

## MARINE AND LAND SAND AND GRAVEL: STEPS TOWARDS A COMPARATIVE ASSESSMENT OF IMPACTS

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### ABSTRACT

Most sand and gravel used as construction aggregates in the UK comes from the land but marine sand and gravel dredging is an important regional source of supply. Environmental assessments are undertaken for planning applications on land and dredging licence applications at sea to minimise, and where possible to mitigate the environmental impacts of operations. However, in overall policy terms there has been no coherent approach to assessing the relative costs and benefits of exploiting these two sources. Therefore, a feasibility study has been undertaken in respect of sand and gravel extraction in England and English waters to:

- evaluate methods and tools;
- evaluate data sources;
- review decision making processes;
- as far as possible, to undertake a preliminary assessment of relative costs and benefits; and
- make recommendations for the design of a full assessment.

This is not an easy task because equivalent quantitative data for the land and marine sectors are limited and are often not collected or collated at the right level of detail. Also, many impacts can only be assessed subjectively, which is difficult when dealing with radically different operations and environments. In order to proceed from a feasibility study to a full national assessment it will be necessary to reconsider which data are collected and how these are collated and presented. However, in the shorter term, it would be appropriate to undertake a regional or sub-regional assessment based on data from a representative sample of sites.

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### INTRODUCTION

A steady and adequate supply of aggregates is essential for construction and the economy. In England, the main sources of supply are crushed rock, land won sand and gravel, and recycled and secondary materials. However significant quantities of marine sand and gravel are dredged both for home and mainland European markets. Although modest in national terms, marine supplies are of regional significance especially to the South East, East and London. Extraction of aggregates from the land is largely administered through the Town and Country Planning system which requires sustainability appraisal of relevant planning documents. There has been no marine planning policy system comparable to that on land to form a framework for aggregates development. However steps are likely to be taken, following on from the Marine Bill, to institute such a system. It is likely, therefore, that a key issue will concern the proportions of sand and gravel that should

come from environmentally acceptable sites on land and from those under the sea. That leads to the question “How might we assess the appropriate levels, in environmental terms, of supply of sand and gravel from the land and from the sea?” that needs to be addressed through a formal and widely accepted approach to comparative assessment

Marine and land sand and gravel can be substituted for one another to a large extent. They have significantly varying impacts on the environment. Adverse impacts are minimised and mitigated through the decision-making processes and policies and by using sound operational practices, but inevitably some impacts remain. The current approach does not take account, however, of the relative scale of these residual impacts to determine, to the extent there is a choice, what the most sustainable balance between the two sources might be. As a first step

there is a need for a systematic assessment of these relative impacts to support policy development.

A feasibility study was therefore commissioned within the Centre for Environment, Fisheries and Aquaculture Science's (Cefas) Marine Environment Protection Fund, funded through the Department for Environment, Food and Rural Affairs' (Defra) Aggregates Levy Sustainability Fund. It was undertaken by Resource Decisions in association with eftec between September 2007 and March 2008 to establish whether it is feasible meaningfully to compare the impacts of extraction of sand and gravel from the land and from the sea-bed. The work considered all sand and gravel extracted for use as aggregate from England and English waters, whether used in England or elsewhere, but did not include material used for beach recharge.

## OBJECTIVES

The main objectives of the study were, in brief:

- a) to evaluate methods and tools for assessing and weighting economic, social and environmental costs and benefits;
- b) to evaluate currently available sources of data in terms of relevance and quality;
- c) to review the current processes for making decisions on permitting applications for extraction and the extent to which environmental, social and economic parameters are taken into account;
- d) to discuss these matters with key stakeholders and to maintain a strong dialogue with the aggregates industry;
- e) to undertake a preliminary sustainability assessment to establish whether useful results are likely to come from a full study; and
- f) to make recommendations, if appropriate, on how a full study should be undertaken, how additional data should be collected at reasonable cost and effort, and whether further development of methods would be needed.

## APPROACH TAKEN IN THE STUDY

Reviews were undertaken of decision making processes, data sources, impacts; and decision support tools, methods, techniques. These were followed by an illustrative preliminary assessment of costs and benefits and drafting of recommendations for full assessment.

Key organisations were involved in a workshop meeting, undertaken after the review stage and before the attempt at preliminary assessment, which focussed on methods for assessing costs and benefits and availability of data. The organisations were: the Quarry Products Association (QPA); the British Marine Aggregates Producers' Association (BMAPA); The Crown Estate (CE); Department for Communities and Local Government (CLG); Cefas; Defra; English Heritage; and Natural England. The British Aggregates Association and the Planning Officers' Society also received papers. Representatives also commented on the draft interim and draft final reports. Full details of the work are set out in Resource Decisions and eftec (2008).

## DECISION MAKING PROCESSES

The extraction of sand and gravel from the land is administered through Town and Country Planning legislation by minerals planning authorities (MPAs). These prepare minerals or local development documents (MDDs/LDDs) that set out policies for extraction within a framework set by national planning guidance and policies in regional spatial strategies (RSS). Planning applications for extraction that conform to provisions in MDDs and LDDs are more likely to succeed. Draft policy documents are subject to sustainability appraisal (which incorporates the requirements of strategic environmental assessment), and public consultation and examination.

CLG issues guidelines for aggregates provision that include indicative figures for regional supply of sand and gravel from the land over a 16 year period. These are apportioned by MPA's as a basis for allocations made in planning documents. The preparation of these guidelines assumes a continued supply from marine sources at approximately current levels rather than indicating any likely preferred level of supply. That is because marine sand and gravel dredging is administered through quite separate regulations by a Marine Consenting Agency. At present there is no marine planning regime with policy documents comparable to any of those on land. However, that seems likely to change, perhaps at a regional level, following the passage of the current Marine Bill into law. In the meantime, the marine industry has voluntarily prepared or is preparing a number of regional impact assessments of the principal extraction areas that effectively constitute informal strategic environmental assessments.

Most land and marine extraction proposals are subject to environmental impact assessment and consents are issued subject to numerous conditions to control operations, reduce or mitigate impacts, and provide for monitoring of effects. Certain aspects of extraction from the land are also subject to environmental licensing conditions. Both the land and marine sectors are further subject to health and safety requirements. Therefore, many of the impacts of operations are internalised to a greater or lesser extent through the observance and enforcement of conditions as well as through an Aggregates Levy, which was introduced by government to internalise residual impacts, and through additional voluntary measures undertaken by individual site operators. This needs to be recognised when impacts are assessed. However, many of these are essentially site specific.

Any full comparison of land and marine sand and gravel extraction should support the decision frameworks through their various stages but, in particular, should allow assessment at the policy level about the appropriate levels of supply from the two sources. Ideally, the approach should contribute to:

- national, regional and local policies for supply from land and marine sources;
- improved review and revision of aggregates guidelines;
- sustainability appraisal for land based policies (and, subject to the outcome of the Marine Bill, marine spatial planning policies); and

- a context for environmental assessments of both land and marine extraction proposals and their determination.

## **DATA**

Data on aggregate minerals operations both on land and offshore is extensive. The main sources are statistics compiled for the CLG (mainly by the British Geological Survey); sustainability data compiled by the QPA and BMAPA; and the CE. These data are collected and collated, variously to national, regional or sub-regional level, for a number of different purposes. Since, in most cases commercial confidentiality of individual operations must be protected, data are aggregated by area or by type of aggregate in a number of ways. For instance, much of the land-based data is presented for all aggregates rather than separately for sand and gravel. As a result, the rich sources of information are often not compatible in detail for the land and marine sectors making direct comparison difficult. In principle, this barrier could be overcome by collecting and collating data on a more consistent basis but that might cause problems for the organisations undertaking surveys in meeting their own requirements. This placed major limitations on what could be achieved in terms of a preliminary assessment, meaning that the exercise was only useful for illustrating and testing methodological issues rather than providing any conclusions on the comparison itself.

Any full study would need initially to compile and critically evaluate data to a greater degree than has been possible in the present study. However, the indications are that while some data would support a quantitative, and monetised, assessment, many impacts would need, at present, to be dealt with qualitatively. If additional data validation and collection is supported then a more robust basis could be secured and an assessment could rely more heavily on cost-benefit analysis. Since most impacts are site specific, there would be obvious benefits in compiling data for representative samples of land and marine operations and generalising these, rather than working at a national or regional level from already generalised data. This would, however, require much co-operation from the industry and great care to protect commercially sensitive information.

## **IMPACTS**

The term “impacts” is used in this work for both positive and negative impacts, entailing benefits and costs respectively. The environmental, social and economic impacts considered were:

- Payments for factors of production
- Interruptions of rights of way/access
- Effects on amenity
- Provision of recreational opportunities
- Effects on species, habitats, geodiversity
- Effects on historic assets
- Mineral resource potential
- Changes to flood potential
- Effects on water quality

- Effects on substrate
- Production on unsaleable material
- Fuel and energy use and emissions
- Offsetting of greenhouse gas emissions
- Accidents
- Congestion
- Nuisance e.g. noise, dust
- Effects on fisheries
- Effects on sediment circulation

This list is not necessarily exhaustive but sufficient for consideration at a feasibility level. While many of these impacts apply to both land and marine sand and gravel operations, a few are limited to one or the other. For instance: while restoration of land sand and gravel workings has now been developed to high standards, marine sites can only be left currently to be naturally re-colonised; and effects on fisheries and sediment circulation apply only to marine sites.

## **DECISION SUPPORT APPROACHES, METHODS AND TECHNIQUES**

Seven decision support approaches were reviewed:

- safe minimum standards
- assessment of ecosystem services
- environmental and strategic environmental assessment and sustainability appraisal
- cost effectiveness analysis
- lifecycle assessment
- cost-benefit analysis
- multi-criteria assessment

Five supporting techniques were also considered:

- economic valuation
- benefits transfer
- meta-analysis
- deliberative methods
- expert groups

The review concluded that a number of techniques could be adapted and used in combination in this context. Lifecycle analysis is appropriate as a broad framework for identifying in a systematic way the impacts that need to be included in a comparative assessment. The stages considered in this research were:

- Evaluation of resources and reserves
- Extraction including rehabilitation
- Transport to processing
- Processing
- Transport to point of use or to onward distribution

'Impacts' include both the positive and negative effects of aggregates production. To ensure that all the effects on ecosystem services are considered, this might be supplemented by applying an ecosystem services approach which, in this context, would mean identifying which ecosystem services might be affected by aggregates production at each stage in the lifecycle.

Once impacts have been identified they then need to be assessed, ultimately to determine whether supplying aggregates from marine or land sources is more beneficial in a given context. Impacts are easiest to compare where they are expressed in a single unit of comparison. Cost-benefit analysis (CBA) provides the most suitable framework for evaluating all the positive and negative impacts of each supply option in a single unit (i.e. monetary terms) and across different time periods. It derives a 'net present value' or NPV which provides the total benefits now and in the future minus the total costs now and in the future, in today's money and can therefore be used to compare different options directly.

Application of CBA to any environmental decision is normally limited by the availability of the necessary data or valuation estimates, and CBA is therefore usually "constrained CBA". Sensitivity analysis can be used to test whether any conclusions derived from the available estimates are robust or whether the absence of estimates is likely to have a bearing on the conclusions. This is almost certain to be the case in this context, at least in the short to medium term, given lack of data and valuation estimates particularly for the marine environment.

CBA therefore needs to be supplemented by a qualitative approach. Multi-Criteria Analysis (MCA) provides an appropriate framework which can incorporate available quantified and monetised information. MCA ranks options by assigning scores and weights for the criteria that characterise the option and producing an overall assessment. In this case, it is suggested that the judgement of experts should be used to score impacts according to their nature and scale, and that members of the public and local communities should be used to weight impacts according to their perception of the relative importance of impacts.

Some general issues will need to be considered in applying these frameworks and methods such as uncertainty, equity and distributional issues.

## **THE ILLUSTRATIVE PRELIMINARY ASSESSMENT**

Because the available compatible data for the land and marine sectors was limited, it was necessary to use those limited data to illustrate the approach. First, the scope was defined: it was decided through stakeholder discussion that the trial preliminary assessment should consider the relative impacts of all marine and land-based sand and gravel supplied in England. This does not represent a plausible supply scenario because producing all aggregates from land or sea is not a practicable choice. Nevertheless, it was considered appropriate for illustrative purposes.

The next step was to identify which impacts are relevant for comparison. This started with the full set of impacts identified with stakeholders. For the purpose of

the feasibility study a number of simplifying assumptions were then applied in order to be able to identify some key impacts that could then be compared. The assumptions included: that the chain of economic payments resulting from the purchase of materials from either marine or land sources is equivalent in net terms and cancel out; that the environmental costs of depleting the natural resource base are equivalent whether material is sourced from marine or land sources; and, that a number of impacts are low level and unlikely to affect the overall conclusion. Costs and benefits were ranked qualitatively from +3 to -3 and those with a ranking of +1 to -1 were excluded.

This led to a focus on a limited number of impacts:

- rights of way/access
- provision of amenity
- provision of recreational opportunities
- impacts on species / habitats
- effects on water
- effects on soil / substrate
- unsaleable material
- use of fuel / energy
- measures that offset emissions
- nuisance

These were quantified and monetised where possible, although data only permitted monetisation of a few impacts for both land and marine sources preventing any proper comparison. In a full assessment MCA would then be carried out. For illustrative purposes it was possible to assess all the impacts qualitatively on the scale of +3 to -3 to supplement the partial CBA.

Given the present limitations on data, a comprehensive national quantitative assessment is premature but qualitative analysis is possible. A data collection and collation strategy would need to be developed and implemented for several years and more relevant valuation studies would be needed to provide a robust basis for using cost benefit analysis. Also, a much more rigorous analysis would be needed to confirm the inclusion or exclusion of specific impacts from any full assessment. The assumptions made to test the feasibility study approach are not necessarily appropriate in a full assessment and would require more detailed consideration.

Further, a comparison of land and marine supplies, on that basis, would establish relative levels of impacts at a national level, but would not directly inform policy decisions on the appropriate levels of supply from each. It would be necessary to focus on plausible future supply scenarios, but these are best considered at regional or sub-regional level. Thus, any national picture would best be built up from a "bottom-up" assessment rather than a top-down one. This would also take account of the significant variance of impacts at local and site specific level that may otherwise skew any decisions. Therefore recommendations were made for a regional/sub-regional analysis based on detailed consideration of representative samples of sites. A

national picture could be built up either from several regional/sub-regional exercises; and by following a national data improvement initiative.

Whatever the approach, careful design, compilation and evaluation of data, wide involvement of expert and stakeholder groups, and clear discussion, interpretation and presentation would be necessary. Simplifying assumptions should be tested, clearly identified and avoided if in doubt.

## **CONCLUSIONS**

It was concluded that undertaking a national comparative study is not feasible in the short term because an assessment would need to focus on agreed plausible future supply scenarios. Producing all national minerals from one source or the other is not in practice an option, but there are choices to be made about the balance of supply at regional or sub-regional level. Many impacts are location and site specific. Moreover data sets are not sufficiently developed at present to enable this (or any) type of assessment at national level immediately. Any national picture should therefore be built up as a bottom-up assessment rather than a top-down one.

Nevertheless, there is a clear need for evidence on relative impacts to inform rational decisions about how demand for aggregates is met. Therefore it was recommended that, to facilitate comparative assessment in the longer term, comprehensive compatible data should be collected, collated and validated at national level. This will allow for a generalised approach to analysing relative impacts based on extrapolation of information from site-based assessments.

More immediately it was recommended that a regional or sub-regional study should be undertaken using data from representative samples of sites. This would allow a higher proportion of impacts to be monetised and compared using cost-benefit/multi-criteria analysis. Fewer impacts would need to be compared subjectively. However, subjective weightings tested through expert and informed focus groups would still need to be developed in order to establish the significance of specific impacts at each stage of the life cycle.

## **REFERENCES**

Resource Decisions and etfec, 2007. Marine and land sand and gravel: a comparative assessment. Marine Aggregates Levy Sustainability Fund 80pp [www.alsf-mepf.org.uk/projects/2007/0706.aspx](http://www.alsf-mepf.org.uk/projects/2007/0706.aspx)