficiency within regions, thereby avoiding the need to transfer the environmental costs of aggregates extraction to other areas;
- careful and continual assessment of existing and anticipated future exports of aggregates to areas outside Wales (in consultation with those importing regions outside Wales) to determine whether that supply is the best environmental and practicable option for all.

30. The RAWPs must continue to monitor the production and distribution of aggregates and assess permitted reserves to determine the implications for national and local policies. Their role will be extended (see paragraphs 27 and 50) to include an analysis of the environmental capacity of local

[24]Wise about Waste: The National Waste Strategy for Wales, Welsh Assembly Government, June 2002

authority areas in each region to supply aggregates to ensure that an adequate supply is maintained and that supply is obtained from the most acceptable locations. Development plans must indicate clearly how the future supply of aggregates will be obtained and be based on the Regional Technical Statement (see paragraph 50). The RAWPs will monitor development plans to ensure that available permitted and allocated reserves will ensure that regional supply is likely to be adequate within the plan period to meet the anticipated demand for primary aggregates of 20 million tonnes per year (paragraph 20).

31. Crushed Rock:

It is likely that the main supply of aggregates will continue to be provided from hard rock resources. There are two key issues in relation to crushed rock supply:

- Wales has a plentiful supply of hard rock resources but it is still a fundamental objective to conserve natural resources for their intrinsic qualities and possibly for future generations to exploit, particularly those in relatively short supply. These include resources suitable for use as road surfacing materials with high skid resistance;
- Landbanks of hard rock reserves in North Wales are excessive (see paragraph 45). All Mineral planning authorities must each year assess and review the likelihood of future extraction from long inactive reserves that have not worked for 10 years and submit their findings to the Welsh Assembly Government at the end of each calendar year. This assessment should include two lists. One where extraction is, in the opinion of the mineral planning authority, likely to begin again, and one where it is not. In either case, a full justification for the judgement must be included. Where further extraction is judged to be unlikely, Prohibition Orders should be made without delay. Funds from the Aggregates Levy Sustainability Fund may be sought to contribute to costs. Mineral operators and landowners will be expected to assess, objectively, whether such sites will ever be worked again, and act in the spirit of this advice, by, perhaps, relinquishing extraction rights.

32. Sand and Gravel:

- The current pattern of land-based extraction of sand and gravel is unlikely to change significantly in North Wales where landbanks of permitted reserves are adequate and therefore, supply responds to market demand. However, resources must be safeguarded for possible use by future generations.

- In South Wales, there is a unique dependence on marine aggregates to provide sand and gravel. About 95% of the sand used in south east Wales comes from marine derived sources. In May 2001 a draft Marine Aggregates Dredging Policy (MADP) for the Bristol Channel and Severn Estuary was issued for consultation and is expected to be published in its final form early in 2004.

- As a corollary, research has been completed to determine the potential land-based resources of fine aggregates in south east Wales[25] and the comparative environmental impact of different supply options[26]. The Welsh Assembly Government issued a Position Statement on the Sand and Gravel Supply for South East Wales in December 2002. This made clear that the use of marine dredged sand and gravel would probably continue for the foreseeable future but only where this remains consistent with the principles of sustainable development. Marine Aggregates Dredging Policy will issue early in 2004. There remains uncertainty about future aggregates dredging continuing to supply the South Wales construction market.

- While it is recognised, therefore, that land based extraction is not considered appropriate at the present time, those resources must be safeguarded for potential use by future generations in development plans now in view of their relatively limited regional availability. Mineral planning authorities are required to safeguard the resources in their development plans in accord with MPPW (paragraph 13) and to make clear whether or not it will be acceptable for the resources to be exploited during the plan period and what criteria would be used to judge any future proposals. This approach will bring greater certainty to all. The resource areas are shown in the Map at the end of this section. This Map is provided for information to illustrate the distribution of resources. The Assembly holds detailed maps of the resources on a Geographic Information System (GIS) with an ordnance survey base together with environmental and planning information obtained as part of the research study.

33. If land based sand and gravel extraction were to be undertaken in South East Wales, there may be a significant impact on the pattern of supply of crushed rock. At present, marine resources supply sand and some gravel but most coarse aggregate is obtained from hard rock quarries. If land-based resources supplied fine aggregates, they could also supply gravel and this could lead to a proportionate reduction in supply of such material from hard rock quarries.

34. Secondary/Recycled Materials:

- The Wales Waste Strategy[27] and the Assembly's Sustainable Development Scheme both stress the need for waste minimisation and the prudent use of natural resources. Accordingly, there must be a concomitant change in the pattern of supply of aggregates. It is of course acknowledged that it will take time to change current patterns to ensure an increase in the proportion of supply from recycled, secondary and waste materials and a proportional reduction in the amount of primary resources extracted.

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[25]South Wales Sand and Gravel: Appraisal of Land-Based Extraction in South East Wales, National Assembly for Wales (Symonds Group Ltd), 2000

[26]Comparative Impact Assessment of land and marine sand and gravel in South East Wales, Welsh Assembly Government (Symonds), 2002

[27]Wise about Waste: The National Waste Strategy for Wales, Welsh Assembly Government, June 2002

- To begin this process of change, any future increase in total demand for aggregates over and above present levels of demand should be met wherever possible from secondary sources or recycled materials. If supply from primary resources is maintained the aggregates industry will continue to rely mainly on primary resources rather than look to the use of alternative materials. The need for change in the pattern of supply through increased use of secondary and recycled materials is particularly important in Wales where recycling for use as aggregates has not been as advanced as in other parts of the UK[28]. Although the planning system cannot prevent the continuation of supply from permitted reserves **this objective must be taken into account in the determination of proposals for future primary extraction. In other words, where the landbank of permitted reserves is adequate for the foreseeable future (see paragraph 45), mineral planning authorities should consider carefully whether any further planning permissions for primary extraction should be granted but in the knowledge that planning permission should normally be refused**.

35. Mineral waste, secondary and recycled materials are available in plentiful supply in certain areas of Wales and their use as aggregates should be maximised. Substantial stockpiles of slag have been produced and tipped as a result of steel manufacture and slate waste is steadily increasing the already extensive waste tips in North Wales. Blast furnace and steel slag is currently the main source of secondary aggregates in Wales with annual production at about 1 million tonnes. The decline in steel production will however have an impact on future slag availability[29].

36. Research has been completed looking at the issues involved in the potential re-use of slate waste in North West Wales[30]. Many of the historic slate tips are of importance for their cultural and industrial archaeological importance and should therefore be retained. However, slate waste is generated annually at the rate of between 4 and 6 million tonnes and the Assembly Government wishes to maximise its re-use to substitute for primary aggregates. Slate waste currently substitutes for low grade aggregate and its increased use has resulted in additional waste material at aggregate quarries in North Wales. There is evidence that the suitability of use of slate waste in high-grade applications is greater than previously thought and this higher-end use should be encouraged.

37. Further information relating to the promotion of aggregates recycling is provided in section E. The Assembly, with the support of the RAWPs, will take every practicable opportunity to promote recycling. In areas where extensive waste tips occur, development plans should include suitable policies to indicate whether it would be environmentally acceptable for the material to be re-used or recycled. Future mineral waste minimisation should be promoted. The RAWPs should monitor the availability of such material and include the data in their Annual Reports.

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[28]Survey of Arisings and Use of Construction and Demolition Waste in England and Wales in 2001, ODPM (Symonds), 2002

[29] Annual Report South Wales RAWP 2002, 2003.

[30]North Wales Slate Tips - A Sustainable Source of Secondary Aggregates, National Assembly for Wales (Arup), 2001

38. The Aggregates Levy has had an impact on demand for these materials by increasing the market price of primary materials. Recycled materials and slate, which are exempt from taxation, are becoming relatively more attractive economically. The Sustainability Fund in Wales has been used to promote recycling through pilot recycling schemes and further relevant research, as well as providing environmental improvements to communities affected by quarrying[31].

Imports/Exports

39. Latest figures available for 2001 show that net exports of crushed rock from Wales to England were about 5 million tonnes[32]. The main exports were from North Wales to the North West England RAWP region of over 2 million tonnes and from South Wales to the West Midlands of over 1 million tonnes of crushed rock. Inter-regional flows of sand and gravel are relatively small. The main exports were again from North Wales to the North West of 0.5 million tonnes of sand and gravel. The English Guidelines for Aggregates Provision assume that net exports from Wales to England will continue at current levels[33]. The econometric forecasts on which the Guidelines are based concluded that demand for aggregates in Wales would remain unchanged until 2016.

40. The proximity principle is already an important feature of waste planning policy and the reasons for its adoption are also appropriate for aggregates, as both involve bulk transportation of low value materials. The minimisation of road transportation of aggregates is stressed in Minerals Planning Policy Wales (paragraphs 42 and 43). This can only be achieved either by shifting transportation from road to rail or water, or by reducing distance to markets through providing local sources of supply. For most quarries in Wales, road transport is the only option, and therefore long distance movements of aggregates must be reduced if this objective is to be achieved. Because the main inter-regional movements of aggregates, of both crushed rock and sand and gravel, have taken place from North Wales to the North West of England, the North Wales RAWP needs to investigate, as a priority and in consultation with their English counterparts particularly the North West RAWP, whether these movements are sustainable covering, inter alia, a full assessment of environmental constraints, distance to markets and availability of alternative sources of supply, with a view to determining the most sustainable pattern of supply for the future so that fully informed decisions can be taken on planning proposals for new aggregates production.

41. Similarly, the environmental impact of mineral extraction should not be unacceptable in areas outside Wales simply to import aggregates into Wales if similar and useable resources are available within its borders. Welsh local planning authorities are only able to influence planning decisions taken in England through their responses to consultations from English planning

[31]The Aggregates Levy Sustainability Fund for Wales Annual Report 2002-2003, Welsh Assembly Government, 2003.
[32]Collation of the results of the 2001 Aggregates Minerals Survey for England and Wales, ODPM (British Geological Survey), 2003
[33]National and Regional Guidelines for Aggregates Provision in England, 2001-2016, ODPM, 2003

authorities. As much information as is available should be provided in consultation responses about the availability of aggregates in Wales to inform those decisions.

42. These principles are particularly appropriate for general or low-grade aggregates, which can usually be supplied locally. However, certain aggregates have limited availability geologically, such as high quality aggregates for road construction that have the ability to provide particular levels of surface skidding resistance and durability. These are relatively plentiful in Wales but unavailable in some parts of the UK[34]. The Pennant Sandstone outcrop in South Wales has been identified as one of the main prospects for development and the UK importance of the resource should be recognised by relevant planning authorities. **Such material is a special case** that may well justify transportation over long distances because of the national need for the provision of the specific type of material with limited availability.

Marine Dredged Aggregates

43. The Bristol Channel is currently the main source of fine aggregates for South Wales, and particularly South East Wales. Research[35] into the resources and constraints of marine aggregates in the Bristol Channel has shown that potential resources are widespread but that most lie at depths that are not available using current dredging practices and at distances from ports that may be uneconomic. In May 2001, the Assembly issued Draft Marine Aggregates Dredging Policy (South Wales) for consultation. This sets out the Assembly's strategic policy to enable objective and transparent decisions to be taken about the most appropriate locations for dredging marine aggregates in Welsh waters of the Bristol Channel, Severn Estuary and the River Severn. A final version will be published early in 2004.

44. Decisions on planning applications relating to sandbanks that extend into the estuary but which are determined by local planning authorities because the banks are above the mean low water mark and are contiguous with the foreshore, must be considered in accord with the policies in Marine Aggregates Dredging Policy.

Landbanks

45. A landbank is a stock of planning permissions for the winning and working of minerals. It is composed of the sum of all permitted reserves at active and inactive sites at any given point in time and for a given area. Development plans should include an assessment of:

- the current landbank and state how many years of mineral extraction the landbank will provide, based on the latest 3 years production figures (see also paragraph 47 regarding dormant reserves);

[34]High Specification Aggregates for Road Surfacing Materials, DETR (Travers Morgan), 1993,
[35]Bristol Channel Marine Aggregates Resources and Constraints Research Project, NAW, DETR and the Crown Estate (Posford Duvivier and ABP Research and Consultancy), August 2000

- the future landbank - to include land specifically allocated for the working of aggregates, as an "extended landbank".

Together, this will enable a clear picture to emerge of permitted reserves and likely future aggregates extraction where planning permission is probably acceptable. This will allow for sensible forward planning for the extraction of resources that will be set out in the Regional Technical Statement (paragraph 50), and provide a sound basis for future generations to make critical decisions about how best to continue to supply aggregates.

46. In some mineral planning authorities it may not be possible or acceptable to provide an adequate current or extended landbank. In National Parks and Areas of Outstanding Natural Beauty (AONBs), Minerals Planning Policy Wales states that mineral extraction should only take place in exceptional circumstances and may be undesirable in other areas that have been identified for their natural heritage importance. In some areas, suitable resources are not available geologically or are not appropriate for extraction because of environmental designations or the need for protection of existing and future amenity. The RAWPs should consider the assessment of the "environmental capacity" of the authorities in each region to supply aggregates (see also paragraphs 29 and 50 below).

47. Landbanks in Wales are extensive, particularly of crushed rock, partly because there are many sites classed as "dormant" under the Environment Act 1995. Development plans should identify those sites that are "dormant" where a further approval to recommence working is necessary, and **count these as "dormant reserves" which should be clearly shown in the landbank calculations as a separate category**.

48. These extensive landbanks are largely a product of historical exploitation of aggregate resources, and, if left unaltered, will often perpetuate unsustainable patterns of supply. **The Welsh Assembly Government does not consider the continuance of the patterns of supply as optimal in the light of increased and better knowledge about how we need to plan for a sustainable future**. Accordingly, Minerals Planning Policy Wales stresses the need for each authority to assess the landbanks and consider those permitted reserves where working is unlikely to recommence so that Prohibition Orders can be made (see paragraph 31 above). Some authorities have already commenced this process which will result in a significant reduction in landbanks in Wales, and these pragmatic efforts are commended. A more realistic landbank assessment is the aim of this process, and axiomatically this would assist the aggregates industry and local authorities in forward planning, as a more accurate and realistic picture of permitted reserves, that are likely to have real potential for future working, would be achieved. **An account of this assessment should be included in development plans, as part of the justification for future allocations for aggregates extraction**.

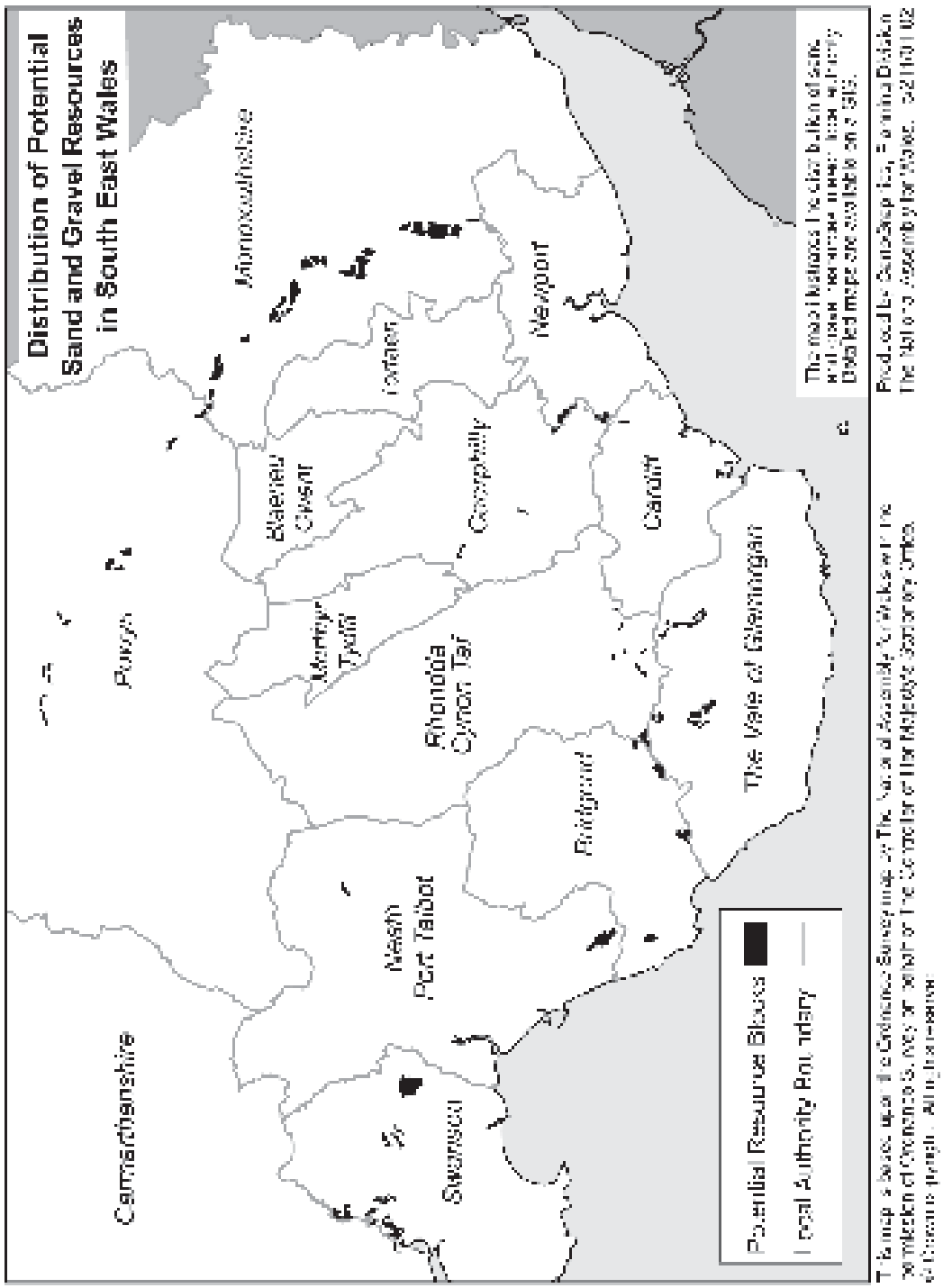
49. It is acknowledged that, for the purposes of commercial stability, the aggregates industry requires a proven and viable landbank. This must be adequate but not excessive. A minimum 10 year landbank of crushed rock and minimum 7 year landbank for sand and gravel should therefore be maintained during the **entire** plan period of each development plan except within National Parks and AONBs, unless agreement is reached for other authorities to make a compensating increase in their provision, as explained in paragraph 50 below. Where landbanks already provide for more than 20 years of aggregates extraction, new allocations in development plans will not be necessary, and mineral planning authorities should consider whether there is justification for further extensions to existing sites or new extraction sites as these should not be permitted save in rare and exceptional circumstances. This may be justified, for example, where supply of an aggregate of a particular specification is clearly demonstrated or where operators are prepared to unilaterally surrender the consents relating to existing permitted reserves through planning agreements or Prohibition Orders.

Regional Production/Supply

50. As aggregate resources are not ubiquitous across Wales, and for the other reasons outlined in paragraph 49, it is unlikely to be possible or desirable to maintain an adequate landbank in every mineral planning authority. The Assembly Government will shortly commission a study of the geological availability of suitable minerals and the "environmental capacity" of each local authority to contribute to the supply of aggregates to meet regional demand (see paragraph 27). The RAWPs will be expected to prepare a 5 year technical statement for their region to ensure that an adequate supply of primary aggregates can be maintained taking into account the sustainable objectives outlined earlier in this section for the provision of aggregates. **This regional statement should be prepared by each RAWP within 18 months of the completion of the environmental capacity assessment for Wales**. The relevant parts of the strategy set out in the regional statement should then be incorporated into the individual Development plans. If agreement cannot be reached within each RAWP, the Welsh Assembly Government will make alternative arrangements for its completion. The Regional Technical Statement will be reviewed every 5 years.

MAP OF POTENTIAL SAND AND GRAVEL RESOURCES IN SOUTH EAST WALES

(see paragraph 32)



B. To prevent unacceptable aggregates extraction from areas of acknowledged landscape, cultural, nature and geological conservation and hydrological importance

National Parks and Areas of Outstanding Natural Beauty (AONBs)

51. Minerals Planning Policy Wales 2000 states that mineral development should not take place in National Parks and Areas of Outstanding Natural Beauty save in exceptional circumstances and sets out the considerations that should be taken into account by mineral planning authorities when considering proposed mineral extraction in or close to those areas. In Wales there is nearly twice the annual production of aggregates from AONBs (1.1 million tonnes)[36] compared with that from National Parks (approximately 0.6 million tonnes. The majority of production from AONBs is undertaken in North Wales. Most of the sand and gravel extraction currently undertaken in South Wales is obtained from the Pembrokeshire Coast National Park .

52. In view of the extent of potential aggregate resources that is available geologically in Wales, and the need to minimise primary extraction, there is no need to permit proposals for the extraction of general aggregates from such areas in Wales save in exceptional circumstances. To justify allocations in development plans or the approval of proposals for new sites, or extensions to existing sites, for the extraction of aggregates of a particular specification in National Parks and AONBs, it must be demonstrated that:- alternative resources, that would be environmentally acceptable for extraction, are not available; the scope for meeting the need some other way has been assessed and rejected; and that the detrimental effects of the proposal can be mitigated or compensated for. The Welsh Assembly Government wishes to be notified of such exceptions to give the opportunity to consider whether it is necessary to call in the determination of the proposal.

53. The RAWPs should take into account the need to protect these areas from extraction and the agreement of other areas to meet the regional contribution that the National Parks and AONBs are unable to meet should be discussed and recorded in the Regional Technical Statement (paragraph 29). Where AONBs cross administrative boundaries it is essential that mineral planning authorities liaise in relation to the forward planning of aggregates provision, and that this effort is also recorded in the Regional Technical Statement.

Natura 2000 sites: Special Protection Areas (SPAs), Special Areas of Conservation (SACs) and Ramsar Wetland Sites of International Importance

54. There is currently limited data on the impact of aggregate extraction of sites that are subject to these designations. The 2001 Aggregates Monitoring Survey stated that 0.36 million tonnes of crushed rock was produced in SPAs or candidate SACs, all in South Wales. The figures for sand and gravel production are unavailable. Policies relating to proposals for new mineral extraction that could impact on these areas are set out in paragraphs 23-24 of MPPW.

[36]Collation of the results of the 2001 Aggregates Monitoring Survey for England and Wales, Table 7, ODPM, 2003

55. Prior to any decision being made by a competent authority that would have a significant affect on the conservation objectives of the site, the need to undertake an appropriate assessment must be considered in liaison with the Countryside Council for Wales. Further advice can be found in TAN 5 Nature Conservation and Planning.

56. It is policy in Wales that the above sites are underpinned by SSSIs, which is the statutory basis of protection for species and habitats in Natura 2000/Ramsar sites.

Sites of Special Scientific Interest (SSSIs)

57. Over 5 million tonnes of aggregates (all crushed rock) are produced from sites that affect SSSIs in Wales[37]. Further research is necessary to determine the extent of the adverse impact on these important sites. These figures do not necessarily reflect the extent of adverse impact as extraction within SSSIs may be minimal. The SSSI may be designated for geological features (of the 5 million tonnes, 3 million is from geological SSSIs) where continued extraction could be beneficial geologically as further areas of geological interest are made accessible. It is recognised that geological and geomorphological factors play an important role in landscape and wildlife conservation. References in this document to nature conservation includes geoconservation.

58. In view of the extent of potential aggregate resources in Wales, the Assembly considers that future proposals for aggregate extraction are unlikely to be acceptable where there would be significant adverse impact on a SSSI. The Countryside and Rights of Way Act 2000 places a duty on all public bodies, including local planning authorities, to take reasonable steps, consistent with the proper exercise of their functions, to further the conservation and enhancement of the features by reason of which a SSSI is of special interest[38]. Before authorising operations likely to damage any notified features in an SSSI local planning authorities must give notice of the proposed operations to the Countryside Council for Wales and must take account of the Council's advice in deciding whether to grant planning permission[39]. If the integrity of the SSSI is dependent on groundwater, the Environment Agency must be consulted on the proposal that may have an adverse affect. If the SSSI is designated for its geological importance, the Association of Welsh RIGS Groups (AWRG) should be consulted for further information on the importance of the site.

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[37]Collation of the results of the 2001 Aggregates Monitoring Survey for England and Wales, Table 7, ODPM, 2003

[38]Wildlife and Countryside Act 1981, as amended by Schedule 9 of the Countryside and Rights of Way Act 2000

[39]The Town and Country Planning (General Development Procedure) Order 1995, Article 10, SI 1995 No. 419 as amended

European Protected Species

59. The presence of a species protected under European or UK legislation is a material consideration when a local planning authority is considering a development proposal which, if carried out, would be likely to result in harm to the species or its habitat. Local planning authorities should advise anyone submitting a planning application that they must conform with any statutory species protection provisions affecting the site concerned, and should consult the Countryside Council for Wales before granting permission. An ecological survey to confirm whether a protected species is present, and an assessment of the likely impact of the development on a protected species, may be required in order to inform the planning decision.

60. Developments are always subject to the legislation covering European protected species, regardless of whether or not they are within a designated site. New developments, including aggregates extraction, for which works would contravene the protection afforded to European protected species require derogations[40] from the provisions of the Habitats Directive. A derogation may only be authorised if:-

a) there is no satisfactory alternative;

b) if the action authorised will not be detrimental to the maintenance of the population of the species concerned at a favourable conservation status in its natural range; and

c) the works to be authorised must be for the purposes of preserving "public health or safety, or for other imperative reasons of overriding public interest, including those of a social or economic nature and beneficial consequences of primary importance for the environment".

Derogations may be granted by a licence issued by the Welsh Assembly Government, if the Assembly is satisfied that the three conditions are met, as above.

61. Planning authorities are under a duty to have regard to the requirements of the Habitats Directive in exercising their functions[41]. To avoid aggregates extraction projects with planning permission subsequently not being granted a derogation in relation to European Protected Species, planning authorities should take the three requirements for a derogation into account when considering proposals where a European protected species is present. The Welsh Assembly Government intends to bring forward legislation that will place a specific obligation on local planning authorities to satisfy the requirements of the Habitats Directive with respect to European protected species as part of the planning process[42].

Historic Environment

62. Wales' historic environment comprises the rich and varied remains of human activity and includes buildings, monuments and historic landscapes as well as buried archaeological sites and palaeoenvironmental deposits. It is the continuous interaction of people with their environment over history that

[40]Derogation: an authorised departure from the system of protection

[41]Conservation (Natural Habitats &c) Regulations 1994 (SI No 1994/2716)

[42]NAW Circular 23/2001 New Guidance for Local Planning Authorities on European Protected Species and Changes in Licensing Procedures.

has resulted in the modern landscape's character, providing local distinctiveness and sense of place. The remains of past activity that makes up the historic environment form a fragile and non-renewable resource providing unique information which enables the understanding of past societies and environments. The importance of this finite resource must be recognised and be given appropriate consideration prior to its identification as suitable for use as aggregates.

63. In order to prevent unacceptable aggregates extraction it is necessary to consider both designated and non-designated elements of the historic environment, including Scheduled Ancient Monuments, Listed Buildings, Registered Historic Landscapes, and Historic Parks and Gardens and archaeological sites and features identified in the Regional Sites and Monuments Records. In line with guidance in MPPW and more comprehensively in Planning Policy Wales (March 2002 Chapter 6) if proposed aggregates extraction adversely affects nationally important archaeological remains, whether scheduled or not, their preservation should be carefully considered. Future proposals for aggregates extraction that would result in a significant adverse impact on the historic environment should not be considered favourably.

64. Mineral waste tips: Mining waste forms important surviving evidence of Wales' industrial past. While the Welsh Assembly Government wishes to maximise the use of waste materials to conserve primary resources, old mineral waste tips with historic, archaeological and cultural significance should be protected and preserved. Most of the slate waste tips are associated with historic workings of slate quarries and mines and many are important historic and archaeological sites in their own right. Quarries and tips can form important elements of historic landscapes some of which are registered as Landscapes of Outstanding and Special Historic Interest in Wales by CCW, Cadw and ICOMOS UK. Blaenau Ffestiniog is an example of such a registered landscape of outstanding historic interest[43].

Surface and Groundwater Resources

65. Environmental damage can be caused by changes to the quantity and quality of surface or ground water resources. All surface mineral workings have the potential to affect the water environment in one way or another. Surface and groundwater resources may be affected by:

- an alteration to the surface topography over which water flows;
- a change to the surface water flow pattern;
- an alteration to the quantity and quality of water flows;
- a change in water infiltration recharging the aquifer, either by quality or rate of recharge;
- de-watering of existing workings or diversion of watercourses which may reduce groundwater levels, may change the supply of water to abstraction points or springs, or cause subsidence of ground surfaces;

[43]Caring for Industrial Heritage of Slate, Cadw - Gwynedd Archaeological Trust, 2000

- alterations to discharges from workings causing flooding, derogation of water sources, pollution or contamination of surface or groundwater sources.

66. Certain types of aggregates extraction are more likely to cause problems than others, although all surface mineral workings and storage of excavated materials has the potential to exacerbate flooding and therefore need careful assessment of the flood risk. Particular attention must be given to :

- quarrying of limestone from major karstic aquifers because of the importance of the water resources and the inherent uncertainty of hydrogeological conditions; and,

- sand and gravel workings in river floodplains because of the increased risks to surface water quality, river flow and floodplain hydraulics.

67. As workings increase in depth, particularly below the water table, it is often difficult to predict with any certainty the impact on groundwater resources. These impacts may be significant at substantial distances from mineral workings. Boreholes will usually need to be drilled to enable monitoring of seasonal groundwater levels to assist forecasts of impact on the groundwater regime. Proposals for future working below the seasonal water table will need to cater for adequate water storage areas based on sound continual monitoring and assessment. Unless the MPA, taking advice from the Environment Agency, is satisfied through careful risk assessment that the consequences of any adverse impact of extraction on the water environment is acceptable or that they can be made so by mitigation measures, planning permission must be refused. This is because changes to the quality and quantity of water resources can cause environmental damage. Conditions imposing depth of working restrictions must be imposed if the potential environmental impact is judged to be unacceptable and this applies equally to applications for new mineral extraction and to applications to review the conditions of working of old mineral permissions. The compensation implications of such a restriction will need to be assessed in relation to mineral review applications. Sometimes working laterally rather than increasing depth may be a more acceptable alternative and should be considered if appropriate to the circumstances. Mineral operators should undertake adequate and timely consultation with the mineral planning authority and the Environment Agency prior to finalising and submitting their proposals for planning approval or restoration schemes that include water features.

68. Planning controls should not duplicate controls provided by other legislation. The Environment Agency has powers to protect aquifers and groundwater flows under water resources legislation but these powers are limited to the control of licensable abstractions and a limited range of other activities which may disturb aquifers and affect groundwater flows. Mineral extraction activities that may impact on groundwater but are not covered by the Agency's powers include:

- dewatering of quarries whether above or below the water table;
- borehole construction;

- all groundwater abstraction outside those controlled under the Water Resources Act 1991;
- construction of highways, cuttings and tunnels or where water levels interfere with engineering works;
- any activity that interconnects naturally separate aquifers or water storage areas;
- construction of bridges and culverts.

Where protection of water resources cannot be achieved through the water resources legislation, the Agency will seek equivalent protection through other appropriate controls including planning legislation.

69. It has become normal practice for operators to monitor the potential impact of mineral extraction on groundwater resources and design any mitigation that may prove necessary during the course of the operation. In view of the difficulty of reversing the impact of mineral extraction, it is considered that in future, predictions of impact should be made prior to the approval of mineral workings and mitigation requirements should be included in the planning conditions so that adequate controls are provided at the outset. It is the responsibility of the developer to provide the MPA with adequate information to satisfy these concerns at the time of the submission of the application. Developers should note that they may need to establish monitoring schemes to enable such information to be obtained and monitoring is likely to be necessary for at least 12 months to provide seasonal groundwater information. In the absence of such detailed data, it may not be possible to reasonably assess a proposed development and it may be necessary to refuse the planning application.

C. To reduce the impact of aggregates production

Buffer Zones

70. MPPW (paragraph 40) established the principle of Buffer Zones around permitted and allocated mineral extraction sites. Development plans are required to indicate the boundary of the buffer zone. Within the buffer zone, no new sensitive development or mineral extraction should be approved. Sensitive development is any building occupied by people on a regular basis and includes housing areas, hostels, meeting places, schools and hospitals where an acceptable standard of amenity should be expected. Sensitive development could also include specialised high technology industrial development where operational needs require high standards of amenity.

71. The objective of the buffer zone is to protect land uses that are most sensitive to the impact of mineral operations by establishing a separation distance between potentially conflicting land uses. Research[44] has indicated that people living close to mineral workings consider dust to be the main impact of mineral extraction and any processing operations, followed by traffic, and noise and vibration from blasting. After careful consideration, including consultation with a number of interested and informed parties, the Welsh Assembly Government takes the view that the following minimum distances should be adopted unless there are clear and justifiable reasons for reducing the distance. An example may be that, because of other means of control, there is very limited impact from the mineral extraction site.

Mineral Extraction Type	Minimum Distance
Sand and gravel (and others where no blasting is permitted)	**100 metres**
Hard rock quarries	**200 metres**

The buffer zone should be defined from the outer edge of the area where extraction and processing operations will take place, including site haul roads, rather than the site boundary, as there may be land within site boundaries where mineral activities are limited or no operations are proposed so that the impact of the proximity of such land is negligible. Where mobile plant is likely to be used it will usually be necessary to control by planning conditions the location of the operational area where plant may operate in order to maintain the buffer zone and thus protect amenity.

Dust

72. Dust is a generic term used to describe particulate matter which may be found resting on the ground or other surfaces, but is capable of becoming airborne to disperse in the atmosphere before returning to the surface. It is defined in BS 6069 (Part 2)[45] as particulate matter in the size range 1-75 microns in diameter. It is produced at minerals extraction sites during a range of activities; site preparation, excavation, transportation and processing

[44]The Environmental Effects of Production Blasting from Surface Mineral Workings, DETR, 1998
[45] British Standards Institution, Glossary of Terms, BS 6069 (Part 2), 1987

operations. When dust becomes airborne, it is referred to as dust emission. A number of factors are important in relation to aggregates extraction and processing; for example, rainfall decreases emissions; wind speed and direction may increase or decrease the impact of dust on a particular area; topography and vegetation may also have an effect. The type of mineral being extracted causes differences in the generation of dust: soft friable materials break apart easily and their extraction produces a greater amount of dust than harder, more cohesive materials. However, more energy and intensive processing are needed to produce saleable products of harder materials, and these operations produce significant quantities of dust. As well as these likelihoods, experience has shown that dust emissions can also result from:

- haulage, particularly on internal un-surfaced routes,on nearby roads which are not adequately wetted and if vehicles are un-sheeted;
- crushing and grading operations;
- blasting, including drilling operations prior to blasting;
- surface stripping, including soil and overburden storage;
- restoration operations.

Further details of the potential for dust emissions from mineral working activities are contained in the Best Practice Guide to Dust and Mineral Operations[46].

73. The main potential effects of dust and dust emissions are:

- Their impact on air quality and human health (see paragraph 75 below);
- The physical need for cleaning, and the soiling of surfaces;
- The contamination of soils and vegetation, impacting on agriculture and/or ecology;
- The contamination of water courses;
- Visual – in terms of dust plumes and reduced visibility.

74. Particulate air pollution is associated with a range of effects on health including those on the respiratory and cardiovascular systems, asthma and, even, mortality. Particles of less than 10 microns in diameter (known as the PM_{10} fraction) can enter the respiratory system and are thought to be responsible for these health effects. The Expert Panel on Air Quality Standards (EPAQS) first considered particles in its report published in November 1995[47]. They concluded that particulate air pollution is responsible for causing excess deaths among those with pre-existing lung and heart disease, and that there is a relationship between concentrations of PM_{10} and health effects such that the higher the concentration of particles, the greater the effect on health. Since then the Panel has considered whether finer particles, perhaps $PM_{2.5}$ or smaller, may be more representative of that

[46]Environmental Effects of Dust from Surface Mineral Workings, DoE, (Arup Environmental/Ove Arup and Partners), 1995

[47]Expert Panel on Air Quality Standards; Particles, November 1995

part of the total particle mix that is responsible for its harmful effects on health. In its report published in April 2001[48], the Panel concluded that on existing evidence, measurement of PM_{10} which includes essentially all respirable particles, provides the most appropriate basis for an air quality standard in the United Kingdom.

75. Where dust is demonstrated to have the potential to affect the use of land the Welsh Assembly Government takes the view that it is a material planning consideration. Part IV of the Environment Act 1995 requires all local authorities to undertake regular reviews and assessments of air quality (including PM_{10}) in their areas. The Better Health Better Wales Strategic Framework sets out the Assembly's plans and priorities for action to improve the health of the people of Wales. It makes a clear commitment to develop the use of health impact assessment in Wales[49]. **The potential impact on health must always be considered in relation to proposals for aggregates extraction and a health impact assessment should be carried out for any proposal for a new quarry or sand and gravel pit located within one kilometre of an existing community**.

76. Planning conditions can control certain activities to protect against dust emissions although many of these are controlled under the Environmental Protection Act 1990, and care should be taken to avoid duplication of controls. The Act provides for industrial premises to be regulated by the Environment Agency and local authorities under the Integrated Pollution Control (IPC) and Local Air Pollution Control (LAPC) regimes. The Integrated Pollution Prevention and Control (IPPC) Regulations being phased in gradually on an industry sector by sector basis between 2000 and 2007, will eventually replace the IPC and LAPC regimes and will apply an integrated environmental approach to the regulation of industrial activities. IPPC aims to prevent emissions and waste production and, where that is not practicable, reduce them to acceptable levels.

77. **Planning conditions can impose:**

- measurable performance requirements - the means of achieving these requirements should be left to the operator;
- an adequate and appropriate monitoring scheme of the environmental consequences of aggregates extraction. In some cases, periodic checks may be sufficient but in others, continuous monitoring and regular audit reports may be necessary. Access to monitoring locations must be available to the operator;
- ameliorative measures to mitigate impacts, such as the provision of wheel-wash facilities, road cleansing, speed restrictions, sheeting of vehicles;
- working programmes/site design and layout - location of dust emission sources away from sensitive development, protection of

[48]Expert Panel on Air Quality Standards; Airborne Particles: What is the most appropriate measurement on which to base a standard? April 2001
[49]Better Health Better Wales: Developing health impact assessment in Wales, National Assembly for Wales, 1999

loading/unloading activities and materials storage areas, control of soil handling and overburden stripping including timing to suit weather conditions.

Impact of Blasting Operations – vibration and fly-rock

78. Production blasting can result in impacts that extend well beyond the extraction site. This is likely to cause concern to neighbours and results from:

- ground vibration –these are stress waves generated within the ground by the detonation of explosive charges. Sometimes these are reported by individuals but usually the levels of vibration generated by mineral workings are well below those required to cause structural damage to properties;
- air overpressure –a pressure wave is formed in the atmosphere by the detonation of explosives, this consists of energy manifested as audible (noise) and inaudible (concussion);
- noise – audible noise is atmospheric pressure variations at frequencies greater than 20Hz (hertz);
- dust; and,
- fly-rock – the projection of material from the blast site to any area beyond the designated danger zone.

79. Ground vibration: It is often difficult to reconcile the needs of efficient and economic mineral extraction with the comfort and amenity of neighbours, particularly where quarries are located close to buildings that are sensitive to vibration such as residential properties. Research[50] has shown that the vibration levels at which complaints are made varies significantly and that long established sites with a good relationship with neighbouring communities are far less likely to attract complaints from local residents. Mineral planning authorities and site operators have accepted the need for more definitive advice to ensure a more consistent approach to controlling ground vibration and responding to complaints from neighbours. This is therefore set out below.

80. Ground vibration is recorded in terms of particle velocity with the maximum or peak value measured in 3 orthogonal directions at any one location – so-called longitudinal, vertical and transverse. The measurement of peak particle velocity (ppv) is the accepted standard for recording vibration levels together with frequency content. The typical range of ground vibration frequency for surface mineral workings is 5 to 40 Hz with values predominantly from 20 to 30 Hz for hard rock quarries. Although sensitivity to vibration varies between individuals, a person will generally become aware of blast induced vibration at around 1.5 mms^{-1} ppv (in some circumstances at levels as low as 0.5 mms^{-1} ppv). Public concern often relates to the potential for vibration to cause damage to property. British Standards[51] specify guide values to preclude damage to various building types from blast induced

[50]The Environmental Effects of Production Blasting from Surface Mineral Workings, DETR, (Vibrock Ltd), 1998

[51]BS 7385: Evaluation and Measurement for Vibration in Buildings Part 2: 1993 Guide to damage levels from groundborne vibration. British Standards Institute

ground vibration. Cosmetic damage, or hairline cracks in plaster or mortar joints, should not occur at vibration levels lower than 20 mms^{-1} ppv at a frequency of 15Hz and lower than 50 mms^{-1} ppv at 40Hz and above. Vibration levels from production blasting measured at residential properties rarely, if ever, approach the levels necessary to cause even cosmetic damage but can have an impact on the amenity of the surrounding area. It is important that proposals for new or extended aggregates extraction should include an assessment of the impact of ground vibration in consultation with the Health and Safety Executive and the operator.

81. Air overpressure: Because air overpressure is transmitted through the atmosphere, meteorological conditions such as wind speed and direction, cloud cover and humidity will all affect the intensity of the impact. In view of this unpredictability, planning conditions to control air overpressure are unlikely to be enforceable. This is not a reason for doing nothing and careful blast design should be able to resolve excessive levels of air overpressure. Such details are controlled by quarry regulations[52] which impose requirements relating to health and safety at quarries.

82. Fly-rock: fly-rock incidents are the unexpected projection of material from the blast site to any area beyond the danger zone as defined by the shotfirer. It occurs when there is excess energy beyond that required to break the mass of rock between the explosive and the rock face so that excess energy is available to project rock debris. Flyrock incidents, although potentially dangerous, are relatively rare as the Health and Safety Executive through the quarry regulations ensure, as far as is practicable, that blasts are implemented exactly to the design specification. This specification is intended to ensure that the correct amount of explosive is placed within each borehole and that the placement of the explosive and stemming material takes full account of the mass of rock between the borehole and the free rock face. The 1999 regulations impose requirements to ensure the health and safety of people who work in quarries and the general public in the vicinity of a quarry. It is not appropriate for planning control to impose further restrictions than are controlled through the health and safety legislation.

83. Planning conditions relating to the control of blasting should only: relate to those aspects of environmental management that are under the control of the operator; should be directly relevant to environmental issues; and, should not be in conflict with existing health and safety legislation. Consequently, planning conditions should provide for the:

- acceptable days for blasting operations: unless there are exceptional circumstances such as a safety emergency, blasting should take place at regular times within the working week, that is, Mondays to Fridays. Blasting on Saturday mornings should be a matter for negotiation between the operator and the MPA taking into account the views of any nearby residents. No blasting should take place at any other time, that is, Saturday afternoons, Sundays, Bank or National holidays;

[52]The Quarries Regulations 1999 SI No.1999/2024

- acceptable times of blasting operations: blasting should only take place between the hours of 10.00am and 16.00pm, except when there is an emergency in the interests of safety;
- maximum level of ground vibration at vibration sensitive locations: ground vibration as a result of blasting operations should not exceed a peak particle velocity of 6 mms^{-1} ppv in 95% of all blasts measured over any 6 month period, and no individual blast should exceed a peak particle velocity of 10 mms^{-1} ppv;
- approval of a scheme by which air overpressure is managed and mitigated through careful design of blasting operations;
- approval of a scheme of vibration monitoring so that compliance within set limits can be adequately demonstrated by the operator at any time.

84. Vibration from blasting may have an adverse impact on structures of historic importance that may be of fragile construction, such as listed buildings or ancient monuments. It may be necessary for developers to provide specialist advice to demonstrate adequate protection for such structures prior to development proposals involving blasting operations being approved.

Noise

85. Where aggregates extraction and related operations occur close to areas that are sensitive to noise, particularly residential areas, noise impact must be minimised to acceptable levels. The effects of noise should be fully considered in formulating future proposals for aggregates extraction and noise emissions should be monitored throughout the permitted mineral activity. **Where the effects cannot be adequately controlled or mitigated, planning permission should be refused**.

86. Minerals Planning Guidance Note 11: The Control of Noise at Surface Mineral Workings (1993) provides advice on the monitoring and assessment of noise levels and much is still applicable (see paragraph 4 for cancellations). The Technical Advice Note (TAN) for Noise[53] provides advice on how the planning system can be used to minimise the adverse impact of noise. Although the TAN does not deal specifically with noise from surface mineral extraction sites, general points are applicable and explanations of noise measurement terms are also relevant. Noise can also be controlled under Part III of the Environmental Protection Act 1990, which requires local authorities to inspect their areas to detect any statutory nuisances and to investigate complaints. Action can be taken through the courts, if necessary, to secure the abatement of a statutory noise nuisance.

87. The aggregates industry should aim to keep noise emissions at a level that reflects the highest possible environmental standards, taking all reasonable steps to achieve quieter working while having regard to the principles of BATNEEC – the best available technique not entailing excessive cost. MPAs should have regard to the background noise levels and the threshold at which significant effects are likely at noise sensitive areas and properties

[53]Planning Guidance (Wales) Technical Advice Note (Wales) 11 Noise, Welsh Office, October 1997

when considering the acceptability of proposals or setting noise limits in a planning condition. Conditions on planning permissions should identify the noise sensitive properties at which noise limits are set and establish a scheme of monitoring that identifies how, where and when noise is to be measured and how the results will be used and assessed.

88. **Noise limits** –noise limits should relate to the background noise levels[54], subject to a maximum daytime noise limit of 55 dB(A) where background noise levels exceed 45 dB(A). 55 dB(A) is the lower limit of the daytime noise levels where serious annoyance is caused. Where background noise is less than 45 dB(A), noise limits should be defined as background noise levels plus 10 dB(A). Night-time working limits should not exceed 42 dB(A) at noise sensitive properties. Daytime working is defined as 0700-1900 hours and night-time as 1900-0700 hours. Noise limits should be set in terms of $L_{Aeq,T}$ over a 1-hour measuring period. $L_{Aeq,}$ is the noise index used to describe the "average" level of noise that varies with time (T) and should be measured "free-field" that is, at least 3.5 metres away from a façade to prevent reflection of noise by any façade that faces the noise source. During temporary and short-term operations higher levels may be reasonable but should not exceed 67dB(A) for periods of up to 8 weeks in a year at specified noise sensitive properties.

Visual Impact

89. Hard rock quarrying physically alters the ground surface through the development of faces and benches, and these landscape changes are often irreversible. Other operations related to quarrying may have an impact on the landscape, including the historic landscape: quarry tips; aggregates storage areas; screening mounds; settlement ponds; processing plant; roads and buildings. Most quarries are located in rural areas where their development introduces a visual intrusion similar to industrial development within predominantly agricultural or forestry land uses. Proposals for new aggregates extraction or significant extensions to existing operations should be assessed carefully to determine the potential impact on the landscape character of the setting. This assessment will enable a comprehensive understanding of the visual impact of the proposed development from various locations to determine the acceptability of the development, the phasing and layout of the development, and, the most appropriate restoration strategy. The Countryside Council for Wales has produced an information system methodology and guidance[55] on landscape character appraisals and these will establish a consistent approach in assessing the specific impact in different landscape areas.

90. Operators should use up-to-date and innovative methods to illustrate their proposals, such as video sequences based on accurate digital terrain models, so that potential visual impact can be better understood by MPAs and local communities. Visual impact assessment should be undertaken from various

[54]Background noise is normally measured as $L_{A90,T}$ or the noise level exceeded for 90% of the specified measurement period (T).

[55]The LANDMAP Information System - LANDMAP Methodology, Countryside Council for Wales, 2001

viewpoints including main settlements, major traffic routes and footpaths, both close to the site and from greater distances to reflect its landscape setting. Photographs taken at specified locations or computer generated photomontage should be produced to illustrate the visual impact at various stages in the development, both with and without mitigating proposals. Computer techniques enable 3 dimensional topographical models to be generated and these can provide interactive methods to illustrate options of working, phasing and restoration. Virtual reality images can demonstrate the impact of changes over periods of time very effectively. These should now be used as a matter of course for all major development proposals.

91. Specific site appraisals of landscape character will be required whether or not the site is within or close to a landscape designated for its intrinsic importance. Topography and vegetation cover are critical factors that influence the ability of the landscape to absorb the development. A landscape assessment will invariably form part of the Environmental Statement required in relation to Environmental Impact Assessment.

92. There are a number of remedial measures to ameliorate visual intrusion caused by aggregates extraction or ancillary development:

- Quarry faces/rims
  - choice of direction and method of working
  - screening by mounds and planting
  - bench planting
  - restoration blasting;
- Spoil disposal
  - choice of location, including perimeter tipping
  - use for screening purposes
  - infilling old quarries, voids or worked out areas
  - landcaping;
- Stockpiles-location
  - enclosure and screening;
- Plant/buildings-location
  - avoiding skyline development
  - screening
  - design – choice of colour and low profiles
  - suppression of dust and steam plumes;
- Road/rail access-site location
  - screening
  - landscaping
  - designed to prevent views of operational areas
  - well presented signage
  - high specification layout with kerbs and metalled surfaces;
- Restoration
  - improved techniques and best practice
  - careful management of soils and vegetation
  - monitoring and enforcement of conditions
  - forward planning and progressive restoration.

93. An adequate site margin is essential to provide a transition between the extraction area and its surroundings; it enables better site safety and stability and existing vegetation to be retained to form immediate screening; it enables flexibility in providing protection of visual amenity; and, enables

future modifications in site practices to ameliorate unforeseen changes. Progressive and phased restoration minimises the undesirable impacts on visual amenity and is particularly important for operations of long duration, and must be used wherever possible.

94. Abandoned and closed quarries can become visually acceptable through natural restoration and no further works may be necessary. Old quarries provide opportunities for biodiversity with the development of natural or semi-natural habitats. Geotourism is becoming increasingly important and Wales is a significant base for educational visits partly because of its special legacy of abandoned mineral workings. Botanical interest is provided in limestone quarries where calcicolous species-rich grassland develops. Cliffs and caves provide niches for birds and mammals. The views of local residents and conservation bodies on restoration strategies should be taken into account in considering the visual and landscape impact of quarry landforms.

Site Management

95. **Environmental audits** can assist aggregates operators in becoming more environmentally responsible and in encouraging continuing site improvement. They also enable the industry to demonstrate how ithas met its responsibilities to regulators and the local community. Environmental audits range from a checklist of environmental objectives to more complex programmes. They provide a systematic record as to how the operations are progressing to meeting its environmental objectives. The environmental audit should include the following stages:

- Establish baseline data on current operations, including any significant environmental issues;
- Set the objectives for environmental management;
- Establish strategy/proposals for future improvements;
- Implement and monitor site activities, including action relating to complaints;
- Assess and report on the environmental data gathered;
- Make recommendations for action and further development.

The Assembly expects all existing and future quarry operators in Wales to carry out regular environmental audits (normally annually unless operations are temporarily suspended), and to submit these to the mineral planning authority. A summary of the monitoring of mineral working sites undertaken by the mineral planning authority and the environmental audits received together with any related action taken should be included in the future development plan Annual Monitoring Report submitted to the Welsh Assembly Government.

96. **Community Liaison:** Research[56] has shown that well established liaison with local communities helps to provide a better understanding of the impacts to be expected from aggregates extraction. Many quarries have established site liaison groups to provide a forum for regular discussion and explanation of current problems. Liaison groups may become set up through the initiative

[56]The Environmental Effects of Production Blasting from Surface Mineral Workings, DETR, (Vibrock Ltd) 1998

of the operator or the MPA. Where regular complaints are received or there is local concern about specific impacts, the MPA should request the operator to co-operate in establishing regular meetings of a nominated group. The group should comprise an equal balance of local residents and representatives of the operator together with officers and/or elected members of the MPA or community/town council where considered necessary. The frequency of meetings depends on the stage of the site development and extent of complaints about the operations, and is likely to be 2 to 4 times yearly. An elected member of the local authority may chair the meetings. Members of the public and media should be allowed to attend and participate at the discretion of the members of the group. Every effort should be made to ensure that meetings are open (except when confidential issues are debated) and informal with the objective of providing a better understanding of the operational requirements of the site and any public concern caused by the operations. It may be appropriate to consult local RIGS Groups who have substantial experience and knowledge of aggregates extraction and geoconservation.

D. To achieve a high standard of restoration and aftercare, and provide for a beneficial after-use

97. Reclamation means the treatment of land affected by mineral workings in such a way as to restore the land to a satisfactory state and is defined in the Town and Country Planning Act 1990 to include both restoration and aftercare. Restoration and aftercare must provide the means to maintain or, wherever possible, enhance at the earliest opportunity the long-term quality of land that has been used for mineral extraction, so that it may become suitable for a beneficial use. If there is any significant doubt about whether satisfactory reclamation can be achieved at a site, planning permission should be refused. It is the responsibility of the mineral operator to design and implement a high quality restoration and aftercare scheme that must be an integral part of any mineral extraction application. The scheme should be reviewed regularly in consultation with the MPA during the course of extraction. For sites of 5 years duration or less full restoration and after-use proposals should be established and approved as part of the approval of the mineral development. For sites likely to work for longer duration, an initial restoration scheme should be submitted for approval at the outset with regular review of the restoration scheme during site operations. Reclamation includes both restoration and aftercare including events that take place before, during and after extraction, including soil and overburden stripping and storage, and advance screening and landscaping.

Restoration

98. A restoration condition is defined as a condition requiring that after operations for the winning and working of minerals have been completed, the site shall be restored by the use of any or all of the following, namely, subsoil, topsoil and soil making materials[57].

99. There are a number of issues that can inhibit the successful restoration and aftercare of mineral sites:

- Inadequate or poor quality soil to achieve satisfactory re-vegetation;
- Insufficient material to restore the land to reasonable contours in relation to the surrounding ground;
- Insufficient land around the excavation area to achieve a suitable landform;
- Exposure of restored land to extremes of climate hindering the success of new planting;
- Unsuitable choice of species, planting technique or design;
- Inadequate or unsatisfactory drainage;
- Instability of quarry slopes or surrounding land;
- Lack of care and expertise in undertaking restoration and aftercare.

Careful treatment of soils throughout the working and restoration process is critical for successful reclamation. Detailed advice on soil stripping and storage is provided in Annex C.

[57]Town and Country Planning Act 1990 Schedule 5

100. For new quarries and quarry extensions and for the future development of sites subject to mineral review applications, a quarry restoration design in a working plan (see paragraphs 97 and 106) must be submitted and approved by the MPA, before any work commences on site. This can form part of the planning application for the quarry development or a subsequent scheme required by a planning condition or Section 106 Agreement. The restoration design must include where appropriate:

- Existing, phased and final landforms;
- Quarry floors, faces and spoil tips;
- Soil storage areas including an assessment of volumes and quality;
- Phasing of progressive restoration;
- Location of proposed bunds and screening to mitigate environmental impact;
- Landscape strategy – areas of existing planting for retention and proposed planting;
- Where applicable, proposals for on or off site drainage, water storage, or new or diverted water features or water courses;
- Where applicable, proposals for reinstatement of footpaths;
- Mechanisms for protecting or recording existing site features such as interesting geological exposures or historic structures;
- Strategy for aftercare including timing of restoration proposals;
- Strategy for the after-use of the quarry area.

For operational quarries of long standing, opportunities to modify methods of working to achieve these restoration objectives should be considered as soon as possible in conjunction with the MPA. These modifications could include re-location of quarry operations, bunding and screening to mitigate environmental impacts, and progressive restoration using techniques such as advance screen planting and restoration blasting[58].

101. **Progressive restoration** of quarry areas must always be an integral part of the working method wherever possible except for relatively small sites of short-term duration. Progressive restoration not only minimises the working area and consequently reduces visual impact, but also enables the site to progress to maturity earlier than would otherwise be the case. The minimum practicable working space required should be determined at the outset of working to enable phased working areas to be designed so that restoration keeps pace with the site development.

102. **Restoration margins** should be included in the design of the working scheme to provide a transition between the quarry and its surroundings. This provision may well increase the potential for after-use of the quarry. The dimension of the margin and the amount of land-take will depend on the restoration proposals, the geological stability of the margins, the final depth and landform of the mineral workings (to achieve the required angle of slope) and the intended after-use. It is inevitable that the permitted site

[58]Effective Approaches and Techniques in Landscaping and Reclamation of Hard Rock Quarries, DETR, (Wardell Armstrong) Draft, 2004

boundary will have to include land beyond the excavation area or the potential for restoration may be severely constrained. Only development that will enable the restoration of the site to be achieved is likely to be suitable within the margin although storage of soils or overburden would be an appropriate use of this land during site operations.

Preparation of a Reclamation Scheme

103. In granting planning permission for mineral working, MPAs should always carefully consider the applicant's proposals for reclamation of the site, how and whether the proposals are likely to achieve the intended results and, therefore, how requirements to ensure satisfactory reclamation can be incorporated into appropriate planning conditions. It is equally important that the applicant should thoroughly understand, and make financial provision for, the responsibilities he will be taking on under the reclamation conditions likely to be imposed on a planning permission.

104. Responsibility for the restoration and aftercare of mineral sites lies with the operator and, in the case of default, with the landowner. Applicants should, therefore, demonstrate with their applications what the likely financial and material budgets for restoration, aftercare and after-use will be, and how they propose to make provision for such work during the operational life of the site. This is important to avoid future dereliction and the possibility that the costs of reclamation of mineral sites might have to be borne by other public or private sources.

105. The drawing up of practical proposals for site reclamation will require a careful site investigation by the potential mineral operator prior to the submission of an application. The outcome of the investigation should be reflected in the documentation submitted with the application. It is in the applicant's interest to discuss working and reclamation proposals and possible planning conditions with the MPA, prior to formal submission of an application. These discussions should also involve the statutory consultees, the landowner, tenant and any other person with a relevant interest.

106. To demonstrate that a site can be reclaimed to an acceptable standard and after-use, the applicant is advised to prepare, at the outset, a working plan which includes restoration proposals and is based upon findings from the site investigation. This should be in sufficient detail for the MPA and any statutory consultees to form a judgement as to its feasibility. For after-uses which involve some form of plant growth (eg for agriculture, forestry or amenity including some forms of nature conservation) the plan will usually involve a number of key stages:-

i stripping of soils and soil-making materials and either their storage or their direct replacement (ie 'restoration') on another part of the site;

ii storage and replacement of overburden;

iii achieving the landscape and landform objectives for the site, including filling operations if required, following mineral extraction;

iv restoration, including soil placement, relief of compaction and provision of surface features;

v aftercare.

107. Applicants may wish to call attention to, and authorities will wish to consider, any evidence as to how the applicant's proposed methods of site management, restoration and aftercare are likely to work out in practice. This might be done by providing evidence about the way a similar site is currently being managed, or how restoration and aftercare have been achieved on a similar site. MPAs should thus have regard to the practicality of the proposal before them. The possibility that reclamation techniques may have improved in the intervening time must also be borne in mind.

108. There is clear evidence that the technical knowledge now exists to enable most land worked for minerals to be reclaimed to a high standard. However, to achieve this requires commitment from all parties involved in the planning and implementation of site working and reclamation. Restoration and aftercare should be seen as an integral part of the working of the site. The protection, for example, of the soil resource at all stages during the life of the site is of paramount importance to the success of reclamation, as is the need to work towards a final landform (with or without the use of fill), which is in keeping with the natural character of the area, and suitable for the intended after-use of the site.

109. A formal reclamation scheme that accompanies the planning application for the mineral working should indicate how the restoration and aftercare of the site is to be integrated with the working scheme, and should demonstrate the suitability of the proposals for the proposed after-use. Before designing a reclamation scheme, the operator should undertake a comprehensive site survey to identify any existing features on the site that may be incorporated into the reclamation scheme, together with a survey of the soil resource and site hydrology. Consideration should also be given to the potential impacts of the reclamation proposals on adjacent land.

110. It is becoming common practice for the operator to discuss working and reclamation proposals with the MPA and where appropriate the statutory consultees before submitting the planning application. This provides an opportunity for the parties to discuss and agree the information which needs to be provided by the applicant when submitting the planning application, and should promote early consideration of the reclamation proposals including the acceptability of the proposed after-use. The actual information needed will be site specific, however, a general guide to the type of information relevant to site reclamation is summarised in Box 1.

111. Reclamation usually involves a number of key stages as indicated in the main text (paragraph 106). These stages need to be translated into planning conditions. Box 2 provides a breakdown of these stages, indicating the key topics that may need to be covered by reclamation conditions.

BOX 1

INFORMATION WHICH A MINERAL OPERATOR MIGHT PROVIDE TO MPAS IN SUPPORT OF A PLANNING APPLICATION TO ASSIST BOTH THE AUTHORITY, AND STATUTORY AUTHORITIES ADVISING IT

The list of items should be treated as useful guidance for mineral operators; and on individual cases should take account of the information requirements which may have emerged during pre-application discussions between the parties.

1. A copy of the relevant planning application and Section 66 and 67 certificates.
2. An Ordnance Survey plan of the area at 1:2,500 indicating:-

2.1 The outer boundaries of the area to be excavated;

2.2 The outer boundaries of the total site so that the areas allocated for topsoil, subsoil, soil making material and overburden storage can be seen; and

2.3 Details of any existing topsoil or subsoil heaps that may be used in the restoration, including position, types and quantities available.

3. Details of the type and depth of proposed workings and volumes of material to be removed. If the mineral operator has drilled the site during routine site evaluation then any data obtained should be offered, especially with relation to watertable level, soil-making materials which would be useful in the restoration scheme and should not be removed from the site, and depth and nature of topsoils, subsoils and overburden.
4. A strategic plan of the type of reclamation proposed including:

4.1 Projected plan of contours and final levels of the site, together with information about replacement depths for soil-making materials, subsoil and topsoil in the form of target restoration profiles;

4.2 Areas to be restored to agriculture, forestry and amenity uses or for built development;

4.3 The phasing and time-scale of the working, restoration and aftercare;

4.4 The methods of filling where appropriate, types of fill and materials proposed (eg controlled wastes, mine and quarry wastes etc);

4.5 The methods of stripping, transporting and restoring soils; including, where appropriate, schemes for retrieving and utilising soil making materials, dealing with different soil types and machine movement;

4.6 Proposed outfalls for drainage of the restored land;

4.7 Proposed access roads to restored land.

4.8 For sites taking controlled waste, details of proposed pollution control measures.

5. Any air or ground photographic evidence that might be available for the area (this is not essential but might be helpful if available).
6. Details of existing land uses/land cover – ie for agriculture (grass, crops etc), forestry (broadleaves, conifers, mixed etc); areas of nature conservation importance/amenity (where appropriate, baseline ecological survey covering vegetation, animals and habitat types etc).

BOX 1 C/tinued

INFORMATION WHICH A MINERAL OPERATOR MIGHT PROVIDE TO MPAS IN SUPPORT OF A PLANNING APPLICATION TO ASSIST BOTH THE AUTHORITY, AND STATUTORY AUTHORITIES ADVISING IT

7. Details of the overall drainage characteristics of the site, including the existence of any known field drainage system, and the positions of main outfall ditches and watercourses.
8. If any restoration is likely to be taking place within 12 months of the commencement of working, then full details of the proposed aftercare should be submitted.
9. Where restoration will not take place for several years, the operator should submit a summary of the principal items which he proposes to include in an aftercare scheme, to be agreed at a later date.
10. Details of proposals for nature conservation enhancement, indicating how they fit with local nature conservation strategies and the biodiversity action plan.

Note: Where mineral operators provide detailed information on a site's physical conditions in respect of agricultural land, the Welsh Assembly Government's Department of Environment, Planning and Countryside is prepared to utilize such data in the preparation of the statement of physical characteristics subject to satisfactory validation. To be of value to the Department, auger boring data should be collected on a grid basis at an appropriate sampling density for the site. At each grid intersection information is required down to 1.2 metres depth on soil texture, colour, gleying and abundance and size of surface stones. Supplementary representative soil profile pits should also be dug to provide information for each mapping unit on soil structure, depth to slowly permeable layers and abundance and size of subsoil stones, also down to 1.2 metres.

BOX 2

KEY TOPICS TO BE CONSIDERED WHEN DRAWING-UP RECLAMATION CONDITIONS

Soil stripping	Timing/condition of the soil Machinery used/routing of vehicles Separation of different soil types/horizons
Soil and overburden storage	Separation of different soil types/horizons; overburden storage Location of storage mounds, height, shape Methods of construction; including environmental safeguards for noise suppression Maintenance requirements (seeding, mowing etc)
Landform for after-use	Contouring of excavated area and of permanent mineral waste tips Placement of fill or overburden - sequence, phasing, method, order, depth; environmental safeguards Final levels/gradients
Restoration	Soil placement - - methods, order, thickness of topsoil, subsoil or soil making materials Timing and methods of placement Routing of vehicles during soil placement: (as for storage – environmental safeguards) Relief of compaction For controlled landfills, installation of gas and leachate control systems (spacing, location, compatibility with reclamation objectives, including vegetation establishment and management) Drainage outfalls
Provision of surface features	Ditches and drainage work Erection of fences Creation of attenuation ponds etc for water management
Aftercare	Planting or seeding, cultivating, fertilising, tree and hedge planting, watering, drainage Secondary treatments

Aftercare

112. An aftercare condition should always be included wherever appropriate to ensure that long-term restoration is secured. It is a condition requiring that such steps shall be taken as may be necessary to bring land to the required standard for whichever of the following uses is specified in the condition, namely-

a. use for agriculture;

b. use for forestry;

c. use for amenity;

d. use for nature conservation/biodiversity.

An aftercare condition can specify the steps to be taken or require the steps to be taken in accordance with a scheme approved by the MPA[59]. The steps specified may consist of planting, cultivating, fertilising, watering, draining or otherwise treating the land. Other works, such as the construction of paths and fencing, management arrangements of retained features, such as geological or historic structures, cannot be included in the aftercare condition but can be dealt with under other planning conditions or agreements.

113. The aftercare period is five years starting with compliance with the restoration condition or such other maximum period after that compliance as may be prescribed by further regulations; and may relate to any part or phase of the site development. Before imposing an aftercare condition, the MPA must consult the Department for Environment, Planning and Countryside of the Welsh Assembly Government where the after-use is to be agriculture, the Forestry Commission for a forestry after-use and the Countryside Council for Wales where nature conservation sites are to be provided. If ongoing groundwater monitoring is required the Environment Agency should be consulted. The date of the commencement of the aftercare period should be agreed and established for the avoidance of doubt, preferably through a formal decision of the MPA when the restoration scheme has been completed to a satisfactory standard[60].

114. An aftercare period of 5 years is likely to be adequate if the after-use is for agriculture. However, a longer period may be necessary for other after-uses where tree or hedge planting is involved, or where nature conservation is important particularly where new watercourses are to be developed. Any extension of the aftercare period beyond 5 years should be agreed at the outset between the MPA and operator and such agreement included in a Section 106 Agreement or planning obligation. If there is evidence that this arrangement is not working in practice, the Assembly will act swiftly to make new regulations in accordance with the provisions of the 1990 Act.

[59]Town and Country Planning Act 1990 Schedule 5

[60]Effectiveness of Provision for the Aftercare of Mineral Workings, DETR, (Aspinwalls), 2000

115. The long-term success of restoration and aftercare will require close liaison between the MPA and the mineral operator, and, in some instances, with the landowner. Annual aftercare meetings should be arranged, and reports prepared and supplied to the MPA by the operator to illustrate the progress of the scheme and the forward work programme for the subsequent year (see also paragraph 128).

116 Where an aftercare condition has been imposed, any person with an interest in the land may apply for a certificate of compliance. The MPA is obliged to issue a certificate to that effect once it is satisfied that the condition has been complied with.

Drawing up of Restoration and Aftercare Conditions

117 Planning permissions normally run with the land and are not usually personal to the developer. Where a permission is granted, therefore, the conditions should be drafted in such a way that, even if the interest of the mineral operator applying for permission is subsequently disposed of, the requirements for reclamation can still be fulfilled, whether by a new operator or in the case of default, by the land-owner. The general principle is that a MPA should take into account whether it is feasible to implement the applicant's reclamation proposals successfully. Planning conditions for reclamation should be specific to the proposed site and should normally be framed with the intended after-use in mind. They will vary according to:-

i the characteristics of the individual site;

ii the intended after-use;

iii the type of mineral to be worked;

iv the method of working;

v the timescale of the working;

vi the general character of, and planning policies for the area.

118. Where possible, it is normally desirable to have 'progressive' or 'rolling' reclamation to minimise the area of land occupied at any one time by the mineral working, unless to do so would be likely to affect adversely the standard of reclamation achieved, or would be impractical having regard to the type of operation and nature of the site. Conditions for progressive reclamation normally limit the area taken for mineral working at any one time and relate it to the rate of restoration of earlier phases of the operation. It is however important that conditions permit a sufficient area of land to be stripped of soils in advance of mineral extraction to allow for wet years when soil stripping operations may be impracticable. It is not advisable to specify actual dates in conditions for phasing unless there are overriding reasons to do so.

119. As stated in paragraph 97, for short-term workings it is usually appropriate to impose a detailed set of conditions at the time of granting planning permission. For longer-term workings, early agreement on the details of at least the later stages of reclamation may not be appropriate. However, to enable the MPA to assess the appropriateness in landscaping terms of the

final restored landform, and to identify opportunities for advance planting of vegetation, it is sensible to have, at least, a general outline of the final landform and intended after-use. For example, landscape and reclamation plans should address the impacts which mineral extraction can have on the existing landscape. These will include the working face and operations at the face, locations of waste tips, and haul roads. Where practical, a key objective may be to avoid breaking the natural skyline from particular viewpoints by the mineral working itself, or by the processing plant or spoil heaps. Co-ordination of phasing, provision of temporary or permanent screening, and progressive reclamation can together minimise visual impact and the impact on landscape quality.

120. For longer-term workings, it is also appropriate to agree at the outset outlines of requirements covering the main stages (eg filling, restoration and aftercare), together with detailed schemes for stripping and storage of soil materials. This must be sufficient to clearly demonstrate that the overall objectives of the scheme are practically achievable. Such workings should then normally require the submission of a detailed scheme or schemes for restoration and aftercare, for agreement, by some specific stage towards the end of the life of the permission. Sites where progressive reclamation is to be carried out can require submission of schemes for agreement from time to time as appropriate.

121. The intended final landform, gradients and drainage of a site should be designed and specified at the outset, with controls in planning conditions as appropriate. For many sites there may need to be some flexibility, and a continuation of the iterative design process, to take account of changes necessitated by operational, geological and mineral working safety demands. However, major planned final landform elements are not easily adjusted when extraction is almost complete, and modifications should not compromise the overall environmental acceptability of the scheme.

120. For after-uses requiring the growth of vegetation, effective reclamation will depend on the appropriate identification and management of soil resources prior to and during work as well as in the later stages of restoration and aftercare. Soil resources in this context are taken to include any medium which is not contaminated and which has a realisable potential to permit plant root growth and to retain and provide water and nutrients. Planning conditions will normally prevent soil resources from being exported from the site. In addition they will usually require the separate stripping, storage (where necessary) and respreading in correct sequence of defined thicknesses of topsoil, subsoil, or any other soil-making materials. Some sites may contain considerable variations of soils within them, such as major textural differences, and it may be desirable to require separate stripping (and storage and restoration) of these materials. Such soil variations should have been identified in pre-application site surveys and provided for in the reclamation plan.

123. The objective of restoration conditions is to secure the replacement of soil materials on landforms and levels which accord with the planning requirements, in ways that ensure that land is brought back to the standard required for the proposed after-use(s). This usually involves replacement of topsoil, subsoil and soil making materials in correct sequence on worked and suitably contoured land, in such a way as to minimise damage to soil structure and to other characteristics important for the growth of plants. If soils are damaged or lost during stripping, storage or restoration it can significantly affect the quality of the final restoration, even following five years of aftercare treatments. Restoration conditions also need to cover remedial treatment of soil so as to facilitate the use of cultivation, harvesting and drainage equipment for the aftercare period and the longer-term management of the land. In some cases it may be appropriate not to replace soil across the whole site, particularly where some forms of nature conservation requiring nutrient poor substrates are intended.

124. Schedule 5 to the 1990 Act provides powers to enable MPAs to impose 'aftercare conditions' on the grant of planning permission in relation to land which is to be used for agriculture, forestry or amenity following mineral working. The need for aftercare conditions stems from the recognition that land which is to be fully reclaimed needs not only the replacement of the topsoil and subsoil or other soil-making materials (through restoration conditions), it also needs to be cultivated and given treatment for a number of years after the initial restoration has been carried out in order to improve the structure and stability of the soil, and to bring it to a satisfactory standard. It also provides an opportunity to establish the site infra-structure such as drainage and the initial establishment and management of vegetation. The ultimate aim behind the concept of aftercare is that, over time, the land will be brought to a standard whereby it does not have to be treated differently from undisturbed land.

125. Aftercare conditions can be imposed in one of two forms (Schedule 5, paragraph 2(3)):-

i an aftercare condition imposed at the time of granting of planning permission, specifying the steps to be taken, or

ii a condition which requires an aftercare scheme to be submitted by the mineral operator or other appropriate person for approval (after modification if necessary) by the MPA.

An aftercare scheme will usually be appropriate with a long-term permission where restoration and aftercare may not be begun for a number of years. It should provide a flexible framework for a successful programme of aftercare. There may, however, be cases where it would be appropriate to specify aftercare steps in the aftercare condition itself – eg where mineral working will be short-term and the aftercare relatively straightforward, or for the first phase where progressive restoration and aftercare are to be carried out relatively quickly.

Monitoring and Enforcement of Conditions

126. This technical advice has set out guidance on the importance of accurate and relevant planning conditions, and planning obligations under section 106 of the 1990 Act, to achieve successful reclamation of mineral sites. However such conditions will be of little practical effect unless they are properly implemented by the mineral operator, and unless the MPA has an effective system for monitoring the activities on a regular basis and for taking enforcement action if this is necessary. It is recognised that neither mineral companies nor MPA's have unlimited resources. The objective should be for all relevant parties to have in place adequate systems, including quality controls and staff with appropriate training and skills, to achieve their parts in securing successful site reclamation in the most cost-effective manner.

127. There are a number of key stages and operations which critically affect the success of reclamation, such as soil stripping and avoiding loss in storage; creating final landforms including materials balance, slopes, levels, and any water areas; restoration of soils; and aftercare management including drainage and management of vegetation. Mineral operators should ensure that good records of all relevant planning documents, and of operations carried out, are kept at each site; and similar information should be held by the MPA.

128. It is essential that mineral operators provide MPAs with an annual report on each of their sites, which indicates how they have monitored and complied with specific planning conditions. For new sites such a requirement could be included as a planning condition, providing that the actual conditions to be monitored and reported on are sufficiently precise and identified. However, monitoring reports should not be seen as an alternative to proper and objective monitoring of compliance by the MPA.

129. MPAs should also have a planned series of visits to sites to check on key activities at the right times, such as in advance of soil stripping and stages of restoration, in addition to routine monitoring and recording of progress.

After-use

130. Notwithstanding the longevity of most minerals permissions, the future use of land taken for aggregates must be considered before planning permission is granted so that the mineral extraction and restoration scheme can be designed accordingly. Development plans should provide guidance on the after-uses that are likely to be acceptable for existing sites that may be reclaimed during the plan period. Restoration of mineral sites provides an opportunity to influence future land-uses. The choice of after-use should be guided by a consideration of what is likely to be both beneficial and sustainable over the longer term, the interests of the landowner, any landscape assessments, local bio-diversity action plans and countryside strategies that may be relevant. Early consultation with local authorities is therefore paramount. For operational quarries of long standing, opportunities to modify after-use may now exist in the light of these assessments, plans and strategies. After-use of such sites must be regularly reviewed in the light of these and future initiatives.

131. **Agriculture:** Much of the land taken for mineral working is in agricultural use prior to extraction operations, and the latest figures on reclaimed mineral workings in Wales (1988) show that the vast majority of land had been restored to agriculture between 1982 and 1988[61]. As explained below, other more imaginative choices of after-uses have come to the fore in recent years, particularly where agriculture is not likely to be appropriate because of the lack of suitable soils. It is vital to be certain that the quality of the restored land will be capable of supporting an agricultural after-use. The soil and site requirements for agriculture are well researched and reported[62 63 64.] Where an agricultural after-use is proposed in an application for aggregates extraction or in a restoration scheme submitted later, the Department for Environment, Planning and Countryside of the Welsh Assembly Government must be consulted and close liaison will be necessary during soil stripping and storage, restoration works and aftercare.

132. **Forestry:** A forestry or woodland after-use is likely to be a preferable option to agriculture where there are insufficient soils to support such a use, or where slopes are excessive so that long term maintenance would be difficult and must therefore be minimised. Quarry faces present a particular challenge for re-vegetation because of limited access, paucity of niches for vegetation to become established, hostile environment, erosion and lack of soils. Planting at the base of quarry faces and on benches will help to disguise a quarry face and should be considered as part of progressive restoration.

133. The Forestry Commission has completed research to improve methods of establishing woodland on man-made sites with a view to meeting the Commission's objective of woodland expansion on brownfield land. This research has considered the success and failure of a range of restored sites in Great Britain[65.] Detailed advice on the planting design for the reclamation of sites to woodland and forestry is contained in Annex D.

134. **Amenity, nature conservation and geoconservation:** There is an increasing emphasis on the need to conserve and improve biodiversity both nationally and locally as required by UK and Local Biodiversity Action Plans. Many of the characteristics that limit restoration to agriculture can provide real opportunities for nature conservation. These include lack of topsoil, low fertility and steep or irregular contours that would make such land difficult and often expensive to reclaim to agriculture. Research has been undertaken to assist local authorities, restoration agencies and industry in the

[61]Results of the Survey of Land for Mineral Workings in Wales, Welsh Office, 1988
[62]Code of good agricultural practice for the protection of soils, Ministry of Agriculture, Fisheries and Food, 1998
[63]The reclamation of mineral workings to agriculture, RPS Clouston and Wye College, 1996
[64]Soil Forming Materials: Their Use in Land Reclamation, DETR, (Wye College, University of London and the Forestry Commission), 2000
[65]Reclamation of man-made sites for Forestry, Forestry Commission

assessment, protection, creation and management of nature conservation interests on damaged land[66]. This has shown that nature conservation can be one of the least costly after-use options in terms of initial capital outlay but longer-term management needs must be addressed. On some mineral sites, habitats have become established naturally and any restoration works may destroy the biological importance of the site. However, nature conservation rarely generates a self-sustaining income and therefore it is essential to establish adequate funding to secure long-term site management. Bids may be made to the Aggregates Levy Sustainability Fund for funding to support future management.

135. One of the options may well be to encourage restoration by natural regeneration over parts of the site, so that a mosaic of habitats is established naturally. This approach is useful where there is a serious lack of soil material for restoration purposes. It would enable scarce soils to be used more constructively elsewhere on the site would contribute to habitat diversity. It will require some lateral thinking and appropriate advice should be sought from conservation agencies and wildlife trusts[67] to maximise opportunities. It is important that areas set aside for nature conservation purposes are carefully integrated into the reclamation objectives for the site as a whole. Guidance should also be sought from the statutory consultees for the main after use of the site where agriculture or forestry is concerned.

136. Mineral extraction can expose geological features that are important for research or educational purposes where restoration would be undesirable. These sites are often suitable for selection as Regionally Important Geological Sites (RIGS). It is essential that the nature or geological conservation value of land used for mineral extraction is assessed before any restoration work commences. Where nature or geological conservation interest is known or suspected to be significant, an ecological/earth science survey should be undertaken. Even where nature or geological conservation or amenity is not the chosen after-use, there may be opportunities to conserve plant or animal communities in part of the future development or to protect nature or geological conservation interests through a flexible approach to the after-use scheme. This should be fully explored in consultation with AWRG and local RIGS groups.

137. Where nature conservation is the primary objective, ecological advice is likely to be necessary to evaluate the land, and to assist in the design and management of the reclamation scheme. This is also true even if the land is to be allowed to re-establish its nature conservation value naturally. The problems of soils structure, compaction, drainage and injurious weeds are endemic on many newly restored sites and are difficult to deal with in a "conservation" restoration and interim measures may be necessary to prepare the land for the final after-use. The nature conservation interests must be monitored regularly to ensure that the objectives are being achieved and to prompt remedial action where necessary. Consultation should be undertaken with the Countryside Council for Wales where nature

[66]Reclamation of Damaged Land for Nature Conservation, Department of the Environment, (Land Use Consultants and Wardell Armstrong), 1996

[67]Conservation or Greening? The Challenge of Post-industrial Landscapes, British Wildlife, 4(5), pp273-279. (J Box), 1993

conservation is the proposed after-use, and with that body and the relevant wildlife trust if the land is to be allowed to regenerate naturally. Where geoconservation or geotourism is an integral part of the after-use, AWRG or local RIGS groups should be consulted. If historically important remains are retained within the after-use of the site it may be necessary to consult the local archaeological trust for advice and information. Mineral extraction sites can include historically important features related to former extraction and associated industries, such as limeworking, which if retained, can significantly add to local distinctiveness and sense of place and are important for research and educational purposes.

138. Amenity after-use to provide open space available for public use is usually more appropriate where the reclaimed land is located close to centres of population and informal recreation would be suitable. Footpaths that are extinguished as a result of mineral operations should normally be incorporated into the future development proposals unless it is clearly impracticable. The future management of these areas should be established and often a warden will be necessary where regular maintenance is necessary or vandalism may be a problem. Applications may be made to the Aggregates Levy Sustainability Fund to support future management. Consultation with the local community, or local authority highways and planning departments should be undertaken at an early stage to establish local involvement in the scheme. Public accessibility to any retained features of historic or nature conservation should be considered for educational or research purposes.

139. **Other Uses:**

Nearly all other after-uses will require a separate planning permission.

- **Recreation** - Closed quarries can provide ideal opportunities for recreational development such as, rock climbing or angling. Some provide sites for uses that may be unsuitable elsewhere, such as those that may be considered to be a source of nuisance, motor cycle scrambling, shooting ranges or water skiing; or that require specific landforms, such as diving schools that need a certain depth of water. Public safety is clearly a prime consideration in the use of former quarries. Removal of derelict plant and other structures together with ensuring the stability of quarry faces is essential unless they are incorporated into new development proposals.
- **Industrial and commercial development** – the potential for industrial or commercial development is dependent on location and proximity to transport links. Remote sites clearly have less potential. The greater floor area with stable slopes, the more potential there will be to accommodate such after-uses. Quarry floors can provide sites suitable for land uses that need screening from view, such as recycling centres for construction and demolition wastes, waste transfer centres, or end of life vehicle storage and dismantling yards. If such uses are proposed, early consultation with the Environment Agency is essential.

E. To encourage the efficient use of minerals and maximising the potential use of alternative materials as aggregates

140. The Welsh Assembly Government wishes to promote the minimisation of waste[68] and the use of industrial by-products, recycled materials and mineral waste as aggregates to reduce the demand for the production of primary resources. The large quantities of waste products that arise in Wales and are currently disposed of to landfill constitute one of the largest waste streams and take up significant landfill space. The potential use of all waste materials that are available in the locality should be fully considered in Environmental Statements submitted as part of the planning approval process for any new or extended primary aggregate resources. This will help to make sure that any opportunity to use waste materials and thus conserve primary resources is fully assessed before further extraction of natural resources is permitted.

141. The Waste Strategy for Wales and the Assembly's sustainable development scheme emphasise the need to minimise waste arisings. Planning Policy Wales March 2002 and the Waste Technical Advice Note[69] set out the principles of the waste hierarchy that promotes waste reduction, re-use, recovery and recycling, energy from waste and lastly, landfill disposal and the proximity principle that encourages the management or disposal of waste as close as possible to the point of generation.

142. **Secondary Materials:** Approximately one million tonnes of steel slag, pulverised fuel ash (PFA) and furnace bottom ash (FBA) was used as aggregates in 2002[70]. Both slag and ash are used as cement additions or general aggregate material. Recent research[71] has indicated that there is little opportunity to significantly increase the use of industrial by-products as aggregates. Availability of slag is likely to decrease as the steel industry in Wales is declining. The RAWPs should continue to monitor arisings and investigate ways of improving their data collection methods to provide a sound basis for determining whether there are measures that may be taken to increase the use of these materials for aggregate purposes (see Annex A).

143. **Mineral waste:** As explained in paragraph 13, most quarries produce crushed rock fines (CRFs) as part of the production process. It is clearly in the interests of operators to maximise the use and sale of CRFs. In general, sandstone quarries produce more waste material per site than limestone quarries. There is very little data available about the volumes of CRFs in existing tips or annual arisings and it is essential that better data is available. This issue will be discussed further with mineral operators and industry associations. The RAWPs should include in their annual surveys a request for estimates of material that is suitable for use as aggregates and already deposited in mineral waste tips, and an estimate of ongoing generation of mineral waste material at all quarries so that a more accurate picture of

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[68]Wise about Waste: The National Waste Strategy for Wales, Welsh Assembly Government, June 2002

[69]Technical Advice Note (Wales) 21 Waste, National Assembly for Wales, November 2001

[70]Annual Report of the South Wales RAWP 2002, 2003

[71]Improving the Information Base on Secondary Minerals/C&D Waste for Use as Aggregates in Wales, Arup, January 2004

arisings can be obtained. The European Union is currently developing a proposed EU Directive on the management of Mining Waste from extractive industries which is likely to require an inventory of mining waste tips which will result in the availability of more information on this significant waste stream.

144. Slate production in North Wales produces 4-6 million tonnes of waste material each year. The Assembly considers that this ongoing production of huge quantities of waste material is unsustainable and that every opportunity must be taken to ensure use of this material to substitute for and therefore help to conserve primary resources. There are over 700 million tonnes of slate waste already accumulated in Gwynedd. Much of this could be used to provide aggregate material although it is acknowledged that a significant number of old slate tips should be retained for their historic and ecological importance. Research[72] completed in 2001 has established the feasibility of increasing the use of slate waste and determined the measures that would help to enable slate waste to be re-used or recycled for aggregate purposes. The exemption of slate from the Aggregates Levy has contributed towards an increase in use of slate waste as aggregates. Other research[73] suggests that it is possible to substitute slate waste for higher grade uses, otherwise increased use of slate waste is simply encouraging the substitution of slate waste for quarry waste.

145. The RAWPs should investigate in conjunction with the Assembly how to maximise the use of all mineral waste materials with potential for use as aggregates and report their findings in the Regional Technical Statement.

Recycled Aggregates from Construction and Demolition Waste:

146. An EC Working Document[74], issued in April 2000, makes a series of proposals for intervention to boost the reuse and recycling of construction and demolition (C&D) waste. It acknowledged that construction and demolition waste constitutes the largest waste stream in quantitative terms apart from mining and farm wastes and that roughly 75% of such waste is landfilled in the EU despite its major recycling potential. Some EU Member States manage to achieve recycling rates of more than 80% of the waste arising. The proposals of particular relevance to planning include:

- identification of zones and/or locations in land use plans where C&D waste recycling facilities would be considered acceptable;
- increase in re-use and recycling rates of between 50 and 75% in 2005 and between 70 and 85% in 2010.

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[72]North Wales Slate Waste Tips – A Sustainable Source of Secondary Aggregates,. National Assembly for Wales, (Arup), 2001

[73]Improving the Information Base on Secondary Minerals/C&D Waste for Use as Aggregates in Wales, Arup, January 2004

[74]Management of Construction and Demolition Waste, EC Working Document No 1, 4 April 2000

147. Construction and Demolition Waste management surveys were undertaken in 1999 and 2001[75]. The latest survey shows that 31% of C&D waste is recycled as aggregates in Wales. Table 2 shows that over 1.5 million tonnes of construction and demolition waste and soils were tipped in 2001 at licensed landfill sites in Wales or received at exempt sites. This is not considered to be acceptable. There would appear to be an opportunity to utilise more of this material as aggregates to secure a beneficial use instead of disposal to landfill. However, research[76] has indicated that the potential to increase the use of C&D waste is limited because much of the waste comprises soils and mixed waste and some is contaminated.

148. Research undertaken into the effects of the landfill tax[77] supports the view that the tax has had a major effect upon the way in which inert waste is managed. There has been a significant fall in disposal of inert waste to landfill and this is partly as a result of increased recycling. However, there is also a significant quantity of material received at exempt sites; primarily because exempt sites are not subject to the landfill tax rather than being put to a more beneficial use for the material. Recovery activities at exempt sites are less well regulated than licensed sites and this has led to the potential for environmental harm from pollution and other issues caused by poorly managed operations. There is a need for improved auditing of such waste and all exempt sites should be required to provide information concerning the extent of recovery activities. The Welsh Assembly Government is consulting about proposals to introduce new controls on exempt sites[78]. The RAWPs should monitor the management of inert waste arisings with potential for use as aggregates in liaison with the Environment Agency.

149. Road planings, produced as a result of repair, maintenance and road construction, are capable of being recycled as aggregates. In recent years, the RAWPs have undertaken surveys of the production and recycling of road planings by local highway authorities as part of their annual aggregates monitoring surveys. The latest survey undertaken for 2002 by the RAWPs indicates that nearly 100% of the material arising was recycled, although some of this is used for low-grade uses such as farm track improvements. Further research is needed to determine the extent of recycling of road planings by the central highway agencies.

150. **Recycling Centres:** The establishment of a network of recycling centres for construction and demolition waste will enable the materials to be stored, separated and processed to maximise their recovery for beneficial use, in particular for aggregates. The cost of transport is a major factor in the economics of recycling and beyond 25 kilometres the economic return on recycling is difficult to achieve. Recycling facilities should be made available

[75]Survey of Arisings and Use of Construction and Demolition Waste in 2001, ODPM (Symonds), 2002
[76]Improving the Information Base on Secondary Minerals/C&D Waste for Use as Aggregates in Wales, Arup, January 2004
[77]Effects of the Landfill Tax – Reduced Disposal of Inert Waste to Landfill, DETR (Ecotec Research and Consulting), 2000
[78]Proposals for Amendments to the Waste Management Licensing Regulations 1994 (as amended) – Consultation Paper, Welsh Assembly Government/DEFRA, June 2003

therefore in each unitary authority area and, where they are not already established, development plans should make provision for suitable sites or provide clear guidance on suitable types of location, bringing a degree of certainty to potential developers.

151. Research has been completed[79] to outline the siting considerations, management controls and physical measures to avoid or reduce the local environmental impacts of producing recycled and secondary aggregates. This Good Practice Guide is aimed at local planning authorities, operators and potential developers, to help them identify possible production sites for recycled and secondary aggregates. The RAWPs should provide information about the need for aggregates recycling facilities in their regions.

152. The most acceptable locations for recycling centres are likely to be:

- Stand alone facilities
  - purpose built sites in industrial areas;
  - at waste transfer sites;
  - in worked out quarries.
- Linked to quarrying/ and/or waste disposal
  - active quarries with or without landfill;
  - inactive quarries;
  - landfill sites.

Notwithstanding the above, proposals will need careful assessment including the need for adequate transport provision and to ensure that the quality of groundwater is protected.

153 **Promoting Recovery and Recycling:** The Aggregates Levy Sustainability Fund was established in April 2002 with the objective of promoting the use of alternative materials as aggregates and providing benefit for communities affected by quarrying operations. There will be the opportunity therefore to use funds to facilitate aggregates recycling in Wales and bids for funding should be made to the Sustainability Fund managed by the Welsh Assembly's Planning Division.

154. Research[80] was undertaken for the Welsh Assembly Government in 2001 to determine the comparative environmental impacts of meeting the demand for fine aggregates supply from both primary resources and recycled sources of material. This has provided an objective assessment of the environmental impacts of different supply options and concluded that secondary and recycled materials has limited potential to replace primary resources for fine aggregates. They are far more suitable for substitution for coarse aggregates.

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[79]Controlling the Environmental Effects of Recycling and Secondary Aggregates production. Good Practice Guidance, DETR, (Land Use Consultants and Wimtec Environment), 2000

[80]Comparative Impact Assessment of Land and Marine Sand and Gravel in South East Wales, Welsh Assembly Government (Symonds), May 2002

Targets for the use of recycled and secondary aggregates

155. The Welsh Assembly Government wishes to maximise the use of secondary and recycled sources to conserve finite primary resources. At the present time, it is estimated that in Wales just over 10% of total aggregates are supplied from non-primary sources. This is probably because of the availability of natural resources of sufficient quality and quantity to meet the demand for building materials at a moderate cost. The change in pattern of supply cannot be achieved immediately particularly as there is an extensive landbank of reserves of primary aggregates in Wales. The Welsh Assembly Government is determined to address this issue.

156. Any application for new aggregates quarries or any major extensions to existing quarries should be assessed carefully to ensure that the potential supply of aggregates from non-primary sources has been fully considered as part of the environmental assessment process. Primary aggregates development should not be permitted where it can be demonstrated that the need could be met at lower environmental cost by the use of secondary or recycled material.

157. **A broad objective is to increase the proportion of aggregates production in Wales from secondary and recycled sources to at least 25% of total aggregates supply within 5 years**. This is only likely to be achieved by a significant increase in the use of slate waste in North Wales. Some European countries have achieved high levels of recycling and demonstrated that C&D waste has considerable recycling potential. However, this level of success has been generally achieved by introducing regulations to ban disposal to landfill or charging heavily for such disposal. With the current legislation and rate of landfill tax, **a more realistic target for the recycling of C&D waste as aggregates is proposed for Wales of at least 40% by 2005**. This will necessitate significant changes in current working practices and is not the draft minimum target suggested by the European Commission [81]. Further recycling of other material in the C&D waste stream that is not suitable for use as aggregates may enable the targets in the Wales Waste Strategy to be met.

158. It is essential to have precise and reliable information about the nature and quantity of construction and demolition waste arisings in Wales and the extent of re-use and recycling. This will enable better monitoring of current trends in order to improve the management of the arisings. Surveys of C&D waste and secondary materials suitable for aggregates are likely to be undertaken for 2003 and will provide an update of any changes since the previous survey in 2001.

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[81] Improving the Information Base on Secondary Minerals/C&D Waste for Use as Aggregates in Wales, Arup, January 2004

ANNEX A

REGIONAL AGGREGATES WORKING PARTIES (RAWPS)

A1. Membership

There are two RAWPs in Wales and their membership is drawn from officers of the mineral planning authorities, the aggregates and recycling industry, the British Geological Survey, Environment Agency Wales, Countryside Council for Wales, the Welsh Assembly Government, the Office of the Deputy Prime Minister together with other Government Departments.

A2 Aggregates Monitoring (AM) Surveys

Aggregates Monitoring Surveys are undertaken by the RAWPs to provide details of the regional and national production and consumption of aggregates. Main surveys are undertaken on a four yearly cycle for England and Wales and also provide information on the regional distribution of aggregates production. The last completed survey was carried out for 2001 and the national collation was published by the Office of the Deputy Prime Minister[1]. The information is collected from minerals producers by the mineral planning authorities in a survey collated regionally by the Regional Aggregates Working Parties. Since the early 1990s, the RAWPs have also undertaken annual surveys of aggregates production and reports summarising aggregates production and reserves in each mineral planning authority are published each year.

A3. Future Role of the RAWPs

Monitoring Aggregates

- To continue to monitor production of primary and secondary aggregates;
- To continue to monitor the distribution of primary and secondary aggregates including imports and exports of aggregates;
- To continue to collect data on primary aggregates reserves at regional and mineral planning authority levels;
- To monitor the generation of all wastes that have potential for use as aggregates;
- To monitor the generation, re-use and recycling of secondary materials and recycled aggregates from construction and demolition waste;
- To monitor UDPs and future development programmes and major proposals to assess the regional demand for aggregates and determine potential areas where there could be a shortfall of supply

Assessment of Aggregates Demand and Supply

- To assess the environmental capacity of MPA areas to meet the demand for aggregates;
- To assess the reserves of primary aggregates in active and dormant sites and the likelihood of dormant sites being reactivated;

[1]Collation of the Results of the 2001 Aggregates Minerals Survey for England and Wales, ODPM (British Geological Survey), 2003

- To assess the use of secondary and recycled aggregates and consider ways to improve data collection and to increase their use to replace primary resources;
- To assess the provision/capacity within each unitary authority area to recycle construction and demolition waste, identifying scope to improve the recycling and reuse of aggregates by examining the extent of landfill disposal (and use on exempt sites) and locations of recycling facilities;
- To assess the arisings of construction and demolition waste, including road planings and their reuse and recovery as aggregates;

Regional Technical Statement for Aggregates

To provide a 5-yearly Regional Technical Statement (within 18 months of the completion of the study of environmental capacity in Wales) to set out:

- The results of the regional assessment of the environmental capacity of each MPA to contribute to an adequate supply of primary aggregates;
- To provide a strategy for the provision of aggregates in the region in accord with that regional assessment, with allocations of future aggregates provision for each mineral planning authority area to provide a strategic basis for future development plans;
- To assess current and future imports and exports of aggregates;
- To assess the current and future contribution of marine aggregates;
- To advise the Assembly on the potential in each region in Wales for increasing the use of alternative materials to replace primary aggregates.

Joint Voluntary Arrangements of Local Authorities

- The Technical Secretariat of the RAWPs will administer the arrangements for establishing joint voluntary arrangements of local authorities to assess the draft Regional Technical Statement for Aggregates to provide a context for proper consideration of land use issues relating to aggregates provision in unitary development plans. All local authorities in the region should be represented with a view to reaching a consensus about the recommendations for the region in the Regional Technical Statement for Aggregates. This will then need to be agreed by each constituent local authority.
- Each local authority in the region should then include in its own unitary or local development plan elements of the agreed Regional Technical Statement that are germane to its area at the earliest opportunity.
- If the local authorities reach no agreement or if individual local authorities do not accept the Regional Technical Statement, the Welsh Assembly Government will consider its default powers to intervene in the planning process as a last resort.

ANNEX B

RECLAMATION TO AGRICULTURE

B1. Policy

Most of the land taken for mineral working in Wales is in agricultural use prior to extraction. Welsh Assembly Government guidance on how development on agricultural land should be treated is set out in paragraph 2.8 of Planning Policy Wales and paragraphs 3 to 11 of Technical Advice Note (Wales) 6 "Agricultural and Rural Development". More specific guidance on mineral development involving agricultural land is set out in paragraph 32 of part B of Mineral Planning Policy Wales and paragraph C3 of Annex C of TAN (Wales) 6.

On many sites, the ability to achieve high standards of reclamation should enable mineral extraction to occur without the irreversible loss of land quality. Where minerals underlie the best and most versatile agricultural land it is particularly important that restoration and aftercare preserve the long-term potential of the land as a national, high quality, agricultural resource.

Government policy seeks also to encourage the diversification of the rural economy where this will not result in the significant loss of high quality agricultural land. Therefore whilst agriculture remains the most appropriate after-use for many mineral sites, other uses such as forestry and some forms of amenity including nature conservation (eg heathland or unimproved grassland), should also be considered on land which was originally in agricultural use. Where these alternatives are proposed on the best and most versatile agricultural land, the methods used in restoration and aftercare should enable the land to retain its longer-term capability to be farmed to its land classification potential, thus remaining a high quality agricultural resource for the future. A wider range of non-agricultural after-uses may be appropriate on land of lower quality. Land of lower quality and fertility may be particularly suited to nature conservation as an after-use, resulting in a greater diversity of habitats.

In many cases it is possible to integrate more than one after-use within a restored site. For example, even where it is proposed that the main land use is to be agriculture, it may be appropriate, subject to other planning considerations, to establish woodlands, nature conservation interest, or water-areas at the margins.

Reclamation to non-agricultural uses does not mean that there can be any lessened commitment to high standards in the reclamation and recycling of land taken for mineral working, and they therefore should not be chosen because they are perceived as 'easier options'. They require equal commitment by mineral operators, mineral planning authorities and any other parties involved to achieve high standards of implementation.

B2. Role of the National Assembly Department of Environment, Planning and Countryside

For mineral planning applications, the Department has a statutory role in advising the MPA on the land use implications of all development proposals affecting Grades 1, 2 and 3a land over a certain size threshold (20 hectares), or on less than 20 hectares in circumstances where the development is likely to lead to further

losses amount cumulatively to 20 hectares in circumstances where the development is likely to lead to further losses amounting cumulatively to 20 hectares or more. The Department is also a consultee on aftercare conditions for all sites to be restored to agriculture irrespective of site size or land quality.

Where reclamation to agriculture is proposed in a planning application the Department has a responsibility to offer mineral planning authorities a view on the appropriateness of this after-use and on suitable aftercare conditions if planning permission is to be given. Such consultation is required regardless of the area of land involved or its agricultural quality. The Department may also provide advice and comment on site working and restoration since the achievement of good standards in the aftercare period depends in part upon appropriate and satisfactory (and enforced) stripping, movement and restoration of soils and contouring.

In determining its responses to development proposals the Department will take into account, inter alia, the feasibility of achieving a high standard of restoration and the adequacy of proposals submitted by the applicant for site working, restoration and aftercare.

When imposing agriculture restoration and aftercare conditions, MPAs should consult the Department on the form of the aftercare condition (cf paragraph 125 in the main text). There will be cases where it would be appropriate to specify the aftercare steps in the aftercare condition itself eg most sites under five hectares. But in many other cases, and particularly where a long-term permission is being sought, it may be more appropriate to impose a condition requiring the submission of an aftercare scheme at a later stage. In such cases, the steps to be included in the scheme should be outlined in the permission, but they can be drawn up in detail by the mineral operator, in consultation with the Department and the MPA, when restoration is nearing completion (see B5 below).

To assist operators with scheme preparation, the Department may be prepared to attend a pre-aftercare meeting convened by the MPA. Guidance on the level of detail generally required and items to be included in aftercare schemes is given below. To be most effective such meetings should be held about six months prior to the commencement of aftercare on all or part of the site. Such meetings may not be required for all sites, particularly where aftercare requirements have been previously discussed in detail or where previous guidance has already been given on a similar site.

The aftercare scheme should be submitted to the MPA by the operator at least three months prior to commencement of aftercare of the full site or any phase of it. This gives adequate time for the authority to consult the Department and for any necessary amendments to be made.

Where aftercare is carried out subject to an approved scheme, it is essential that the MPA, and through them the Department, are consulted by the site operator at least annually on the way in which aftercare conditions are being complied with. This is most effectively achieved by the site operator providing, for the MPA's approval, a record of work undertaken and a detailed aftercare programme for the forthcoming year.

Upon receipt of these documents, the MPA will consult the Department and determine whether it is necessary to arrange an aftercare review site meeting to review progress. In response, the Department will provide advice to the MPA on whether the detailed record of work undertaken and the programme for the forthcoming year satisfy aftercare requirements. The Department will attend such agreed aftercare review meetings as may be appropriate.

Aftercare meetings generally need to take place between the person(s) responsible for carrying out the aftercare (the mineral operator, tenant or landowner) the MPA, and any expert advisers.

There may be cases where inspections at more frequent intervals than a year would assist in achieving adequate aftercare. If this is the case it will be for all parties to agree to holding the additional meetings.

The MPA may involve the Department in the issuing of a certificate confirming that aftercare conditions have been complied with (see paragraph 116 in the main text).

B3. Reclamation Standards

Aftercare can only be used to bring the land to a required standard which is defined in general terms according to the intended after-use. Where restoration to agriculture is carried out in accordance with Schedule 5, paragraph 3(1), then a statement will have been prepared describing the physical characteristics of the land when it was last used for agriculture. Here, so far as it is reasonably practicable to do so, the objective is to restore land to its original quality. This is a more precise requirement than for other circumstances, where the land must be returned to a standard where it is fit for the use specified in the aftercare conditions (Schedule 5, paragraphs 3(2) to (4)). The latter standard is acceptable, for example, in situations where poor quality land is involved or where a site contains previously despoiled or derelict land. In these circumstances, it is appropriate to define measurable performance criteria or checklists. These could cover, for example, the thickness of topsoil, subsoil, other soil materials; soil texture; stoniness; water holding capacity; degree of compaction (bulk density).

B4. Handling of Soils during Mineral Operations

For after-uses requiring the growth of vegetation, effective reclamation will depend on the appropriate identification and management of soil resources prior to and during work as well as in the later stages of restoration and aftercare. Soil resources in this context are taken to include any medium with a realisable potential to permit plant root growth and to provide water and nutrients.

Pre-application site investigations should provide adequate information on the amounts and characteristics of topsoil, subsoil, soil-making materials and overburden; drainage and original landforms.

Planning conditions will normally require the separate stripping, storage (where necessary) and respreading in correct sequence of defined thickness of topsoil, subsoil, or any other soil-making materials. Some sites may contain considerable variations of soils within them, such as major textural differences, and it is often desirable to require separate stripping (and storage and restoration) of each main soil type. Subsoils, for example, often comprise two or more layers which may

vary in their physical and chemical characteristics. Such soil variations should have been identified in pre-application site surveys and taken into account in the proposed restoration profiles in the reclamation plan. However, it is important not to make the requirements for separate stripping of each soil type too complicated for the operator to deal with in a practical manner.

The Department of Environment, Food and Rural Affairs (DEFRA) has produced a Good Practice Guide to Handling Soils which can be obtained on DEFRA website address www.defra.gov.uk/environ/landuse/soilguid/index.htm.

FIGURE 1: TYPICAL SOIL HORIZONS AND CHARACTERSITCS

TOPSOIL
Usually darker surface layer. Biologically active.
Often well structured. Important nutrient source - supplemented by ferilisers.

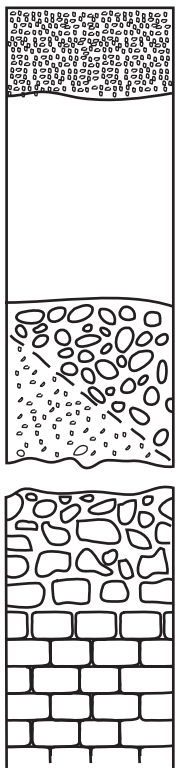
SUBSOIL
Weaker less developed structure.
Less biologically active.
Important for moisture storage.

OVERBURDEN - UNCONSOLIDATED
(typically glacial till, or alluvium)

MINERAL RESOURCE - DRIFT DEPOSIT
(e.g. terrace sand and gravel)

OVERBURDEN - SOLID
Typically weathered or poor quality rock.

MINERAL RESOURCE - SOLID DEPOSIT
Limestone, sandstone, shale, coal etc



SOIL SCIENCE TERMS

A Horizon
Zone of accumulated humified organic matter, intimately mixed with mineral soil.

B Horizon
Mineral soil. Zone of chemical alteration of parent material 9weathering). May have signs of poor drainage (gleying) or of long term accumulation of materials from overlying horizons (illuviation). Often. weaker, less developed structure than topsoil, but can be well structured in upper part.

C Horizon
Mineral horizon of unconsolidated material, some chemcial weathering causing partial altering of parent material.

C Horizon

R horizon

Bed rock

The dumptruck method if correctly implemented, should minimise soil compaction and allow movement of soils across a wider range of moisture contents than a scraper, which undoubtedly compacts soils moved when moist. It may also reduce the need for remedial work during the aftercare period. The dumptruck method should, therefore, be considered particularly for sites affecting the best and most versatile agricultural land.

Compaction, smearing and loss of soil structure can be caused by handling and movement of soils in unfavourable weather and soil moisture conditions, by unsuitable storage of soils, and by passage of machinery with high axle weights or ground pressures across soils. In many cases it is not possible to remedy such damage, particularly where compaction has occurred in the lower soil profile.

Planning conditions should aim to minimise this potential for damage through limiting when and how soils are moved. Soils movements can be restricted to dry conditions in general terms, by reference to particular soil moisture conditions or by rainfall criteria.

Even during periods of weather generally suitable for soil stripping, supervision should ensure that operations are suspended after heavy rain. The damage caused to soils by continuing earthmoving during adverse soil moisture conditions may be costly or impossible to reverse during aftercare. Suitably dry soil moisture conditions for stripping subsoils are more likely to be achieved if the site is kept vegetated or, in arable situations, if a temporary grass sward is established for the period prior to stripping.

In areas of high rainfall and with some heavier-textured soils it may be more difficult to get ideal circumstances in which to move subsoils. In these circumstances the soil handling methods employed should be designed to minimise compaction and an appropriate programme of cultivation devised.

Table 1. Soil Characteristics and effects of disturbance

Soil characteristics	Effects of disturbance	Effects controllable by planning condition
SOIL PROFILE AND DEPTH: Arrangement and thickness of different horizons (topsoil, subsoil and weathered parent material).	Possible mixing of soil types and soil horizons, loss of material, possible bulking during soil movement and subsequent resettlement.	Careful separate stripping, storage and respreading of soil horizons, to specified depths, commensurate with amounts of soil present, and proposed after-use. Avoidance of soil mixing.
SOIL TEXTURE: Size range of primary particles present (sand, silt, clay etc).	Not necessarily altered if soil movement carefully controlled.	Careful separate stripping, storage and respreading of soil horizons.
STONINESS: Particles greater than 2mm diameter. All stones dilute the volume of soil and reduce available water capacity. Larger stones interfere with cultivation especially those in the topsoil.	Possible increase due to mixing of different soil horizons or replacement of stony horizons nearer the top of the soil profile. Contamination with overburden	As for SOIL PROFILE AND DEPTH. Also, ripping followed by stone picking upon replacement of stony layers.
SOIL STRUCTURE: Arrangement of individual soil particles into larger compound units or 'peds' with channels between	Inevitable disturbance by soil movement; extent depending on initial structure, site conditions, method of movement. Compaction; increase in bulk density; loss of number and continuity of macro pores and fissues; impeded drainage. Subsoils are generally most prone to longer term damage.	Avoid soil movement in wet conditions; use direct respreading where possible; specify agreed soil handling methods and machinery so as to avoid trafficking by heavy machienry; subsoiling and other cultivations of replaced soil; remedial cropping.
BULK DENSITY: The weight of soil per unit volume. A measure of compaction, and related to soil structure and texture.	Possible loosening during stripping decreases bulk density but main danger is increased bulk density by passage of earthmoving machinery.	As SOIL STRUCTURE.

Soil characteristics	Effects of disturbance	Effects controllable by planning condition
SOIL DRAINAGE: Movement of water through the soil. Depends mainly on soil texture and structure; and level of water table.	Disturbed by soil movement.	See SOIL TEXTURE and STRUCTURE. Levels and gradients of reinstated sites; subsequent installation of drainage system.
AVAILABLE WATER CAPACITY: Measure of moisture that plants can extract from the soil. Related to texture, structure, stoniness and depth of the soil profile that roots can exploit	Altered by change in soil structure due to soil movement. Usually decreases with increases in bulk density and water becomes less accessible to plant roots where compaction is severe.	Not directly; but indirectly by conditions on soil movement
NUTRIENT STATUS AND CHEMICAL CHARACTERISTICS: Content of main plant nutrients (N,P,K,Ca,Mg), acidity (pH), and micro-nutrients (eg Mn, Cu, Mo, Fe).	Soluble compounds leached during storage of soils, and pH may be lowered. Anaerobism in wet/compacted soils. Possibility of contamination.	Addition of lime and fertilisers, as indicated by standard analysis, on replacement of soils and during aftercare period. Occasionally may need fertiliser and lime added to soil stockpiles. For forestry, foliar analysis may determine nutrient requirements during aftercare

Wherever possible soils should be moved directly from areas being stripped to areas being restored, as storage necessitates double handling and increases the opportunities for soil losses. Progressive reclamation reduces the need for soil storage, but this may still be required for part of a site.

Current evidence suggests that while some deterioration to soil quality can occur during storage, such changes tend to be fairly rapidly reversed following restoration, although microbial biomass and activity as well as structural stability may take longer to recover.

Planning conditions will need to define the location, height and shape of storage heaps and in many cases provide for their management, such as by seeding and weed control.

Soil stores should not be sited in locations which lie wet or are liable to flooding, or where soil mixing, loss or damage by trafficking is likely to occur. When planning the siting of storage mounds consideration should also be given to landscaping and noise attenuation requirements.

Whilst it is generally accepted that low soil storage heaps are preferable in order to minimise deterioration of soils in the inner parts of heaps, there are no universally applicable maximum height limits. However it is recommended that soil heaps should be restricted to the minimum height practicable, compatible with the amount of soil storage space available on site.

DEFRA have published a "Code of good agricultural practice for the protection of soil" which provides practical guidance to farmers on the avoidance of long-term damage to soil. This includes advice on the handling and management of soil during and after mineral extraction. While being primarily aimed at land for agriculture, the guidance also has wider relevance for the management of damaged soils used for other purposes.

Conditions should be used to control the routeing of vehicles to avoid unnecessary trafficking over unstripped or restored soils, or over soil storage heaps. Recently respread soils are particularly vulnerable to damage. Criteria for the control of soil movement need to be determined for each site individually since soil and site characteristics vary.

B5. Soils - Restoration Requirements

Restoration refers to the replacement following mineral extraction of any or all of the following, subsoil, topsoil and soil making material. Restoration conditions can require the placement of soil in the appropriate order, and to appropriate depths. They can also require mechanical subsoiling of the restored soil layers to relieve compaction and remove stones. It is generally appropriate to require subsoiling of the uppermost layers of overburden before placing subsoils. Where soils are not placed by loose tipping using dump trucks, it is often appropriate to replace subsoils in layers, with subsoiling of successive layers prior to placing the topsoil. All soil movements and treatments must be undertaken when the soil moisture conditions are suitable and having regard to the effective depth of subsoiling equipment. The guidance in Table 1 (soil characteristics and effects of disturbance) is also applicable when considering suitable restoration conditions.

The use of available soil resources should be planned so as to match soil quality and depth with the requirements of the proposed after-use(s) and target reclamation standard. This may be particularly appropriate where the reclamation scheme includes a number of after-uses.

Many older mineral workings and some more modern sites have limited quantities of soil available for restoration purposes. It is often inappropriate to import large volumes of soil, because of the high cost, and the variable and often poor quality of available materials. The use of on-site quarry and other waste materials as soil making material is already widely used by some sectors of the minerals industry and those involved in derelict land and landfill restoration.

Soil wetness caused by inadequate drainage is one of the most common limitations to the achievement of high standards of reclamation. There are a number of causes of excessive wetness including:

i poor infiltration leading to surface ponding and run-off;

ii compacted and slowly permeable horizons within the restored soil profile impeding the downward movement of surplus water;

iii a slowly permeable substrate below the soil profile;

iv a high water table.

Site drainage can usually be achieved by a combination of topography, permeable soils, and where necessary, the installation of underdrainage.

Compaction within the soil profile occurs most often when machinery is allowed to pass over the restored soil. Relief of compaction in the deeper soils usually requires loosening either by subsoiling or ripping during the restoration stage, with in some cases, repeated treatments during and possibly beyond the aftercare period. Sequential ripping and replacement of shallow layers of soil can enhance the effectiveness of profile loosening. For agricultural after-uses, it is usually necessary to install an underdrainage system as part of the after-care requirements (see B5). Compaction of the surface may be required however, for specific uses, such as built development of some forms of habitat creation. This should be carefully planned and not result from poor practice.

Ripping is most effective on soils which are dry enough to shatter readily. However some soils may remain too wet over most of the year to be effectively ripped.

Soils replaced over impermeable substrates rely on the lateral movement of water either across the soil surface as run-off or through the soil profile. This is greatly assisted by a sloping topography, and a loose and permeable soil. Where soils are directly replaced over free-draining substrates, such as the permeable floor of some limestone or chalk quarries, there is less need for gradients to be created for drainage purposes. However, it is particularly important that soils are placed and maintained in a loose state to allow for downward drainage.

Discharge from on-site drainage can affect downstream watercourses or groundwater. Sites with potential drainage problems should be subject to an investigation to ensure the acceptability of the reclamation proposals. Early consultation with the Environment Agency is recommended.

B6. Aftercare Requirements

The ultimate aim of aftercare treatment is to bring restored land into a condition which does not need to be treated differently from undisturbed land in the same use (see also paragraph 125). The text below provides general guidance on preparing aftercare schemes.

The preparation of an aftercare scheme should begin at least six months prior to commencement of aftercare on all or part of the site with the submission of outline proposals to the MPA. This will allow time for consultations and any necessary amendments to be made before a scheme is agreed.

The preparation of a successful aftercare scheme requires two levels of information from the mineral operator:-

i An outline strategy of commitments for the five year aftercare period.

ii A detailed programme for the forthcoming year.

The outline strategy should broadly outline the steps to be carried out in the aftercare period and their timing within the overall programme. A summary of the main items to be covered within the outline is given in Table 2. It should be submitted to the MPA at least three months prior to the commencement of aftercare.

A map should accompany the outline, identifying clearly all areas subject to aftercare management, with separate demarcation of areas according to differences in the year of aftercare and proposed management. Where a choice of options is retained this should be made clear together with criteria to be followed in choosing between them.

Table 2. Outline Strategy for an Aftercare Scheme

The outline strategy document should cover as appropriate the aftercare steps detailed below plus any additional aspects that may be required by the mineral planning authority. Person(s) responsible for carrying out these steps ought also to be identified. Aftercare steps to be covered include:-

1. Timing and pattern of vegetation establishment

A brief description of sequence of vegetation establishment over the full aftercare period eg "the land will be put down to grass. Initially with a short term ley which will be ploughed up and reseeded after 2 to 3 years and replaced within a long ley mixture," or "Trees will be planted in years x and y according to plan X". Details of species composition, stock type and size, spacing, method, timing and position of planting. For nature conservation, proposed method of vegetation establishment (natural colonisation, turf transplants, seeding etc). A ground plan showing where different species are to be planted is helpful. Where a range of options are to be retained this should be made clear.

2. Cultivation Practices

An outline of the range of cultivations likely to be undertaken. This is necessary since on some sites certain practices can be determined to soil structure. Adoption of non-specified techniques will be permissible at a subsequent date subject to mineral planning authority approval where these are unlikely to prove harmful. The need for flexibility is recognised in view of changes over time in the design and availability of machinery.

3. Secondary Treatments

Commitments to undertake secondary treatments such as moling, subsoiling (and in some instances, for woodland establishment, discing to form low planting ridges), and stonepicking need to be outlined. Since the efficacy and need for such treatments is dependent upon soil conditions all that is required is a general statement of intent accompanied by criteria for determining the need for such treatments. For example "During cultivations any stones lying on the surface which are larger than would pass through a wire screen mesh spacing of xxx mm, together with other objects likely to obstruct future cultivation, will be removed from the site."

4. Drainage

This should cover any commitments in principle to undertake under-drainage; consultations with the mineral planning authority in advance of installation to agree scheme design; timing of installation work within the aftercare programme plus commitments to carry out any necessary maintenance works or temporary drainage measures.

5. Management of soil fertility, weeds etc.

To cover measures for improving soil fertility and control of weeds. The basis for determining need and application rates should be outlined (eg soil sampling and analysis); appearance of health of vegetation in amenity schemes. Methods of maintenance of required soil fertility (fertilisers, use of legumes, organic manures, sewage sludge etc).

6 Irrigation and watering

This is likely to be a component in a minority of aftercare schemes only. Where it is proposed information should be provided to cover equipment specifications, siting of installations, and criteria for determining irrigation rates. (It should be made clear that all necessary consents for abstraction etc must be obtained in advance.) Where investment in equipment is intended, early discussion will enable applicants to assess whether their plans are compatible with aftercare requirements.

NB Footnote. Fencing, provision of water for livestock and management of water areas are not covered by aftercare conditions since they are not "treatment of the land". Where their provision is essential for satisfactory aftercare management alternative arrangements are needed to cover these aspects. Some aspects can be required as a separate planning condition.

Table 3. Detailed Annual Programme for an Aftercare Scheme

The elements of the scheme requiring consideration should identify the person(s) responsible for the succeeding year's programme unless this is adequately covered in the outline strategy. Detailed prescriptions should then be provided for specific steps where appropriate including:-

1. Vegetation establishment

Details should be provided for the cropping programme/planting schemes on site (see also 6. below). For each field/area information should include details on:

The nature and timing of any cultivations and stone picking operations including approximate depth of activities.

The content and origin of seeds mixtures; proposed seed rates and timing of sowing operations.

Proposed fertilizer and lime application rates based upon the results of soil nutriend analyses.

Details of spraying programmes, both herbicides and fungicides, so far as these are known at the ftercare meeting. Plus commitment to carry out all reasonable spring dressings as the on-going situation demands.

2. Vegetation Management

For grassland, this should cover the anticipated timing and frequency of cutting; grass removal; proposed grazing regime including type, age and numbers of livestock and the extent of the grazing period. For other vegetation types, similar consideration should be given, together with specific requirements for the desired vegetation, including weed control.

3. Secondary Treatments

Specifications should include timing, working depths, tine spacings and the equipment to be used for moling and subsoiling operations.

4. Field Drainage

Details on the timing of underdrainage installation work for the forthcoming year plus scheme details including a map showing pipe layout plus details on installation method; drain spacings; drain depths; pipe size and gradients; nature and depth of permeable fill; putfalls; post installation remedial works.

5. Irrigation/watering

Details of irrigation proposals specific to the forthcoming year.

6. Tree and hedge establishment

This should confirm establishment proposals for the forthcoming year covering ground preparation, planting details (species, type of stock, establishment methods, planting density, timing) and maintenance including, as appropriate, beating up (ie replacement of dead trees); weed control policy; fertiliser application protection from gracing animals and cutting/pruning.

Commitments to provide the MPA with additional plans, specifications, site records or analyses for approval at specified intervals ought also to be covered. Normally such information is required one month in advance of agreed consultations.

The detailed programme should cover requirements for the forthcoming year, including those identified in Table 3. It should:-

i Amplify the outline strategy for work to be carried out in the forthcoming year.

ii Confirm that steps already specified in detail in the outline strategy will be carried out as originally intended.

iii Include any modifications to original proposals, eg due to differences between actual and anticipated site conditions.

The first detailed programme should be submitted with the outline strategy. Subsequent detailed programmes should be submitted annually to the mineral planning authority for approval not later than one month prior to the annual aftercare site meeting, at which they will need to be discussed and agreed.

These schemes need to be discussed and agreed by the mineral planning authority, the person(s) responsible for the conduct of the aftercare programme and any expert advisors. In the majority of cases, the operator, tenant or landowner has a vested interest in the success of aftercare as the greater costs have already been incurred in complying with restoration conditions. Where expensive equipment is to be purchased for aftercare purposes, early consultation is particularly advantageous to ensure that proposed purchases are compatible with aftercare requirements.

The MPA will need to bear in mind that no two aftercare programmes will be exactly the same and that the way in which any individual scheme is implemented will depend on a number of factors such as weather conditions, the quality of materials used and the condition of the individual site.

Achievement of satisfactory soil drainage is essential if high standards of reclamation are to be achieved since excessive wetness affects seed germination, root development and the range of plants, including agricultural crops, that can be grown. Of particular relevance to restored land, inadequate drainage increases a soil's susceptibility to structural damage and reduces the effectiveness of remedial aftercare treatments. It also reduces the number of days when land is suitable for cultivation, passage of machinery, grazing by livestock or use for some intensive amenity purposes.

In lowland situations, it is common for underdrainage to be required where it did not previously exist and such instances occur where:

i permeable sandy materials are removed and the depth is significantly reduced between topsoil and underlying impermeable layers eg clay subsoils, underlying basal clays or a landfill cap;

ii soil handling operations significantly damage soil structure so reducing the permeability of subsoils;

iii removal of material introduces the need for groundwater control

It must be accepted, however, that underdrainage installed at the outset may be affected by subsequent ground settlement and thus, may need to be repaired or replaced.

Adequate fertiliser should be used on restored land and additional nitrogen, especially following soil storage, is often appropriate. Fertiliser and liming recommendations for agricultural restoration are usually based on DEFRA indices derived from standard soil analyses. These are given in DEFRA Reference Book 209 (7th Edition 2000) "Fertiliser Recommendations".

Weed infestation can cause crop failure on land being reclaimed to agriculture. Thus weed control by appropriate application of herbicides or, in grass, by cutting or grazing will be a necessary part of the aftercare programme. Arable crops may require regular weed control throughout the growing season as well as other sprays against diseases and other pests. Specialist advice is needed to choose which herbicides, fungicides and pesticides to use and when and how to apply them.

Uncontrolled grazing by animals such as sheep and rabbits can seriously affect the quality of reclamation. Excessive grazing pressure can expose the soil surface and result in erosion, while excessive trampling of fragile soils can result in poaching, loss of soil structure and erosion. In contrast, grazing at low intensity can be an important management tool, as it can encourage the establishment of wildflowers, and for agricultural land, it can contribute to the build up of soil nitrogen and promote soil structural development.

Livestock should therefore be carefully managed on reclaimed land. In the early years following restoration, possibly extending beyond the aftercare period, the land may be unable to support as many animals per hectare as undisturbed land. It will normally be necessary to exclude livestock altogether during winter months and at other times if soils become wet.

B7. Reclamation of sand and gravel workings

Much of the sand and gravel resource in Wales is overlain by relatively thick and high quality soils, which enables high standards of reclamation to a range of after-users to be achieved. Where sites overlie the best and most versatile agricultural land, it is usual for them to be reclaimed to agriculture. Reclamation to the original agricultural quality should be achievable provided appropriate techniques are used throughout the life of the site. The most common limitation to agricultural land is identified to be droughtiness due predominantly to the coarse textured soils commonly overlying sand deposits, and compaction within the restored profile. Droughtiness can be minimised to some extent by ensuring soils are well managed so as to maintain and promote a good soil structure and water holding capacity, and by ensuring that soil depths are adequate to store sufficient moisture for use by plants during dry periods. At some sites very stony soils can also be a limiting factor.

B8. Reclamation of hard rock quarries

These include igneous rock, limestone/dolomite and sandstone quarries. The size of many of these quarries and the timescale over which they are worked can present difficulties for effective reclamation. This is often compounded by limited availability of fill material and/or a shortage of soil; physical constraints include the level of the water table; the amount of and access to, level floor areas in dry quarries; and sidewall stability.

While the final site reclamation and possible after-uses should be considered at the time of the planning application and appropriate provision included in the conditions, it is likely that most schemes will require updating and amendment during the life of the working. Planning permissions may allow for this by requiring a general treatment scheme to be prepared before extraction starts, to be followed up by submission of detailed schemes for particular phases as they are completed; and by setting a timescale for submission of the final reclamation plan which is commensurate with the duration of the mineral planning permission. For long-life quarries, wherever the upper faces will be visible for many years prior to completion of mineral working, it will be useful to consider, where appropriate, a condition requiring progressive reclamation of finished upper faces and benches.

B9. Tailings Lagoons

The fine particle residues from the processing of sand and gravel or hard rock are normally disposed of as high moisture slurries into tailings lagoons. The reclamation of tailings lagoons may present major engineering problems and affect the choice of after use.

The reclamation of tailings lagoons usually involves the planting of vegetation for agriculture or other use. The time period required before such planting can take place will depend on the time required for dewatering and stabilisation of the deposited material. It may be appropriate to remove the deposited material and replace with material more suited to the choice and standard of after use.

ANNEX C

SOILS

C1. The soil resource

Existing soil materials are an important resource in the reclamation of sites with permission to extract aggregates, and every effort should be made to identify soil types and their quantity before soil stripping operations commence. A soil survey by suitably qualified personnel is usually necessary. Information should be obtained on the location of soil types, their extent, and the thickness of topsoil and subsoil layers. Sites vary considerably in the types of soils available, and some will lack sufficient soil for reclamation to a soft end-use to be sustainable in the long term. It is therefore important to obtain information on type and quantity of any soil-forming materials beneath the soil that might supplement the soil upon reclamation. Guidance on methods for assessing the suitability of soil-forming materials has been published in the Department of the Environment, Transport and the Regions 'Soil-forming materials: their use in land reclamation' (DETR, 1999).

C2. Soil stripping

Soil stripping operations must be undertaken only when physical conditions minimise the likelihood of damage. Soil strength is greatest when soil materials are very dry, and compaction is caused when handling during wet conditions. Soil stripping should never been undertaken between October and the end of April, unless weather conditions are exceptional in promoting soil drying. In addition, stripping operations should cease when the soil becomes wet during normal rainfall events and should not recommence until it has dried sufficiently. In general, the summer months of July, August and September are most suitable for soil stripping. Consideration should be given to draining permanently wet sites in advance of stripping operations. This might entail drainage operations at least a year beforehand.

Apart from tree felling, works to enclose the site and essential drainage works, no other operations should normally take place until topsoil, subsoil and soil-forming materials have been fully removed over the area or agreed phase. On areas previously covered by trees, stumps and roots should be pulled out and shaken to separate them from soil materials. The stumps, roots and brash must be disposed of in accordance with plans agreed by the Mineral Planning Authority.

Soil stripping operations should be carefully planned and closely supervised. As a general principle, no traffic should be allowed on unstripped soil except that necessary to perform the operation. Effort should be made to demarcate areas set aside for stripping with appropriate signs and/or fencing to prevent wanton access

Where native soils are present with little disturbance to them, it is important to strip and store topsoils and subsoils separately from one another. Where contrasting soils are present on site, these should also be stored separately.

The excavator and dump truck method for soil stripping is considered optimal for reducing the risk of soil compaction. A 360° excavator is used to strip soil materials, and dump trucks used for transporting them to store or use for restoring other parts of the site. A strip system should be set up, to enable effective synchronising of operation between the plant used. Plans of the method of working should be drawn up, with written systems of work or method statements to reinforce the procedure. The width of the strip should usually be between 3 to 6 m wide, and is determined by the length of the excavator boom less the stand off to operate. The excavator should stand on ground from which the full soil thickness (including soil-forming material as necessary) has previously been stripped. Dump trucks should only travel over areas of ground that have previously been stripped. A grading bucket should be used to strip soils in order to enable each soil horizon to be removed cleanly.

Soil will vary in composition across any site in ways that a normal soil survey will not identify. It is important that the contractor employed to strip the soil materials is trained to recognise the various types of soil horizon likely to be encountered during stripping operations. This will permit some flexibility in the operation so that local changes in horizon thickness can be accommodated. Contamination of topsoil with subsoil, and subsoil with soil-forming material, should be avoided as much as possible.

Further details of soil stripping operations are given in 'Good Practice Guide for Handling Soils, Sheet 1: Soil stripping with excavators and dump trucks' (MAFF, 2000).

C3. Soil Storage

Storage of soil in mound or heaps will inevitably cause soil degradation, physically, chemically and biologically. Whenever possible, site organisation should be such that soil materials stripped in advance of mineral extraction in one phase of the site are used immediately in the restoration of an earlier phase of activity. Thus, soils are moved directly from undisturbed parts of the site and placed, by loose tipping (see below) on overburden at final restoration contour.

Inevitably, however, there will be a need for some, preferably limited, storage of soils. It is important that topsoil, subsoil and soil-forming materials are stored separately from one another, and that the risk of cross contamination is minimised. Stores should be located carefully on the site so that there is no risk of excessive handling, or of loss of soil by slippage or erosion into the void. Cut-off drains should be installed upslope of storage mounds if there is a risk of flooding. Soil materials should be stripped from areas designated for soil storage so that soils are tipped directly on overburden materials.

Where a site is to be restored to a mixed land use (e.g. agriculture and forestry), it is important to choose the most suitable soil materials for each type of use. For example, acidic soils are usually best suited to forestry and least suitable for agriculture. The location of soil stores designated for a particular land-use should take into account where in the restored site such land-uses are situated.

It is important that damage to soil is minimised during soil mound construction and in the removal of soil from store. Stores should not normally exceed 4 m in height. Mounds should be constructed by a combination of end tipping from dump trucks, preferably followed by 'haymaking' using an excavator standing on the overburden. Bulldozers are also used for mound formation, though they can compact soil in moving it into position. No plant or equipment should be permitted to travel over or stand upon the soil during mound construction.

Soil mounds should have side slopes of about 25° from the horizontal. The top of the mound should be domed, or slope so that rainwater is shed. Hollows should be avoided as these will fill with water after rain. Light grading of the mound side slopes is permitted in order to reduce water penetration into the soil. Attention to mound contours should take place on a daily basis. Mound formation should cease in wet conditions.

On complex sites, there may be a need to construct several mounds of a particular type of soil (e.g. topsoil, subsoil). Unless particular types are designed for use for particular end-uses (e.g. agriculture or forestry), the removal of soil materials from store for restoration should aim to minimise the length of time such materials remain in store.

Mounds should be seeded to grass as soon as possible after construction with a low maintenance grass mixture appropriate to the types of soil stored. Mounds should not be trafficked by machinery during grass sowing or subsequent maintenance except during that operation. Most mounds will not require the addition of fertiliser, but some soil-forming materials may benefit from a light application of a nitrogen fertiliser to promote grass establishment. Broadleaved weeds should be controlled by cutting or herbicide use.

Soils should be loaded from storage mounds using a 360° long carriage excavator. It is inevitable that this may need to sit on the mound in order to load trucks, but trafficking should be limited to the minimum necessary to gain access. On no account should dump trucks travel over any mound (including those of soil-forming material) during this phase of working. Soil compaction caused during mound formation can be partially relieved if care is taken in moving soil from store to truck. Using a toothed digging bucket, thin layers of soil can be stripped and massive soil structure can be broken up. The bucket is filled by a raking action, drawing in the fully extended arm of the excavator whilst the teeth are inserted into the surface of the soil. This action is repeated until the soil is fully loosened when it can be loaded carefully into the truck. Trucks should not be overloaded, as this will encourage compaction and run the risk of spillage. Soil loading should only take place when the soil is in a dry state, and in dry weather conditions.

C4. Soil replacement

Reinstatement of soil materials has been recognised as one of the most crucial operations in restoration. Poor practice at this stage can cause irreparable damage especially compaction, and consequently greater risk of vegetation failure and soil erosion.

There is currently much discussion about methods of handling soil materials for replacement during restoration. Two methods are commonplace in the UK: (i) motor-scrapers, and (ii) the 'loose tipping' method using truck and shovel. In the latter, dump trucks are used to transport and drop soil materials, and a tracked hydraulic 360º excavator is used to spread them. The excavator stands on the overburden, and the re-laid soil is not traversed by earth moving machinery. Considerable research for DETR, MAFF and the Forestry Commission since the 1980's has shown the value of the latter approach over the former (e.g. Land Research Associates, 1997, 2000; Moffat and Bending, 2000). Advantages of loose tipping include:

- a constructive reclamation ethos is encouraged. There is no need to undo damage caused by trafficking (c.f. compaction caused by motor-scrapers
- a more open, less dense soil structure is formed. Resistance to penetration by roots of vegetation is low
- infiltration is encouraged, reducing the risk of water erosion
- a loose profile of any desirable thickness can be constructed in a one-pass operation
- profiles containing two layers can be constructed e.g. soil over soil-forming materials, without compacting the lower layer
- there is no need for ripping or decompacting operations
- there are greater opportunities for operations under wet weather, compared to spreading using motor-scrapers. Time between the end of restoration and the beginning of aftercare (planting) can be saved
- the operation is easier to monitor and supervise
- there is greater opportunity to remove stone and obstructions
- there is more opportunity to incorporate inorganic or organic amendments
- improved vegetation establishment reduces costs of repair, replacement and maintenance. In tree planting schemes, reduced beating up leads to a shorter period when weed control is necessary.

Loose tipping is recommended where woodland or forestry is the proposed after-use. As with soil stripping, a detailed plan and method statement should be prepared in order to ensure smooth working and co-ordination between excavator and dump truck. The method entails working to a strip system, and replacing soils sequentially across the site (see Figure 1). In each strip soil materials are replaced to replicate the original soil with soil-forming materials and subsoil followed by topsoil materials. Only when the strip has been completed is the next one started.

Dump trucks bring soil materials to the area where they are to be replaced. Soils are dropped from the back of the truck against the strip completed last. The excavator stands on the overburden next to the newly dropped soil and spreads this into a layer. The width of the strip is determined by the excavator arm length and is typically 5-8 m. If there are to be more than one soil layer (i.e. if both topsoil and subsoil are both available for replacement) then the whole length of the strip should be restored with subsoil before the process is repeated with topsoil. If materials are massive in structure, the spreading operation can be used

to break up the blocks, using the excavator bucket to smash or slice them up. Large stones can be removed during the levelling operation and collected on the overburden for later removal, or placed so that they are buried by the next drop of subsoil.

Research has demonstrated that loose tipping can take place in wetter soil conditions than conventional soil replacement using earth-scrapers without harm to soil physical properties. Nevertheless, it is advisable to restrict activities to times when soils are dry and to cease operations during and for some time after rainfall.). It is important to recognise that the benefits of truck and shovel restoration will be lost if dump trucks are permitted to traverse across laid soils as such trafficking will cause soil compaction.

Further information on the loose tipping method is given in 'Good Practice Guide for Handling Soils. Sheet 4: Soil replacement with excavators and dump trucks.'(MAFF, 2000).

C5. Soil cultivation

Traditional methods of relieving soil compaction have involved deep ripping using a tractor to pull tines through the soil. Today, careful soil stripping, storage and replacement by loose tipping methods, if practised effectively, will eliminate the need for this operation. Nevertheless, operational constraints, poor weather conditions and difficult soil materials may mean that some compaction is induced in restored soils. This must be relieved to encourage deep rooting.

There are now two main methods for dealing with compaction, deep ripping and 'complete cultivation'. The latter method emulates loose tipping by using an excavator to loosen the soil. It has been the subject of research by the Forestry Commission (Moffat and Bending, 2000) and found to produce soil physical conditions very similar to that achieved by loose tipping. The two methods will be described below:

(a) Deep ripping

This method involves the use of a crawler tractor (at least 300hp, often equivalent to Caterpillar D6, D8 or D9 depending on tool assemblage used) which is used to pull a tool bar on which a number of tines are mounted. These fracture and lift the soil, de-compacting it. Tines on which 'wings' are welded have been shown to be most effective and it is recommended that these are the only form of tine used to relieve soil compaction unless the soil contains large stones/concrete or artefacts such as wire hawser. Winged tines capable of loosening soil to a depth of 1000 mm have been tested and are suitable for decompacting soil if it is at a suitable moisture content and sufficient power is provided to draw the tines through the soil. However, ripping to 750 mm is more usual, and generally acceptable in Wales. A one pass system is recommended, with tines set behind the tractor tracks and a third midway between them. However, if power is limited a two pass system, using shallow tines to loosen surface layers followed by deeper ripping to decompact the subsoil, can be adopted. Ripping should always take place parallel to slope.

(b) Complete cultivation

Like loose tipping, complete cultivation should be carried out by an excavator working to a strip system. A detailed plan plus method statement should be drawn up and understood by all personnel involved in the operation. The width of the strip is usually between 5 to 6 m, dependent on the arm length of the excavator.

For sites where there is a single soil or soil-forming material layer, the first operation in each strip is to create a void the width of the bucket (usually 1.0 m) and the depth of working across the width of the strip. Soil material from this void is placed on undisturbed ground adjoining the cut. Soil is then excavated from the second cut in increments no greater than 150 mm in thickness to the working depth by successively extending and retrieving the arm of the excavator. The front edge of the bucket should be maintained at an angle of 90º during each pull so that the rounded inner surface of the bucket fractures and crumbles the soil. Compaction at the base of the trench is relieved to a further 150 mm using the teeth on the bucket to scarify the surface. Material from the second cut is then dropped into the void, leaving the bucket at a height of approximately 1000 mm above the ground to facilitate further breakdown of clods and blocks. This procedure is repeated successively across the strip. Material from the first cut should be taken to fill the final cut. The excavator should then be used to level the rough surface of the strip, using the bucket to blade the soil out. Under no circumstances should the excavator travel over newly loosened soil.

Where both topsoil and subsoil have been replaced, the system above must be modified so that two cuts are open simultaneously, one to receive subsoil, the other to receive topsoil.

Both deep ripping and complete cultivation should take place only when the soil is dry (5% below the soil plastic limit is recommended). Operations should not take place if this condition is not met – ripping in unsuitable conditions may induce more damage than it relieves. Rain will normally curtail activities and they should not recommence until soil drying has occurred.

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ANNEX D

PLANTING AND SEEDING

D1. Species choice

The selection of appropriate tree species for planting on reclaimed sites will be dependent on the characteristics of the soil cover placed on the restored surface. Where topsoil or peat are available on sites that are not unduly exposed the presumption should be to plant native broadleaves exclusively preferably of local origin, in order to create woodlands with a natural appearance and ecological integrity. Guidance on the types of semi-natural woodland in Wales is given in Forestry Commission Bulletin 112 'Creating new native woodlands' (Chapter 5). On dry sites mixtures dominated by sessile oak and silver birch will be most appropriate with mixtures dominated by downy birch, common alder and willow sp more suitable on wet sites. Guidance on trees and shrubs native to Wales is given in Forestry Commission Practice Note 8 'Using local stock for planting native trees and shrubs' (Table 1/Figure 1).

A requirement will often exist to return upland sites disturbed by mining to commercial forestry production. In these circumstances Japanese larch, rather than sitka spruce, should be replanted. Planting of the latter should only be considered where substantial quantities of peat and/or topsoils containing more than 20% organic matter are available. Scots pine is a useful alternative in situations where, to meet landscape considerations, an evergreen cover is required. Corsican pine should be substituted in coastal areas.

Many non-native broadleaved tree and shrub species are better able to deal with the comparatively hostile conditions presented by sites restored using soil-forming materials than their native equivalents and this should be recognised in selecting species. It may be necessary to mix non-native broadleaves and conifers with native species in such cases to achieve success. Particular attention should be paid to exposure, droughtiness and soil reaction. Guidance on the general preferences and tolerances of tree and shrub species is given in the Department of the Environment, Transport and the Regions 'Soil –forming materials: their use in land reclamation' (pages 120 –124).

D2. Planting design

The potential of newly planted trees to develop into woodland with a composition consistent with that of native woodland will, depend heavily on design. Predictable differences in growth rates between tree species are often accentuated in planting on restored ground and this can lead to suppression of slower growing species such as oak. Group mixtures are more robust than intimate mixtures and are more visually appealing than the much criticised 'pyjama stripe' line mixtures. Group size and spacing should be calculated to ensure that the opportunity is provided to manage the woodland to a desired character with the phased removal of non-native species and the retention of native species. Single species groups also allow maintenance effort to be targeted towards those species requiring greatest attention. Guidance on types of planting mixture and the most appropriate use of nurse species is given in Forestry Commission Handbook 11 'Creating and managing woodlands around towns' (pages 67-72).

Planting design should be sufficiently flexible to allow individual species to be matched at a local level to site conditions, for example willow to wet flushes. Careful attention should be paid to woodland boundaries alongside footpaths where trees and shrubs producing flowers and fruit such as cherry, rowan and rose should be used. Where a need exists to restrict access into a woodland, consideration should be given to creating thickets of spine bearing trees and shrubs such as thorn and rose in order to avoid long-term dependence on fencing.

D3. Plant protection

In order to achieve satisfactory plant survival and growth rates during the period of establishment, it is essential that trees are not subject to damage by animals. In South Wales browsing by trespassing sheep and horses poses a significant threat to newly planted trees. Protection from domesticated animals is most appropriately provided by the construction of stock proof fences. The perimeter of individual planting areas should be secured and the presumption should be to construct fences alongside road corridors rather than to rely on cattle grids and / or gates. Guidance on fencing materials and construction methods is given in Forestry Commission Bulletin 102 ' Forest fencing' (pages 5-10).

Hares, rabbits and voles may also cause damage and where this hazard is identified protection should be provided either by the construction of hexagonal mesh fencing or by individual protection in the form of shelters and guards. Shelters may provide a number of additional benefits improving survival, increasing early establishment growth rate and providing protection during herbicide application. Further details on the function of shelters is given in Forestry Commission Handbook 7 'Treeshelters' (pages 28-30).

D4. Seed provenance

Provenance most simply refers to the origin of seed or cuttings and native trees and shrubs grown from seed collected locally should be obtained for use in planting schemes. Planting stock grown from local seed will be better adapted to climatic conditions than that derived from seed collected in other geographical regions. While initiatives are underway to improve the availability of commercially grown planting stock produced from Welsh seed, supply at the present time is erratic.

Given the loss of biodiversity resulting from the clearance of woodland in the course of mining, consideration should be given to collecting seed from stands of trees within or adjacent to mining sites. Guidance on seed collecting is given in the Forestry Authority Wales 'Information on seed collection from native trees'. Seed can be stored for several years under controlled conditions allowing propagation to be staggered to meet the demand for planting stock. Specialist nurseries are able to provide a contract growing service but as a lead in time of 3-5 years is required a commitment to this approach is required at a very early stage.

D5. Stock specification

Planting stock with high root to shoot ratios are most appropriate for use on restored sites. Most suitable stock types are generally 2 year old bare rooted transplants 30-45 cm in height and one year old cell grown plants 20-40 cm in height. Whips, feathered and standard trees suffer from poor survival and are

prone to dieback. Bare rooted plants that have been undercut should be favoured as this practice encourages the development of a compact, well-branched and fibrous root system. Alder sp seed should be inoculated in order to encourage nodulation and enhance the ability of trees to fix nitrogen. Rooted cuttings of species such as willow and poplar may be suitable but hard pruning can be required where the previous season's growth has been vigorous.

Particular attention should be paid to the root collar diameter of trees, which should be a minimum of 7 mm for broadleaves and 5 mm for conifers. It should be noted that these diameters are greater than those in the relevant British Standard (BS3936: 1984). Plants should be hardened off outdoors at the supplying nursery for 3 months before use.

The survival of cell grown plants of species such as birch and pine is often greater than that of bare rooted plants and this should be recognised in specifying stock. The use of cell grown plants is advantageous on sites where operational difficulties or weather conditions may prevent planting until late in the season. Guidance on planting stock is given in Forestry Commission Handbook 5 'Urban forestry practice (pages 72-74).

D6. Planting

Restored sites offer exposed conditions that are extremely hostile to newly planted trees and this can be reduced by planting trees at comparatively close spacing. This allows nurse species to provide greater support to more demanding species at an earlier stage. This is instrumental in creating a micro-climate to favour the emergence of these species. The minimum planting density considered should be 2500 per hectare (2.0 m x 2.0 m) for sites restored using soils and this should be increased to between 3086 per hectare (1.8 m x 1.8 m) and 3906 per hectare (1.6 m x 1.6 m) on sites restored using soil-forming materials.

Increasing stocking density promotes greater root exploration within the soil mass and this can help guard against resettlement. It is particularly appropriate in circumstances where organic amendments have been added to soil-forming materials as this enables a greater proportion of the nutrients added to be utilised. It also reduces the time taken for canopy closure and correspondingly the period of time over which trees must be weeded intensively.

Transplanted and cell grown trees and shrubs can be notch planted on well prepared sites. This involves cutting two slots at right angles to form an 'L'. The soil is lifted using the spade in the course of cutting the second slot which creates a void along the first slot. The tree is inserted under the spade into the void and is held upright as the soil falls back when the spade is removed and the tree is firmed up using light pressure applied by the toe. Planting trees into a single slot is not satisfactory as this results in smearing and air pockets remain even after firming up. Poor root to soil contact can result in high failure rates. The excavation of planting pits is not necessary other than to aid the planting of trees which have large root systems such as poplar and willow. Planting pits, should not be used as substitute for ground preparation irrespective of their dimensions. Pits on compact sites are liable to flooding and trees may be at risk from regression once the root system becomes constrained.

A number of poor practices can seriously affect the survival and growth of newly planted trees and the quality of workmanship should be monitored to ensure that roots systems are not wrapped or pruned for ease of planting. The root systems of trees quickly desiccate on exposure to sun or wind and for this reason trees should never be placed on the soil surface before planting.

Trees should be planted whilst dormant and this provides a window of opportunity from the beginning of November until the middle of March, although this can be greatly affected by seasonal variation. Planting should be suspended when soils are frozen, snow covered or waterlogged.

Restored ground should be planted at the first available opportunity in order to take advantage of soil conditions at their most favourable.

D7. Seeding

Direct seeding offers an alternative to the planting of nursery grown trees but its use on reclaimed sites must be very carefully considered. Common problems include the unpredictability of germination, wide spatial variation in seedling density, the impossibility of controlling the proportions of species within the woodland cover and their relationship to one another and high losses due to predation, desiccation and seeding failure. Benefits secured by careful site preparation can be lost with significant settlement of soils and loss of nutrients added from organic amendments taking place before germinating seedlings begin to root extensively.

Direct seeding may present some scope on sites restored for nature conservation particularly as a means of augmenting natural recolonisation. Given the difficulties of successfully establishing a woodland cover within a statutory 5 year aftercare period, consideration should be given to a Section 106 agreement to extend the period of maintenance and monitoring to 10 years. Guidance on direct seeding is given in Forestry Commission Technical Paper 22 'Recycling land for forestry' (pages 26-35).

Grass seeding

Loose tipped soils are less prone to erosion than those that are compact and the establishment of a grass cover simply for this purpose is unnecessary on sites with properly designed, constructed and maintained drainage systems. While soiled areas will naturally re-colonise over a period of 2-3 years, the presence of only a spartan vegetation cover during the first year after planting can greatly enhance survival rates. This benefit is lost if a grass cover is established before planting and weed control is called for prematurely.

Nonetheless grass seeding may be appropriate on sites where the vegetation on soil mounds has not been managed during storage or where nitrogen-rich organic amendments have been applied in the course of ground preparation and there is a threat of annual broadleaved weeds rapidly emerging. A grass cover provides a means of retarding the development of broadleaved weeds which can be difficult and expensive to control using herbicides. In general, the preference should be to use uncompetitive grasses such as fescues and bents. These require little fertiliser input, are not especially palatable and quickly give a naturalistic appearance.

Where a ley cover is required meadow grasses or dwarf ryegrasses should be used as these can be easily sprayed off before planting. Seed mixes containing agricultural varieties of ryegrass should be avoided as these are difficult to eradicate. Legumes including clover and trefoil should not be included in seed mixes as these can grow vigorously on soils where phosphate is applied and proliferate as grasses are weakened by repeated herbicide application. The effects of weed growth on the survival and growth of trees is described in Forestry Commission Handbook 2 'Trees and weeds' (pages 6-24).

D8. Fertiliser and lime application

Soils that have been stored over an extended period are likely to be deficient in nitrogen and possibly phosphorus. Soil-forming materials lacking organic matter have little or no innate ability to retain the nutrients applied by means of inorganic single or compound fertilisers and the frequent and heavy dressing of these is thus considered inappropriate. The addition of organic amendments to soil-forming materials is considered preferable and this should be calibrated to provide sufficient nitrogen and phosphorus to meet the needs of trees throughout the establishment period and possibly beyond, thereby dispensing with the need for top dressing. Deficiencies of potassium, magnesium and iron are rarely encountered on coalfield areas. Guidance on the diagnosis of nutrient deficiencies and fertiliser application is given in Forestry Commission Bulletin 110 'Reclaiming disturbed land for forestry (pages 52-54/Appendix 8).

Fertilisers should only be applied where trees display deficiency symptoms and these should preferably be confirmed by foliar analysis. Fertilisers should be applied at the beginning of a growing season. Slow release inorganic fertilisers and processed biosolid products are the most effective means of applying nutrients on high rainfall, upland areas.

Legumes such as clover, trefoil and lupins planted as ground cover fix insufficient nitrogen to significantly raise soil nitrogen capital and can be difficult to control during the period of establishment. Their use in reclamation to woodland and forestry is no longer advocated.

Liming provides a means of raising soil pH but is effective only if incorporated to the full rooting depth of trees and thoroughly mixed. Benefits are short-lived and pH levels can only be maintained by frequent application, which is impossible on planted sites. The presumption should therefore be to select acid tolerant species on sites where pH levels are between 3.5-5.0. Iron pyrites is likely to be responsible for values below 3.5. This generates sulphuric acid on oxidation, which causes pH to fall dramatically. Iron pyrites is a common constituent of colliery shales but causes problems only where the quantity present exceeds 0.5%.

High levels of magnesium appear to be commonplace on coal sites but their effects on tree growth have not been recognised until comparatively recently. Available magnesium concentrations above 601 mg/l (ADAS index 6) can cause growth disorders in sensitive species, such as Japanese larch, as a result of antagonistic effects and can hinder the uptake of calcium. The visual symptoms may appear similar to that of nitrogen deficiency. The addition of organic matter can offer a valuable buffering capacity.

D9. Weed control

Weed control is essential in order to avoid competition for moisture, light and nutrients between planted trees and shrubs. Grasses and herbaceous plants should be controlled in a 1.0 m diameter circle around individual trees or 1.0 m wide strip along planting rows. Two alternative approaches can be adopted towards this, the first involving the spreading of mulches and the second, the application of herbicides.

Bark mulches have been widely used for high quality landscaping with natural soils but is not generally appropriate for more extensive woodland planting on restored sites. Large volumes are required, the distribution of which upon planted areas can lead to compaction. In addition, weed growth is suppressed for only a comparatively short period. Black polythene or polypropylene products provide an alternative but are not biodegradable, unlike bituminous felt and 'wulch' or wool matting. The latter is preferred as a natural material, is permeable and releases nitrogen and other elements during decomposition. Difficulties can be experienced with adequately securing mulch mats on stony sites and this can provide shelter for voles who may strip unseen bark from trees.

On the majority of sites herbicides will provide the most effective and efficient means of controlling weed growth to aid the establishment of trees and shrubs. However, it is important that all reasonable precautions are taken to safeguard wildlife and the environment during application. This includes avoiding products that are hazardous to bees when weeds are flowering and products in or near water unless the label specifically allows such use. A series of codes of practice have been published as part of the implementation of Part III of the Food and Environment Protection Act 1985. These are intended to help users meet their obligations under the current legislation. Users must obtain and refer to the Code of Practice for the Safe Use of Pesticides for Non-agricultural Purposes.

Herbicide application

Herbicide application will be necessary on most sites in order to ensure the successful establishment of trees and shrubs. Care should always be taken in applications near watercourses. The following steps should be taken to ensure herbicide use is effective:

- apply herbicide at application rates appropriate to the weed vegetation
- time the application of herbicide correctly, paying particular attention to the growth stage of weeds
- assess the weed species composition and select a herbicide, taking full account of this information
- avoid spraying herbicide when rain is a possibility, which may result in repeat application
- avoid spraying chemical in periods of drought when the vegetation is least responsive
- target herbicide after the first or second year to species that will still benefit e.g. oak, ash and pine
- give consideration to close spacing in order to reduce the period over which weed control is required.

Herbicides should always be applied by appropriately trained and experienced personnel in order to avoid the possibility of damage to trees. Overhanging vegetation should be cleared back to avoid chemical dripping onto trees. Application should be suspended in windy periods in order to prevent drift of herbicide. Ultra low volume application may present advantages on exposed upland and coastal sites. Guidance on the use of herbicides to control weed growth amongst trees is given in Forestry Commission Field Book 8 'The use of herbicides in the forest (pages 1-34).

D10. Replacement of failures

The replacement of failures will be required in order to achieve the desired stocking densities. The beat up requirement should be determined at the end of the first and second summers by estimating the number of failures by species in each planting compartment. An attempt should be made to determine the causes of failure and identify any patterns that may emerge e.g. the high mortality of one particular batch of a species. This will provide vital information to determine whether trees should be replaced on a 'like by like' basis or the most successful (and presumably tolerant) species being used exclusively for the purpose.

Replacement plants should be pit planted in order to remove surface crusting and relieve recompaction. The surface vegetation should be cleared to reveal the planting positions. These measures are designed to ensure that replacement plants are readily identified during weeding operations being otherwise easily overlooked.

D11. Monitoring performance

Routine monthly visits are recommended to monitor progress and identify problems at an early stage. Vigilance is required to ensure heavy losses do not arise as a result of the activities of domestic and wild animals. Incursions of the former into planting areas as a result of a damaged fence can prove extremely destructive and several such events can compromise schemes that would otherwise have proved successful. Monitoring is also crucial to ensure herbicide application is appropriately timed, to identify any nutrient deficiencies and to judge the performance of any contractor engaged to carry out works.

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ANNEX E

GLOSSARY

Aftercare	Steps specified in a planning condition or scheme that are to be taken to bring land to the required standard suitable for its subsequent or proposed use; agriculture, forestry or amenity use, including planting, cultivating, fertilising, watering, draining or otherwise treating the land.
After-use	The ultimate use after mineral working for agriculture, forestry, amenity (including nature conservation), industrial or other development.
Aggregates	Particles of rock or inorganic manufactured material used for construction purposes
Air overpressure	A pressure wave in the atmosphere produced by the detonation of explosives, consisting of both audible (noise) and inaudible (concussion) energy.
AONB	Area of Outstanding Natural Beauty
AWRG	Association of Welsh RIGS Groups
BAA	British Aggregates Association
Benches	Long horizontal steps to which successive quarry faces are taken and along which mineral or overburden material is worked.
Buffer Zone	An area of land separating a mineral site from potentially sensitive land uses such as housing, and which acts as a physical barrier.
Bund	A constructed earth mound or embankment which may be used to screen the interior of a site from the outside, and to store soil and other materials extracted as part of the mining operation
CCW	Countryside Council for Wales
CRFs	Crushed rock fines
dB(A)	Decibels measured on a sound level meter incorporating a frequency weighting (A weighting) which differentiates between sounds of different frequency (pitch) in a similar way to the human ear. Measurements in dB(A) broadly agree with an individual's assessment of loudness. A change of 3 dB(A) is the minimum perceptible under normal conditions, and a change of 10 dB(A) corresponds roughly to doubling or halving the loudness of a sound.
DTLR/DETR	Department of Transport Local Government and the Regions/Department of Environment Transport and the Regions (now Office of the Deputy Prime Minister in relation to aggregates planning issues)
Dust	Particulate matter capable of becoming airborne to disperse in the atmosphere prior to returning to the surface, in the size range of 1-75 microns.
FBA	Furnace Bottom Ash – the coarser fraction of the waste recovered from coal burning power stations

Fine aggregate	Graded material. For road making material the size is less than 3mm in diameter. For concrete aggregate the size range is less than 5mm in diameter.
Fly-rock	The projection of material from a blast site to any area beyond the designated danger zone.
Ground Vibration	Stress waves generated within the ground by the detonation of explosive charges.
Karst	used to refer to a limestone region characterised by underground drainage channels including swallow holes, caves and springs
$L_{Aeq,T}$	The equivalent continuous sound level – the sound level of a notionally steady sound having the same energy as a fluctuating sound over a specified measuring period (T). Used to describe many types of noise, and can be measured directly with an integrating sound level meter.
MPA	Mineral Planning Authority
MPPW	Minerals Planning Policy Wales (2000) National Assembly for Wales
NCG	National Co-ordinating Group (of RAWPs in England and Wales)
Overburden	Material laying between soil layers and above mineral reserves
Peak particle velocity	A measure of ground vibration magnitude which is th maximum rate of change of ground displacement with time, usually measured in millimetres/second.
PFA	Pulverised Fuel Ash – the resultant ash carried out of a furnace by waste gases following combustion of pulverised coal in coal fired power stations
PPC	Pollution Prevention Control (IPPC - Integrated Pollution Prevention Control)
QPA	Quarry Products Association
Reclamation	All operations that are necessary to return the land to an acceptable environmental condition for the resumption of the former land use or for a new use. These operations can take place during mineral extraction, including soil stripping and storage, and after extraction, including filling and contouring, or the formation of water areas. It includes both restoration and aftercare.
RAWPs	Regional Aggregates Working Parties
RIGS	Regionally Important Geological and Geomorphological Sites
SAC	Special Area of Conservation
SPA	Special Protection Area
SSSI	Site of Special Scientific Interest
Stockpile	A pile of mineral product used to store the material prior to further processing or sale.
UDP	Unitary Development Plan