APPENDIX 1

Public Consultation

Echo Family Announcements

Cork 021-4274455
Limerick 061-414237
email ads@eecho.ie

In Memoriam

Douglas Rice

In loving memory of my brother DOUGLAS (DOUGIE), late of "San Michel", Magazine Road whose fourth anniversary occurs today.
Time goes so quickly
But our pain is always there,
When you left us that August
Our lives have never been the same.
The memories we have of you Dougie
Are forever in our hearts.
Always in our prayers.
(Jim, Susan and Stephanie)

O' Sullivan: Loving memories of our dear sister PEG nee Kenneally also remembering her husband MIAH.
God's greatest gift remembrance.
(Bernie, Patrick, and family and Matt)

Wiseman: In loving memory

In Memoriam

Twohig

10th ANNIVERSARY
Remembering FR. CON, late of Our Lady Crowned Parish who died on 25th August, 1996.
There is no one dead,
while there is someone
left to remember,
And when there is no
one left to remember,
then we will all be
together.
(Always remembered by Our Lady Crowned Parish, Mayfield).

Wiseman (First Anniversary) In loving memory of my aunt PEGGIE, whose anniversary occurs today.
Quietly today your memory
we treasure.
Missing you always,
Forgetting you never.
(Sadly missed by Ann Michael, Jason, Evan, Emma and Matthew)

Wiseman: In loving memory of PEGGIE, late of 4 Upper Dublin Hill whose first anniversary occurs today. RIP.
No special day is needed,
For us to think of you,
You were someone special,
And we thought the world
of you.
Of all the gifts in life,
However great or small,
To have you as my Aunt,
Was the greatest gift of all.
(Always remembered and loved by Patrick and Nicola). Auntie Peggie
You name is often spoken,
We talk about you still.

Birthday Remembrance

Healy

Cherished memories of my beloved wife and mother KATHLEEN, who is 59 today.
No card can we send you
Mam,
For there is no address,
Only a beautiful garden,
Where you have gone to
rest.
So fill her arms with
flowers Lord,
And when you see her
smile,
Tell her that we love her,
And miss her all the
time.
"Happy Birthday Mam"
oxox
(Loved and missed every day from your loving husband, sons, daughters and grandchildren)

Planning Notices

Cork County Council: Full planning permission for development is sought for construction of livestock housing, extension to silage slab, extension to milking parlour and associated works at Lisheen, Ballyhooley, Co. Cork by Mr Sean Leamy. This planning application may be inspected or purchased at the offices of this planning authority and a submission or observation in relation to the application may be made to the authority in writing on payment of the prescribed fee within the period of five weeks beginning on the date of receipt by the authority of this application.

Cork County Council: Full planning permission for development is sought for construction of loose house, dungstead, slatted tank and associated works at Kilshannig Upper, Rathcormac, Co. Cork by Mr Hugo Merry. This planning application may be inspected or purchased at the offices of this planning authority and a submission or observation in relation to the application may be made to the authority in writing on payment of the prescribed fee within the period of five weeks beginning on the date of receipt by the authority of this application.

Cork County Council: Full planning permission for development is sought for construction of livestock

Planning Notices

Cork County Council: Avril Sheehan is applying for full planning permission to construct a dwelling house, a garage for domestic purpose, to install a proprietary treatment unit and to carry out all associated site works at Lissanisky, Ballymurphy, Bandon, Co. Cork. The planning application may be inspected or purchased at the offices of the Planning Authority and a submission or observation in relation to the application may be made to the authority in writing on payment of the prescribed fee within the period of 5 weeks beginning on the date of receipt by the authority of the application

Cork County Council: permission sought to construct a single-storey extension to the rear of existing cottage, plus internal alterations including new window on the side elevation (west) & modification of one existing window on the front elevation (south), detached garage & wastewater treatment plant at Ballynabrannagh, Leamlara for David Murphy. The planning application may be inspected at the offices of the Planning Authority, Cork County Council, County Hall, Cork, during normal opening hours, i.e. 9.00a.m. to 4.00

Public Notices

Roadmac Ltd, Tulligmore, Dripsey, County Cork intends to apply to Cork County Council for Planning Permission for the continued operation of their quarry at Tulligmore. Roadmac Ltd also propose to recover inert construction and demolition waste for use including the restoration of certain areas of the site and to compost green waste (garden, park and landscape) at the quarry. An Environmental Impact Statement (EIS) is being prepared as part of the planning application. Roadmac Ltd invites interested parties to submit written comments on the proposed development for consideration in the EIS. Comments should be sent to O'Callaghan Moran & Associates, Granary House, Rutland Street, Cork to be received by the 08/09/2006.

Planning Notices

Cork County Council: I Sean Burton am applying for planning permission for an extension to an existing hardware retail unit and associated site works at Banteer Road, Kanturk. The Planning Application may be

Public Notices

COMHAIRLE CATHRACH CHORCAÍ
CORK CITY COUNCIL

ADVANCE NOTICE
FLOOD PRECAUTIONS CORK CITY

A natural cycle of unusually High Tides is predicted in September on the following days and times:

Thursday	7th September 2006		18.11 PM
Friday	8th September 2006	06.32 AM	18.55 PM
Saturday	9th September 2006	07.14 AM	19.38 PM
Sunday	10th September 2006	07.57 AM	20.19 PM

The peak tide is predicted for Saturday 9th September, evening.

Adverse weather conditions such as Heavy Rainfall, Southerly Winds, and Low Barometric Pressure, if they occur, increase the predicted tide levels further.

During these tide periods there is a danger of flooding in the City. It is possible that flooding may occur in the low lying areas of the City Centre, including Union Quay, Trinity Bridge, Sawmill Street, Cotter Street, and Steele Lane areas. Precautionary measures should therefore be taken to protect property.

Further information can be obtained from
David Coughlan, Technician,
Drainage Section, City Hall.
021-4924536
david_coughlan@corkcity.ie

Planning Notices

Cork County Council: Adam Dawes applies for permission for a one and a half-storey dwelling, and associated site works at Station Road, Sheen Upper, Blarney. This

Planning Notices

Cork County Council: Peter Murphy is applying for permission for the construction of 2 no. 2 storey dwelling houses and associated site works at White Oaks, Farney

Tullig
Coachford
Co Cork

6th September 2006

Dear sir or madam

I wish to make the following observations in connection with the application by Roadmac Transport Ltd, Tulligmore, Dripsey, Co Cork.

We live in close proximity to the quarry and experience frequent disruption due to noise in particular and also dust during spells of fine weather. It is not unusual for heavy trucks to be coming and going from the site from 5:30am to 9:00pm. We have previously complained to Cork County Council on these matters.

We are very concerned about any proposed extension of activity at this site. We believe that the site has been excavated to such an extent already that the supply of water to our and other homes in the area is threatened. This threat will be greatly exacerbated by a green waste processing facility. This will also increase the volumes of traffic to and from the site in what is still a quiet rural area.

For these reasons we wish to object to the proposed development.

Yours sincerely

Michael & Peg O'Riordan

Tulligmore,
Dripsey,
Co. Cork
5th September 2006
021 7334339

To Whom It May Concern:

We are writing to you as we will be strongly objecting to your plans to turn our area into a dump is it not bad enough to have our home covered in dust and muck every day? We are woken at 6.30am every day with the trucks going in and out of the quarry as our home is directly across from the quarry as you will see when you do your E.I.S. We all have our own private wells and are worried about our water being contaminated. Who is going to monitor this? At the moment nobody is, so why should it be any different in the future? What about rats and disease? What about the devaluation of our homes? Who is going to issue the waste management licence for this?

Jim and Ann O' Brien.

O'Callaghan Moran & Associates,
Granary House,
Rutland Street,
Cork.

04th September 2004

Re: Roadmac Planning Permission @ Tulligmore, Dripsey, Co. Cork.

To Whom It May Concern:

I am writing in reference to the above mentioned and wish to lodge my objection for the Cork County Council to refuse planning permission for the continued operation of their quarry at Tulligmore, who also to propose to recover inert construction & Demolition waste for the use including the restoration of certain areas of the site & to compost green waste at the quarry. I base my objections on the following;

1) What precautions are going to be put in place to the screening of what waste is going to be transported in to the quarry?
2) When the waste is transported in, how is the waste going to be dealt with i.e. tipped in to one of the large excavations and covered?
3) What guarantees do you give me that our well water is not going to contaminated?
4) If planning is granted, it is understandable that the increase of rodents will be a problem. How does Roadmac tend to deal with this?
5) "Construction & Demolition Waste" is very vague. This type of waste can consist of anything including Domestic waste. This goes back to point number one.
6) Winter is here, wind is picking up, and I can only imagine the amount of rubbish that is going to be blown around the roads and countryside.

As you can see from my points, its bad enough having to deal with a quarry but having to think that this will be turned in to a dump if not a super dump.

Finally, what authority is going to carry out inspections if this planning is going to be granted? As I can honestly say that this planning will most definitely **NOT** be strictly adhere to.

I trust you understand my position and my concerns for my family and neighbours. I would suggest you put yourself in our habitat and take serious consideration to your decision.

I await your reply.

Thanking you

Michael & Joan McCarthy.

Michael & Joan McCarthy
Resident of Tulligmore

Granary House
Rutland Street
Cork

Tel. [021] 4321521
Fax. [021] 4321522

environmental management for business

Jim & Ann O'Brien,
Tulligmore,
Dripsey,
Co. Cork.

22nd September 2006

RE: Roadmac Transport Ltd

Dear Sir/Madam,

I refer to your submission relating to the proposal by Roadmac to continue quarrying at its site at Tulligmore and to develop C&D recycling and green waste composting.

Your concerns have been noted and will be addressed in the Environmental Impact Assessment, which is currently being prepared.

Thank you for your submission.

Yours sincerely,

Jim O' Callaghan

0513901/JOC/PS

email. info@ocallaghanmoran.com Website: www.ocallaghanmoran.com

O'Callaghan Moran & Associates. Registration No. 8272844U

Granary House
Rutland Street
Cork

Tel. [021] 4321521
Fax. [021] 4321522

environmental management for business

Michael & Peg O'Riordan,
Tullig,
Coachford,
Co. Cork.

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environmental management for business

Michael & Joan McCarthy,
Tulligmore,
Dripsey,
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Jim O' Callaghan

0513901/JOC/PS

email. info@ocallaghanmoran.com Website: www.ocallaghanmoran.com

O'Callaghan Moran & Associates. Registration No. 8272844U

APPENDIX 2

Planning Permission (Blocking Plant)

LOCAL GOVERNMENT (PLANNING & DEVELOPMENT) ACTS 1963-1983

(1)

To: Readymix (South West) Ltd.,
Knockanemore,
Ovens,
Co. Cork.

Planning
Register No: S/2854/86

Application by Readymix (South West) Ltd.

of Knockanemore, Ovens, Co. Cork.

On: 6.11.1986 as amended on 18.11.198

for PERMISSION/~~APPROVAL~~

for Concrete Block Production Facility

at Tullignore, Dripsey

Further to Notice dated 23 Dec. 1986 the Cork County Council hereby conveys a grant of Permission/~~Approval~~ for the development/~~retention~~ described above ~~xxxxxxxxxxxxxxxxxxxxxxxxxxxxxx~~ subject to the conditions set out in the schedule (if any) attached to the said Notice dated 23 Dec. 1986 of its intention to grant Permission/~~Approval~~.

Signed on behalf of Cork County Council.

S. SHINE

Planning Dept.,
County Hall,
Cork.

Date: 26 JAN 1987

Note for guidance of Developers

A grant of Planning Permission or Approval does not of itself empower a person to carry out a development unless that person is otherwise legally entitled to do so.
Unless otherwise stated or unless it is revoked a Permission is valid for a period of five years.
Approval is valid only for the period of the Outline Permission to which it relates.

4

SCHEDULE

Reference No. in Planning Register 8/2854/86

Referred to in Order No. P.D. 3022/86

Column 1 – Condition	Column 2 – Reason
Provided that:	
(1) Noise levels from the site shall not exceed 45 dBa between the hours of 08.00 and 22.00 Monday to Saturday and shall not exceed 35 dBa at all other times when measured at the site boundary. Measurements shall be carried out in accordance with I.S.O. Recommendation R.1996 "Assessment of Noise with respect to Community Response" and shall be of a minimum duration of 15 minutes.	To protect the amenities of the area.
(2) All waste water arising on the site shall be percolated to groundwater. No waste water shall be permitted to discharge directly to surface waters.	To protect the amenities of the area.
(3) Entrance to the site shall be designed and constructed to the satisfaction of the Council's Engineer.	In the interests of road safety.
(4) Sight distance to be provided to the Council's satisfaction in a Northerly direction.	In the interests of road safety.
(5) The developer shall:	
(a) Notify the Planning Authority in writing of the date of commencement of the development AND	To ensure the carrying out of the development in accordance with the terms and conditions of this Permission.
(b) On completion of the development, certify in writing to the Planning Authority that the development has been completed in accordance with the terms and conditions of this Permission.	

Contd/...

APPENDIX 3

Recycled Aggregates Specification and Standards Reports

C & D Waste Management: Implementation of International Best Practice in Ireland

Brendan O'Neill
Department of the Environment, Heritage and Local Government

Abstract

The Construction and Demolition Waste Stream (CDW) is significant in Ireland and has a considerable resource value. Highly impressive rates of recycling of CDW are being achieved internationally. The Paper examines the potential beneficial uses of specific fractions of CDW in earthworks and unbound pavement layers in road construction in Ireland. It highlights where various measures and instruments are already being applied successfully in other countries in order to secure higher levels of recycling of CDW.

Keywords: construction and demolition waste, recycling, resource efficiency, road design, road construction, secondary aggregates, waste management.

The views and opinions expressed in this paper are those of the author, and do not necessarily represent those of the Department of the Environment, Heritage and Local Government.

Brendan O'Neill qualified as a Civil Engineer in University College Dublin and holds Diplomas from Dublin University in both Highway & Geotechnical Engineering and Environmental Engineering. He is an Environmental Inspector in the Department of the Environment, Heritage and Local Government, where he acts in the capacity of technical advisor and specialises in waste management. He has previously worked as a Civil Engineer in both private consultancy and the local authority service. He possesses extensive experience in the design and construction of major roads schemes.

INTRODUCTION

Prologue

This Paper will concentrate primarily on the potential for the use of suitably-prepared construction and demolition waste derived aggregates (CDW) in road construction, rather than on the detailed particulars of technical issues. It will make reference to, but will not dwell on the engineering activities essential to road construction works such as site investigations, sampling regimes, analytical programmes, experimental roads, physical properties of aggregates etc. Naturally, such rigorous requirements must also be respected when contemplating the use of (CDW) in road construction works, and the importance of these approaches and disciplines will rise proportionately with increasing structural significance of the CDW application in the road pavement.

The Paper will provide a simple exposition of the approach to be taken and the challenges which arise when endeavouring to find appropriate uses for CDW in road works. It will not make reference to detailed material properties and will neither formulate mathematical models nor engage in computer simulations. It will outline, in simple terms, the opportunities for the beneficial use of CDW in earthworks and as unbound[1] pavements in road construction in Ireland and will also highlight the measures and instruments which are applied internationally and are designed to ensure that the potential for use of CDW in road works is realised to the greatest practicable extent.

Introduction

It is recognised that CDW constitutes a highly significant proportion of all wastes arising within the European Union. Accordingly, the Council of Member States asked the European Commission to designate CDW as a priority waste stream. The European Commission set up a Project Group on CDW in 1991. In 1995, the Project Group published a series of Reports [1], making 55 recommendations for action to improve the management of CDW.

Following the issue of the Project Group Report, the European Commission funded a Study by the Symonds Consultancy Group *Construction and Demolition Waste Management Practices and Their Economic Impacts* [2], which was published in 1999. The Study describes the Best Practices of CDW management in the 15 European Union Member States, as well as the economics associated with the re-use and recycling of this type of material. In particular, Chapter 8 of the Symonds Study details the range of measures used within the EU-15 Member State countries to promote the re-use and recycling of CDW and also provides an overview of their effectiveness. The Study is fundamental to this Paper and is available on the Internet at http://www.europa.eu.int/comm/environment/waste.htm.

CDW is a very substantial waste stream in Ireland, with a large weight to volume ratio and possessing a high potential resource recovery value. This fact was recognised in the Waste

[1] Unbound pavement materials do not contain cement or bitumen binder.

Management Policy Statement *Changing Our Ways* [3], which laid down a challenge to the construction industry to devise measures which would ensure 50% recycling of CDW by 2003, increasing to a level of 85% recycling by 2013. The Forum for the Construction Industry promptly established Task Force B4 to investigate and report on the potential for improving the recycling of CDW. The Task Force B4 Report (4) contains no fewer than 66 individual recommendations, which collectively are designed to contribute to the achievement of the Government targets for the recycling of CDW. These recommendations take full account of successful international experience and are entirely consistent with the principles to be outlined in this Paper.

The Environmental Protection Agency representative on Task Force B4 prepared a Working Document [5], which set out the estimated composition of typical CDW in Ireland. These particulars were essentially derived from information contained in Appendix D2 of the 1995 National Waste Database [6]. The major constituent of CDW in Ireland is the category *Soil and Stones*, which is estimated to account for 51.1% of total arisings. *Concrete* accounts for some 37.9% of CDW, while the proportion of *Masonry* in CDW is estimated at 1.5%. *Asphalt* consists of 1.6% of CDW arisings. The remaining 7.9% of CDW arisings relate to materials such as wood, metals and plastic, which are unsuitable for use in either earthworks or as unbound pavement materials in road construction and will be considered no further in this Paper. The subsequent sections of the Paper will focus accordingly on the potential for beneficial use of the principal components arising in CDW in earthworks or as unbound pavement materials in road construction - comprising *Soil and Stones*, *Concrete*, *Masonry* and *Asphalt* - as well as the relevant measures and instruments typically applied in other countries in order to secure improved levels of recycling of these fractions of CDW.

Core CDW relates to the materials obtained when a building or piece of civil engineering infrastructure is demolished – the category does not include road planings, excavated soil, external utility/service connections or surface vegetation. For the purposes of this Paper, core CDW is taken to encompass the categories of both *Concrete* and *Masonry*. The actions taken and pilot projects carried out in some Member States demonstrate that recycling levels in excess of 80% are realistic for core CDW. A summary of the performance of each Member State in relation to the recycling of core CDW is presented in Table 1.

The Transport and Road Research Laboratory Paper LR1132 [7] represented a thorough examination of the practical experience, material research and field analyses that had been gained from previous road construction works. Besides suggesting appropriate calculation methodology for pavement layer thicknesses for the various classes of road and traffic assignments, LR1132 also highlighted the fact that the life of the pavement can be increased significantly if the subgrade and formation can be kept dry. In the context of road construction in the climatic conditions of Northern Europe, the need for the Site Engineer to ensure that there is reliable availability of good quality aggregate needs to be absolutely aware that such a requirement is prerequisite if market share is to be gained.

In addition, the Symonds Study stressed that the use of CDW as a construction material should not be discriminated against purely on account of its origin. Accordingly, Symonds[2] suggests four criteria that inevitably apply when a decision is taken to use CDW in road construction in significant levels:

1. Landfills must be well managed, and fly-tipping of waste must be uncommon and subject to sanctions,
2. The holder of C & D Waste must face a significant financial cost for landfilling of the material, with hazardous or mixed wastes subject to significantly higher costs (to avoid contamination and to discourage mixing),
3. The opportunity must exist for the main bulky and inert fraction of the C & D Waste to be treated (crushed and sorted) prior to re-use and recycling, and
4. There must at least be a tacit acceptance (by users, specifiers and other similarly interested actors) that suitably prepared C & D Waste-derived aggregates may be used to displace primary aggregates. Positive action to draw up technical standards is not essential, but C & D

[2] On page 70 of the Study.

Waste-derived aggregates should not be discriminated against on the basis of their origins alone.

When examining the potential for use of Concrete, Masonry and asphalt CDW as unbound pavement materials in road construction, these criteria will be of paramount importance.

Table 1. Core C & D Waste Arisings and Recycling Rates within the EU-15[3]

Member State	Arisings		Recycling Rate (%)
	Total (Tonnes)	Unit Arisings (kg per capita)	
Germany	59		17
United Kingdom	30		45
France	24		15
Italy	20		9
Spain	13		< 5
Netherlands	11		90
Belgium	7		87
Austria	5		41
Portugal	3		< 5
Denmark	3		81
Greece	2		< 5
Sweden	2		21
Finland	1		45
Ireland	1		< 5
Luxembourg	0		No Details
Combined EU-15	180		28

Following the publication of the Task Force B4 Report, the National Construction and Demolition Council (NCDWC) was established to oversee the implementation of the recommendations. A sub-committee of the key stakeholders within the NCDWC was formed to examine the issues associated with "Markets and Specifications for CDW". An outline of the activities and initial findings of the sub-committee are contained within the first *National Construction and Demolition Waste Council Annual Report*: *2002 – 2003* [8]. The deliberations of the sub-committee have contributed enormously to the development of the approach presented in this Paper on the use of recycled Concrete, Masonry and asphalt planings within the pavement layers in road construction.

[3] Derived from Symonds Report (in association with ARGUS, COWI and PRC Boucentrum), *Construction and Demolition Waste Management Practices and Their Economic Impacts*, Final Report to DG Environment, 1999, Figure 1.1, p. 3.

USE OF SOIL AND STONES AS EARTHWORKS MATERIALS

For the purposes of this Paper, the term “Soil and Stones” will be taken to include the range of natural excavation materials typically encountered in road engineering works and reflecting the conventions for earthworks used in BS 5930 [9]: silt, sand, clay, gravel, cobbles, boulders and rock.

Engineers in Ireland have long recognised the necessity for the balancing of the material quantities of cut and fill in earthworks in significant roads schemes. This approach brings substantial economic benefits. It saves on the need for haulage of surplus excavation materials off-site and reduces the need for the import of expensive aggregates for use as a bulk fill material in road construction. Excavated materials are typically used in the construction of road embankments, subject to minimum suitability criteria such as stability, traffickability and absence of excessive settlement. The engineering properties of the various soils that occur in earthworks throughout the length of the road scheme are characterised precisely prior to construction, through a comprehensive range of field and laboratory tests. Rapid in-situ tests, such as Moisture Condition Value, are developed in the course of the analytical programme and these enable the minimum suitability criteria for reuse of each soil type to be verified quickly in the field during the course of the earthworks operations. Where a large surplus of excavated materials arises on a particular roads scheme, the minimum suitability criteria for reuse are set at an appropriately high level to ensure that only the best material is utilised. Where excavated materials are in short supply, the suitability criteria are set close to the minimum theoretical acceptable values. Where there is a deficit in the available quantities of excavation from cut, the length of large road schemes and the extent of land acquisition necessary often presents opportunities for the use of “borrow-pits” of good quality soil or gravel, which can be readily exploited for reuse as fill material. Thus, for large road schemes, there is very little that can be learned from international experience to improve upon the levels of earthworks reusability. This reflects enormous credit on the vision and commitment of Road Engineers in Ireland at all levels - including policy formulation, design, construction and research.

On smaller-scale road schemes, there is generally a greater reluctance to engage in the reuse of excavated materials. An absence of large strata of high-quality soil may make reuse proposals less attractive and more difficult to control. The smaller scale of operation may result in a less comprehensive analytical programme for the soils, reducing the level of confidence in their characterisation. The volumes of excavation to be removed from site and the quantities of primary aggregates needed to raise the levels of low areas may not result in huge costs, thereby avoiding an imperative to balance cut and fill requirements. In these circumstances, some of the measures and instruments from international practice can serve to increase the attraction of earthworks reuse. A prohibition on the landfill of earthworks would remove a potential outlet for the excavated materials, thereby increasing the appeal of reusability. In addition, a requirement to prepare and implement a Waste Management Plan for a road scheme would immediately bring the issue of excavation surpluses into sharp focus at an early stage of the project and thereby help ensure that every opportunity is taken to engage in the beneficial reuse of this material, although perhaps not within the pavement itself. Furthermore, Task Force B4 also identified the desirability of including a separate section dedicated to a “Specification for Waste Management” within the general specification for the scheme, thereby placing waste management on the very same stringent footing as any other activity that takes place on the site from the perspective of both design and construction.

CONCRETE AND MASONRY

Table 6.1 of the Specification for Road Works [10] provides latitude to designers on the use of materials in road construction works. A wide range of uses are “permitted in principle” for Suitable Graded Crushed Concrete in road construction. These uses include:

1. General Granular Fill, and as
2. Selected Granular Fill:
   - •Below Water,
   - •Starter Layer,
   - •Capping Layer,

•Gabions,
•Reinforced Earth Structures,
•Surround to Corrugated Steel Buried Structures, and
•Fill to Structures.

However, an impetus is needed to progress a potential application from being “permitted in principle” to routine and regular use. Landfill Tax is an important instrument widely used in the EU-15 to promote sources segregation and separate collection of wastes.

Given the availability of CDW arising from demolished or decommissioned structures that previously had to withstand heavy loadings, it is apparent that there may also potential be for the use of suitably-prepared CDW C as sub base material (i.e. the lowest structural layer of the road pavement) in appropriate applications. The most likely applications would be on lightly-trafficked roads. However, it is necessary to conduct research to gain an appreciation of the threshold Annual Average Daily Traffic (AADT) levels that would most likely apply to “minor roads”. There is therefore much to be learned from international experienced in this area, such as the COURAGE (Construction with Unbound Road Aggregates in Europe) and ALT-MAT (ALTernative MATerials in road construction) Projects.

COURAGE Study

The standard thickness of the Unbound Granular Material (UGM) layer in road pavements varies greatly across the European Union Member States, typically ranging between 300 mm and 1500 mm. There is a natural reluctance to use materials in UGMs for which behaviour has not been already been well established through performance testing, experience or field trials.

The COURAGE Research Study [11] was completed in 2000. It represented a comprehensive testing programme which was conducted mainly in the laboratory and evaluated the fundamental characteristics and mechanical properties of Unbound Granular Materials that are used in the sub-base and base course layers of pavement construction.

One of the principal objectives of the COURAGE project was to characterise UGMs more precisely and reliably, thereby increasing the potential opportunities for use as aggregates of materials which are currently discarded - such as industrial residues, ash slag and CDW. COURAGE undertook a range of test procedures, which included the determination of the variability of in-situ pavement conditions in order to assist the development of an analytical framework to characterise performance as a basis for reliable road pavement design computations.

The COURAGE Study recommended that more effort should be concentrated on the determination of the relevant mechanical properties of the compacted aggregate mixture, rather than on the intrinsic properties of the individual material particles, as is the current European practice. The Study generally found that the level of pavement performance declined as the moisture content of the UGM layer increased. Accordingly, the testing programme assessed UGMs at the likely in-situ moisture contents which will pertain during the life of the pavement. Design procedures were developed during the Project to determine appropriate road pavement thicknesses. These procedures must be closely followed, particularly in the case of those pavements possessing a thin surfacing of bound asphaltic concrete material.

One of the UGMs chosen for the COURAGE Study was an alternative material arising from demolition waste, which consisted of a recycled crushed concrete and asphalt planings

(RCC&A). The recycled mix concrete consisted of a coarse aggregate and sand within a fine cement paste. The coarse aggregate was primarily fresh quartzite with very little internal fracture planes. Some tourmaline existed in one coarse aggregate particle, possibly up to 10%. The coarse aggregate was a mixture of sub-angular to well-rounded particles to at least two centimetres diameter. The sand fraction in the aggregate was rounded to sub-angular and consisted of mainly quartz with some traces of carbonates. A reasonable level of porosity, of the order of 5% to 7% was in evidence as rounded bubbles within the fine aggregate matrix. Brick was identified as being red with a fine grained internal structure. Individual brick particles were coarse-grained material and discrete. A number of fracture planes were visible within the separate brick particles. Some organic material was present and may be asphalt. The proportion of the constituent materials was approximately 60% quartz, 35% cement paste and 5% porosity. There appeared to be no mechanical interlocking of the particles and the strength may, thus, be equivalent to the strength of the cement paste.

The RCC&A material was subjected to a wide range of mechanical tests in order to estimate the likely field performance under simulated in-situ pavement conditions. As there was concern that the RCC&A might be of marginal quality for use in the structural layers of road pavement construction, a range of test conditions was concentrated on the more limited practical uses of such a material in the sub-base and base course layers of road pavements. RCC&A was found to be strong in compression and to increase in density with greater fines content, but generally was considered only satisfactory for possible use as a sub-base or as a capping layer material. In overall terms, RCC&A was considered to lie in a category ranging from a C2 (satisfactory quality) to a C3 (Marginal Quality) material. The main reasons for this categorisation is that RCC&A possessed insufficient shear strength at expected in-service conditions and had a high susceptibility to permanent deformation at the mid-range of expected in-service conditions.

ALT-MAT Study

Most countries have already set targets for increasing the amount of recycling of CDW. A Landfill Tax is commonly applied and some countries have also introduced a tax on the extraction of natural aggregates. Nonetheless, the use of alternative materials in road construction is still relatively small throughout the world, but the level is widely expected to increase substantially in the future.

The ALT-MAT Research Study [12] was completed in 2001. The ALT-MAT Project was intended to encourage the wider use of alternative materials in road construction and represented an investigation into the field performance, long term stability and leaching potential of alternative road construction materials. The aim of the Project was to provide information to bridge the gap between laboratory test performances and field behaviour. The objective of ALT-MAT was to define methods by which the suitability of alternative materials for use in road construction can be evaluated. These methods concentrated on Unbound Granular Materials and included mechanical properties, functional requirements, leaching potential and long-term stability of the materials.

Technical specifications for road construction aggregates in most countries apply equally to natural and alternative materials. The alternative materials are generally assessed on the basis of the natural materials they most closely resemble. However, ALT-MAT carried out in-situ test and condition assessments on existing road pavements constructed from alternative materials, whereby trial pits were excavated and the samples were taken for laboratory testing. The Final ALT-MAT Report provided an assessment of the suitability of the materials which were tested. It was established that alternative materials often give better mechanical performance in the field than would be expected on the basis of conventional mechanical tests into their physical properties. In general, inspection and monitoring of existing roads showed that alternative materials gave as good and sometimes better support to the road pavement layers as standard reference natural materials. Leaching tests and groundwater sampling indicated that the alternative materials did not appear to be having any significant effect on groundwater quality. The investigations, therefore, provide confidence in the use of alternative materials in road construction

ALT-MAT also reviewed the range of mitigation measures which can be implemented, in circumstances where tests indicate that there is a possibility of adverse environmental impacts due to the use of CDW in road construction. Source-based mitigation methods include aging of CDW materials, thereby allowing harmful constituents to hydrate and/or carbonate in order to avoid expansive reactions following emplacement in the road pavement. The source-based approach can enable the pH to drop from alkaline levels in freshly produced CDW, to near neutral values once in an aged condition. Pathway-based mitigation methods include covering the road surface with a layer of dense, impermeable asphalt or placing low permeability materials on the slopes above the CDW. The aim of the pathway-based method is to reduce the level of contact between water and the CDW, thereby reducing the leaching of harmful constituents from the material, but such methods need to be combined with an effective drainage system. Stabilisation of CDW through use of bitumen or cement as a binder is also a potential mitigation method, although the cost of this option would generally bring an imperative that the alternative material be used in a higher value application such as road base, for which the CDW material may not be intrinsically suitable.

The existing road pavements in each country investigated in the ALT-MAT Project that had been constructed from alternative materials were chosen on the basis of their availability, past use and potential for increased usage in road construction. For the purposes of the testing programme, the performance of the alternative materials was compared to adjoining control sections of each road which had been constructed from natural materials commonly used in road construction, such as limestone. The following gives a short summary of the investigation carried out in ALT-MAT Project of the particulars of sections of road that had been constructed from CDW.

Denmark

Tests were conducted on a local road with very light traffic in Skibet Vejle, in Jutland, which was opened in 1990. The road pavement consisted of 70 mm of asphaltic concrete surfacing, 200 mm of crushed concrete and 300 mm of unbound sand on a sand subgrade. Natural gravel replaced the crushed concrete in the reference section.

The inspection and testing of the eight-year-old road in Vejle, using crushed concrete as a base course layer, has shown good functional behaviour. The structural condition of the crushed concrete section is superior to the reference section containing natural aggregates. The lime content of the crushed concrete has led to elevated pH and consequently there is greater leaching of Chromium and Lead than in the reference natural material, but the leaching of salts from the crushed concrete is low.

U.K.

Since 1991, a number of housing estate roads were built in North Bracknell, using CDW arising from demolition rubble as a construction material in the capping and sub-base layers of the pavement. The alternative construction chosen for the sub-base was 100 mm of natural sub-base material overlying a thicker layer of CDW. The applicable road design standard was classified as within the category relating to less than 250 commercial vehicles per day. A natural limestone aggregate sub-base was used in the reference section.

Overall, the investigations conducted on the road showed that the use of demolition rubble provided an equally satisfactory sub-base as in the section containing natural limestone aggregate. As the natural limestone aggregate greatly exceeded the minimum specification requirements, it appeared more efficient to reserve the limestone for more demanding structural uses and to utilise the CDW as a sub-base material. It would also not be necessary to subject the CDW to use restrictions, based on the potential of the material to affect water quality.

Sweden

In 1997, a road was constructed in Helsingborg in southern Sweden, using a high-purity crushed concrete derived from demolition works as an alternative sub-base material. The applicable road design standard related to a predicted traffic loading of less than 5.0 X 10^6 Estimated Standard Axles. The thickness of the sub-base layer was 765 mm and the total carriageway width was 9.0 metres, including a 0.75 metre hard shoulder on either side. A crushed rock sub-base was used in the reference section.

The crushed concrete met the conventional standards for use as sub-base material in road construction. The functional performance of the crushed concrete was sufficiently impressive to suggest that there is potential to use the CDW in the base course layer. There is greater leaching of some elements from the crushed concrete (e.g. Chromium) than in the reference natural material.

Conclusions from the COURAGE and ALT-MAT Studies

The COURAGE Study concluded that the application of the unbound CDW manufactured from Recycled Crushed Concrete and Asphalt Planings was likely to be limited to the sub-base layers of the pavement in road construction. The ALT-MAT Study increased the levels of confidence concerning the use of alternative materials in road construction, with the field performance at least matching the results obtained from the use of conventional materials. Alternative materials did not appear to be having a significant effect on groundwater quality and techniques are readily available to mitigate environmental risks associated with the use of such materials.

However, in the final analysis, an economically motivated decision by a contractor to beneficially re-use recycled construction & demolition waste will be dependant upon landfill costs, the purchase costs of natural aggregates, the cost of processing construction & demolition waste and particularly upon the length of the relative haulage distances for the competing natural and recycled aggregates.

European Specifications for Unbound Materials for Use in Pavement Construction

Having established from the COURAGE and ALT-MAT Studies that there is a genuine potential for use of CDW in the sub-base layer of road pavements, it is necessary to identify a specification that can be used to prescribe technical requirements for such materials. European Standard *EN 13285: Unbound Mixtures - Specification* [13] specifies requirements for unbound mixtures that do not contain an added binder and will be operational in Ireland from 1st June 2004. Unbound mixtures are generally specified by designers for pavement bases and sub-bases which are used in the construction and maintenance of roads, airfields and other trafficked areas. EN 13285 would be described as a “framework standard” in waste management parlance, with the specific requirements for material properties of unbound mixtures being defined with appropriate reference to other European Standards, in particular *EN 13242: Aggregates for Unbound and Hydraulically Bound Materials for Use in Civil Engineering Work and Road Construction*.

In addition, testing methods to be applied under the terms of EN 13285 utilise a wide range of European Standards, including:

EN 933-1: tests for Geometrical Properties of Aggregates - Part 1: Determination of Particle Size distribution - Sieving Method.

EN 1744-1: Aggregates for Unbound and Hydraulically Bound Materials for Use in Civil Engineering Work and Road Construction,

EN 13286-1: Unbound and Hydraulically Bound Mixtures - Part 1: Test Methods for Laboratory Dry Density and Water Content - Introduction, General Requirements and Sampling.

EN 13286-2: Unbound and Hydraulically Bound Mixtures - Part 2: Test Methods for Laboratory Dry Density and Water Content - Proctor Compaction.

EN 13286-3: Unbound and Hydraulically Bound Mixtures - Part 3: Test Methods for Laboratory Dry Density and Water Content - Vibrocompression with Controlled Parameters

EN 13286-4: Unbound and Hydraulically Bound Mixtures - Part 4: Test Methods for Laboratory Dry Density and Water Content - Vibrating Hammer.

EN 13286-5: Unbound and Hydraulically Bound Mixtures - Part 5: Test Methods for Laboratory Dry Density and Water Content - Vibrating Table.

EN 13285 applies to unbound mixtures of natural, artificial and recycled aggregates with an upper sieve size (D) ranging from 8 mm to 80 mm and a lower sieve size (d) = 0 at the point of delivery. Accordingly, mixtures with an upper sieve size greater than 80 mm are not covered by EN 13285. Moisture content and the density of the compacted layer are outside the scope of EN 13285. Clause

3.4 of EN 13242 defines a "recycled aggregate" as an "*aggregate resulting from the processing of inorganic matter previously used in construction*."

The need for testing of the properties of unbound mixtures under EN 13285 relates to the particular application, end product use or origin of the material. When a particular test is not required, it is to be specified as a "no requirement". All properties specified for an aggregate to be used in an unbound mixture have to be in accordance with the categories set out in EN 13242. Accordingly, specific requirements for the "shape of the coarse aggregate" have to be expressed in terms of parametric values for "flakiness index" or "shape index" (Clause 4.4 of EN 13242). Similarly, the parameters to be used to specify the other aggregate properties scheduled in Clause 4.2 of EN 13285 must be in accordance with the appropriate categories set out in Clauses 4.5, 4.6, 4.7, 5.2, 5.3, 6 and 7 of EN 13242.

Normative Annex D of EN 13285 specifies a comprehensive "Factory Production Control System" for unbound mixtures, where performance will be assessed by reference to these stated principles, to ensure that they conform to the relevant requirements of the European Standard. The essential elements of the Factory Control Production System, which must include sub-contractors, can be summarised as follows:

- Establishment and Maintenance of Personnel Training Procedures,
- Assignment of Roles, Responsibility, Authority and organisational freedom to personnel to maintain and implement a System of Quality Control,
- Establishment and Maintenance of Procedures for the Control of Non-Conforming Products,
- Monitoring, Auditing and Review arrangements to verify effectiveness of procedures and compliance with Factory Control Production System requirements,
- Establishment and Maintenance of a Production Control Manual and Management System,
- Establishment and Maintenance of Protocols for Material Acceptance, Handling, Storage, Conditioning, Transportation and Identification,
- Establishment and Maintenance of Testing Facilities, Equipment and Competent Personnel to carry out the required tests and inspections at the specified frequencies, and
- Establishment and Maintenance of Record Management System.

In addition, Clause 6 of EN 13285 stipulates that the designation and description of Unbound Mixtures is required to include information on the source of the material - if the mixture has been rehandled in a depot, both source and depot shall be recorded. In addition, the supplier is also required to provide information about the aggregates used in the mixture as described in EN 13242. From the perspective of the suitability of end use of the mixture, the supplier is also required at the time the order is placed, upon request, to provide particulars of the water soluble sulphate content as determined in accordance with the Factory Control Production System.

From the perspective of C & D Waste, Informative Annex A of EN 13285 provides guidance on the description of mixtures containing recycled aggregates. The composition of mixtures containing recycled aggregates should be determined by visual sorting into the following groups:

- Crushed Rock aggregates,
- gravel aggregates,
- concrete and other hydraulically bound mixtures,
- slags (including type if known),
- bricks, masonry and concrete blocks,
- calcium silicate masonry,
- lightweight aggregates,
- crushed or reclaimed asphalt,
- organic contaminants – wood, plastic etc.

Four separate categories of C & D Waste are then classified according to the proportion of these constituents that are present in the mix. These are:

A.1 Crushed Mixed Concrete Aggregates
A.2 Crushed Masonry Aggregates
A.3 Crushed Mixed Aggregates, and
A.4 Crushed Road Pavement Materials.

Particulars of these grading envelopes are shown in the tables below:

A.1: Crushed Mixed Concrete Aggregates		
Components		**Percentage by Mass**
Main	Crushed Concrete (Density > 2.1 Mg/m^3) and Aggregates (Including slag)	≥90
Other Granular	Crushed Masonry	≤10
	Crushed Reclaimed Asphalt	≤5
Contaminants	Cohesive Materials (Including clay)	≤1
	Organic Materials	≤ 0.1

A.2: Crushed Masonry Aggregates		
Components		**Percentage by Mass**
Main	Crushed Masonry (density > 1.6 Mg/m^3) Crushed Concrete (Density > 2.1 Mg/m^3) and Aggregates (Including slag)	≥80
Other Granular	Crushed Masonry	≤20
	Crushed Reclaimed Asphalt	≤5
Contaminants	Cohesive Materials (Including clay)	≤1
	Organic Materials	≤ 0.1

A.3: Crushed Mixed Aggregates		
Components		**Percentage by Mass**
Main	Crushed Concrete (Density > 2.1 Mg/m^3) and Aggregates (Including slag)	≥50
Other Granular	Crushed Masonry	≤50
	Crushed Reclaimed Asphalt	≤5
	Granular with density > 1.6 Mg/m^3	≤10
Contaminants	Cohesive Materials (Including clay)	≤1
	Organic Materials	≤ 0.1

A.4: Crushed Road Pavement Materials		
Components		**Percentage by Mass**
Main	Mineral based granular, including glass, ceramics, slags etc.	≥90
Other Granular	Iron and other metals	≤5
Contaminants	Non-incinerated material	≤6
	Organic material	≤5
	Incinerator fly ash	0

Conclusion on the Implication of the New European Specifications

While prudent road construction engineers would ordinarily take all due precautions necessary to satisfy themselves that a quarry had indeed the capacity to provide aggregates capable of compliance with the required specification, the introduction of a documented Factory Control Production System for suppliers of unbound aggregates greatly formalises and intensifies these Procedures.

The specification of the constituents of a designated category of CDW are likely to have a profound impact on the manner in which such material is used in road construction in the future. However, conscientious operators who are striving to produce a high quality CDW material and who comply with the onerous obligations of these specifications should be in a position to compete in the market on an equal footing to primary aggregates.

ASPHALT

Significant quantities of asphalt CDW arise when a road surface is being planed to accommodate resurfacing. This material has traditionally been much valued in Ireland and has commonly been utilised for beneficial re-use in the surfacing of depots and temporary material storage compounds. However, while the same principles apply to the use of asphalt planings as unbound pavement materials, such material may be capable of more advantageous use as a stabilised wet-mix macadam road base material (through the addition of bitumen to the asphalt planings). While the scope of such use is outside the remit of this Paper, it would be necessary to arrange for the specification for stabilised wet-mix macadam to be revised in order to allow for the use of asphalt planings on the lighter trafficked roads. The threshold Annual Average Daily Traffic (AADT) values that would categorise “lightly trafficked roads” would need to be agreed and defined.

KEY INTERNATIONAL FACTORS INCREASING THE CDW RECYCLING IN ROAD PAVEMENTS

This paper has examined issues relating to the composition, performance and specification of CDW for use as an unbound material pavement layer in road construction. Even if all these characteristics are intrinsically satisfactory within a CDW material, it is imperative that the waste management system is set up in a manner to enable CDW to compete favourable with primary aggregates in road construction. As might be apparent from Table 1, there are a number of excellent examples from international experience illustrating how construction and demolition waste can be managed to best advantage in this regard.

Reduction of Transport Costs

The objective of such strategies is to reduce the cost advantages of removing CDW from site and bringing primary aggregates to site. Strategically situated treatment facilities which are situated both to the source of and the markets for C & D Waste, such as on the urban/sub-urban fringes, can ensure that the production and transport costs are minimised in comparison to the corresponding costs associated with the provision of primary aggregates. High landfill levies and increased charges for mixed CDW can help ensure that disposal of construction and demolition waste does not represent a cheap management option. A prohibition on the landfill of certain types of CDW will remove the opportunity to landfill CDW which is readily recyclable, while Aggregate Extraction Levies will improve the competitiveness of CDW in comparison to primary aggregates. The strict regulation of construction/demolition sites, waste carriers and facilities will restrict the opportunities to manage CDW in an unsatisfactory manner. The provision of both primary aggregates and CDW aggregates at the same location allow a totally open choice to purchasers – if the CDW is of similar quality and is cheaper, then there is a strong likelihood that it will be chosen for appropriate construction applications.

Preparation of Waste Management Plans for Individual Projects

A requirement to prepare a Waste Management Plan for each individual project can greatly improve the manner in which CDW is managed. Preparation of a Waste Management Plans can facilitate an early and accurate quantification of wastes/surpluses and material requirements for the Scheme. This allows the designer to match waste arisings with material requirements for the new works. Priority can then be given towards re-use/recycling on site, through the production of recycled CDW of the required specification.

The Use of Producer Responsibility Agreements

The concept of producer responsibility is that the industry agrees to take responsibility for the proper environmental management of the CDW it produces. Designers and advisors would thereby encourage clients to increase the level of CDW recycling, which will be properly specified in the contract documents in the very same manner as all other facets of the construction project.

Compliance with Codes of Practice

Source segregation of wastes is paramount when attempting to maximise reuse and recycling of the waste material. Selective demolition, whereby a building or infrastructure is disassembled in a direct reversal of the construction process, ensures that the useful materials do not become contaminated during demolition. Accordingly, adherence to recognised industry Codes of Practice for selective demolition can maximise opportunities for re-use and recycling of CDW.

Financial Assistance

The provision of financial assistance towards Research and Development provides an impetus to entrepreneurs whom are anxious to exploit available market opportunities. In practice, efforts are generally directed towards known technologies and the major CDW fractions.

Like many other sectors, the finance needed to establish a CDW Recycling Facility can be difficult to raise before a proven market has been developed. Accordingly, grant assistance helps the economics and lends credibility to the business case when seeking loan approval from the banking institutions.

Demonstration projects greatly accelerate the progression of a process from concept to reality. Financial support for promising projects can serve to provide exemplary best practice within a country.

Awareness, Training and Education

A commitment to best practice in CDW management into the environmental policy statements of all industry organisations can create a strong momentum for progress. Specialist training programmes for both site personnel and professional organisations equip the key stakeholders with the necessary site management strategies and techniques. Similarly, the inclusion of CDW management for construction students within the third level institutions creates an important awareness and education for their subsequent professional careers.

An Awards Scheme to acknowledge exemplary best practice in CDW management on successful has the potential to greatly increase the profile of the practice.

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MIX DESIGN SPECIFICATION FOR LOW STRENGTH CONCRETES CONTAINING RECYCLED AND SECONDARY AGGREGATES

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MIX DESIGN SPECIFICATION FOR LOW STRENGTH CONCRETES CONTAINING RECYCLED AND SECONDARY AGGREGATES

Contents

Summary of Research Objectives

The objective of the research was to examine the ways in which the use of recycled and secondary aggregates in low strength concrete for housing applications could be encouraged in concrete specifications. Existing guidance was examined, together with that in newly introduced British and European Standards. The use of Designated Concretes appears to offer the best opportunity for promoting the use of recycled and secondary aggregates in this type of concrete.

MIX DESIGN SPECIFICATIONS FOR LOW STRENGTH CONCRETES CONTAINING RECYCLED AND SECONDARY AGGREGATES

1.INTRODUCTION

Increased environmental awareness has led to pressure to re-use construction materials rather than classifying them as waste. Using redundant materials as an aggregate for new concrete is technically viable and may, in some circumstances, be environmentally beneficial.
The purpose of the work reported here is to encourage the use of recycled and secondary aggregates in low strength concrete applications in housing projects. These applications are currently covered in BS 5328:1997. However, BS 5328 restricts the sources for these types of concrete to aggregates complying with BS 882 (natural aggregates) or BS 1047 (air cooled blast-furnace slag aggregates), thus apparently precluding the use of recycled or other secondary aggregates.

Furthermore, BS 5328 itself will be superseded in December 2003 by BS EN 206-1 and its complementary British Standard BS 8500. Consequently, there is a need to examine these new standards in order to identify a method of specification that will permit the increased use of recycled and secondary aggregates in concrete for housing projects.

2.WHAT ARE RECYCLED AGGREGATES

Recycled aggregates (RA) comprise crushed, graded inorganic particles processed from materials that have been previously used in construction, e.g. crushed concrete and masonry. A specific sub-set of recycled aggregates is recycled concrete aggregates (RCA) where the masonry content is limited to not more than 5% (Table 1). The performance characteristics of RCA are better than RA and consequently there are fewer restrictions on the use of RCA in concrete. Recycled aggregates are, however, not the same as "recovered" aggregates, which are those obtained by washing the cement paste out of fresh concrete and returning the aggregate to the aggregate stockpile. The cement paste goes to a separate storage basin where it can be recycled into further batches of concrete in accordance with the procedures given in BS EN 1008. The requirements for recovered aggregates are given in BS EN 206-1. RCA and RA are, therefore, processed materials that conform to a product specification, e.g. that given in BS 8500-2 (see Table 1). Recycled aggregates are graded into the same sizes as natural aggregates and used in exactly the same way.

Table 1 BS 8500-2 requirements for recycled aggregates

	Requirement					
	Maximum Masonry Content Mass Fraction (%)	Maximum Fines Mass Fraction (%)	Maximum Lightweight Material Mass Fraction (%)	Maximum Asphalt Mass Fraction (%)	Maximum other Foreign Material e.g. glass, metal, plastics Mass Fraction (%)	Maximum Acid Soluble Sulfate (SO_3) Mass Fraction (%)
RCA	5	5	0.5	5.0	1.0	1.0
RA	100	3	1.0	10.0	1.0	1.0

3.RECYCLED AGGREGATES ARE NOT WASTE

"Waste" is produced when a product or material is considered by the owner to have no further use and is discarded, although it could be viewed as a 'resource' in the wrong place, waiting to be used. Due to the legal and cost implications of classifying a material as "waste", most RA will be processed at the construction site and it will never enter a waste stream. However, some sites may discard inorganic construction materials to a waste company that may then process these materials into RCA or RA, but this route has additional costs associated with the raw material being classified as "waste".

4. CURRENT GUIDANCE

4.1 Standards for recycled and secondary aggregates

Most current concrete specifications refer to BS 882 for guidance on the properties of acceptable aggregates for making concrete. However, this document is entitled 'Specification for aggregates from natural sources for concrete' thus essentially precluding the use of recycled materials for use in new concrete. Reference to BS 1047 is also sometimes encountered in specifications, but this standard only covers secondary aggregates made from air-cooled blast-furnace slag.

The new European Standard for aggregates in concrete BS EN 12620 permits the use of recycled aggregates, but does not give any specific compositional limits (product specification). It is intended, however, that when it is revised in five years time (2007), specific limitations on the composition of recycled aggregates will be included.

BS EN 12620 also covers aggregates made from air-cooled blastfurnace slag. Although this standard supersedes BS 1047, the earlier British Standard remains current until its formal withdrawal (1 June 2004). BS EN 12620 differs in approach to British Standards, in that it defines the properties of aggregates in terms of classes for each property. It is then the responsibility of the national provisions or the project specification to define which classes are accepted for use. Additionally many of the tests for aggregate properties are different from those currently used in the UK. This makes direct comparison between BS 1047 and BS EN 12620 impossible. However, with respect to the essential chemical requirements, aggregate complying with BS 1047 would also comply with BS EN 12620.

4.2 Standards for concrete

Until December 2003, specification of concrete in the UK is covered by both BS 5328 and BS EN 206-1 /BS 8500, both of which have equal status. However, BSI recommends that BS 5328 should be used preferentially until December 2003, when it will be withdrawn and fully superseded by BS EN 206-1/BS 8500.

4.2.1. BS 5328

Low to medium strength concretes for a range of uses in housing or other applications are summarised in Table 13 of BS 5328:Part 1:1997. The concretes can be specified as either 'Designated' mixes or 'Standard' mixes, which simplifies the specification process for the purchaser of the concrete and gives maximum flexibility to the concrete producer. However, BS 5328 states that aggregates for normal weight concrete should conform to BS 882 or BS 1047, i.e. that they should be either from natural sources of be manufactured from air cooled blast-furnace slag. The current BS 5328 guidance (for a restricted range of uses) is illustrated in Table 2.

Table 2 Guidance derived from BS 5328

Proposed Use	Recommended Standard Mix	Recommended Designated Mix	Recommended Nominal Slump (mm)
Kerb haunching	ST 1	GEN 0	10
Blinding in foundation trenches	ST 2	GEN 1	75
Drainage pipe bedding	ST 2	GEN 1	10
Small bases for	ST 2	GEN 1	75

external furniture			
Infill around manhole rings	ST 2	GEN 1	50
Driveways	N/A	PAV 1	75
Footings*	ST 2	GEN	75

*In non aggressive soils

Guidance on suitable materials and mix proportions for both Standard mixes and Designated mixes are given in BS 5328:Part2:1997. However these cannot easily be modified to allow for the use of recycled or secondary materials due to the limitations on aggregates included in this standard.

4.2.2. BS EN 206-1 and BS 8500

BS EN 206-1 '*Concrete- Specification, performance, production and conformity'* is a 'Framework' standard. The application of this standard in the UK is described in the
Complementary British Standard BS 8500 Parts 1&2. In this standard, 'Designated Mixes' become 'Designated Concretes' and 'Standard Mixes', become 'Standardized Prescribed Concretes.' Once again, aggregates for Standardized Prescribed Concretes are restricted to only those conforming to BS 882/BS 1047. However, the use of recycled coarse aggregates is permitted in Designated Concretes, subject to certain restrictions on concrete strength and exposure environment. This introduces the opportunity to increase the use of recycled material in concrete for housing applications.

a) Designated Concrete

Designated Concrete is specified by a simple alphanumeric designation (e.g. GEN 1, etc.) and its workability (now known as 'consistence'). The Designation indicates the strength class of the concrete and strength testing forms an essential part of the conformity assessment process. However, provided that the concrete producer holds accredited current third party certification (e.g. QSRMC or equivalent), the purchaser of the concrete does not have to test the concrete on site as the certification body will audit the producer's conformity control. Thus the producer alone is responsible for ensuring and demonstrating that the concrete has achieved the correct strength. The producer thus determines the appropriate mix proportions for the concrete.

Because of the requirement for the producer to measure the strength of a Designated Concrete, this also provides an indirect measure of the quality of the aggregate, which is absent for Standardized Prescribed Concrete (where strength testing is not part of the conformity assessment process). Consequently, any concerns that the use of recycled coarse aggregates may adversely affect the concrete strength are addressed directly. This provides the assurance required for the use of recycled or secondary aggregates in concrete.

b) Provisions for the use of recycled aggregates

BS 8500-2 Clause 4.3 defines the types of aggregates that are suitable for use in concrete. It introduces two categories of coarse recycled aggregate i.e. Recycled Concrete Aggregate (RCA) consisting primarily of crushed concrete and Recycled Aggregate (RA) which may include a higher proportion of masonry. Clause 4.3 defines the compositional requirements for RCA and RA and the limitations on their use in different exposure conditions (see Table 1 of this report). *[It should*

be noted that whilst the use of coarse recycled aggregates is permitted, BS 8500 does not cover the use of fine RCA or RA].
Recycled aggregate must also meet a default value for aggregate drying shrinkage of 0.075%.

RA is limited to use in concrete with a maximum strength class of C16/20 (i.e. equivalent to a characteristic cube strength of 20 N/mm^2) and in only the mildest exposure conditions, whereas RCA can be used up to strength class C40/50 (i.e. a characteristic cube strength of 50 N/mm^2) and in a wider range of exposure conditions. RCA is not

generally permitted in concrete exposed to sea water, de-icing salts or severe freezing and thawing.
Concrete containing RCA is also generally restricted to use in non-aggressive soils
(DC-1 conditions).

Although it is generally accepted that the use of coarse RCA to replace up to 30% of the natural coarse aggregate will have an insignificant effect on the properties of concrete, for BS 8500 designated concretes RC25-RC50, the amount of RCA or RA is restricted to 20% by weight of the total coarse aggregate fraction unless the specifier gives permission to relax this requirement.

5. SPECIFICATION OF DESIGNATED CONCRETE

From the discussion above it will be apparent that the simplest way in which recycled or secondary aggregates can be specified for use in low strength concrete for housing is by utilizing the Designated Concrete concept.

Some appropriate BS 8500 designated concretes for the applications given earlier in Table 1 are shown in Table 3 below:

Table 3 Guidance from BS 8500 for selected applications

Proposed Use	Recommended Designated Concrete	Recommended Consistence Class
Kerb haunching	GEN 0	S1
Blinding in foundation trenches	GEN 1	S3
Drainage pipe bedding	GEN 1	S1
Small bases for external furniture	GEN 1	S3
Infill around manhole	GEN 1	S3

rings		
Driveways*	PAV 1	S2
Footings**	GEN 1	S3

***Freeze-thaw resistance of the aggregates should also be established for PAV concretes**

****DC-1 concrete only**

Concrete workability is now specified in terms of Consistence Classes rather than target slump. Table 4 indicates the limits on slump for each consistence class.

Table 4 Equivalent Slump and Consistence Classes

Consistence Class	Slump (mm)
S1	10 to 40
S2	50 to 90
S3	100 to 150
S4	160 to 210

The specification of concrete containing recycled or secondary aggregates at its simplest would be as follows:

1. ***Concrete shall be a Designated Concrete produced in accordance with BS EN 206-1/ BS 8500-2.***
2. ***The concrete shall be Designated Concrete:……(select from Table).***
3. ***The maximum aggregate size shall be:……mm (only required if the maximum aggregate size is not 20mm).***
4. ***The concrete consistence class shall be:……(select from Table).***
5. ***The use of recycled materials (RCA or RA), if available, as coarse aggregate is the preferred option.***
6. ***The proportion of RA or RCA (as a mass fraction of the total coarse aggregate) is permitted to exceed 20%.***

Table 5. details the full range of Designated Concretes and applications in which the use of RA or RCA would be permitted by BS 8500. Whilst Designated Concretes can be used in certain other applications (e.g. foundations in aggressive soils), there are restrictions in BS 8500 precluding the use of RA/RCA in these situations.

Table 5 Guidance on selection of appropriate designated mixes (expansion of Table 3)

Application[1]	Recommended Designated Concrete	Recommended Consistence Class
General Applications:		
Kerb bedding and backing	GEN 0	S1
Drainage works to give immediate support	GEN 1	S1
Other drainage works[2]	GEN 1	S3
Oversite below suspended slabs	GEN 1	S3
Paving[3]		
House drives, domestic parking and external parking	PAV 1	S2
Heavy duty external paving[4]	PAV 2	S2[5]
Floors:		
House floors containing no embedded metal and which will receive a permanent finish (e.g. a screed or floating floor)	GEN 1	S2
House floors containing no embedded metal and which will not receive a permanent finish (e.g. only to be carpeted)	GEN 2	S2
Garage floors containing no embedded metal	GEN 3	S2
Wearing surface: light foot and trolley traffic	RC 30	S2
Wearing surface: general industrial	RC 40	S2
Wearing surface: heavy industrial[4]	RC 50	S2
Foundations in non aggressive soils only (DC-1 conditions):		
Blinding and mass concrete fill	GEN 1	S3
Strip footings	GEN 1	S3
Mass concrete foundations	GEN 1	S3

Trench fill foundations	GEN 1	S4
Fully buried reinforced foundations	RC30	S3

Notes:

1. ***All concrete containing embedded metal should be treated as reinforced***
2. ***Only in conditions where DC-1 concrete is appropriate***
3. ***Freeze-thaw resistance of aggregates must be established for PAV concretes***
4. ***For extreme applications e.g. foundry floors or busy public roads, seek specialist advice***
5. ***Depends on method of placing***

6. SPECIFICATION PROCESS

An example of how the Designated Concrete approach can be applied to the specification of concrete containing recycled or secondary aggregates for housing applications etc. is given in Appendix A. However, although the use of these Designated mixes offers a means of including recycled aggregates in concrete, it is not currently practical to specify that only recycled materials *must* be used. The current situation regarding the limited available supply of suitable recycled materials (see below) precludes such a restrictive form of specification. Consequently, the proposed specification clauses in Appendix A are designed to *encourage* the use of recycled aggregates, if available, by both removing any restrictions on their use *and* positively including them in the materials specifications. This form of specification has been discussed with both the QPA and the NHBC. Neither organisation has any objection in principle to this form of specification process but NHBC have pointed out that, whilst they support the use of recycled aggregates, the housing market is particularly sensitive to any problems with concrete (real or perceived), which may in turn act to inhibit the uptake of new materials such as recycled aggregates.

7. AVAILABILITY OF RECYCLED AGGREGATES

One of the biggest practical problems with using more RCA and RA in concrete is its limited availability at the right time and in the right place. Thus a concrete supplier may not always have the materials at his plant when a new project starts. The main alternative to using RCA and RA is, of course, natural aggregate and these are still relatively low cost materials although, due to the Aggregate Levy, the cost has increased significantly over recent months. If RCA and RA have to be transported a significant distance from the place of production to the place of use, both the cost and environmental benefits may become more questionable.

8. REFERENCES TO STANDARDS

The following British Standards are referred to in the text:

1 BS 882: 1992: Specification for aggregates for aggregates from natural sources for concrete.
2 BS: 1047: 1983: Specification for air-cooled blastfurnace slag aggregate for use in construction.
3 BS 5328: Part 1: 1997: Concrete – Part 1:Guide to specifying concrete.
4 BS 5328: Part 2: 1997: Concrete – Part 2: Methods for specifying concrete mixes.
5 BS 8500: Part 1: 2002: Concrete – Complementary British Standard to BS

EN 206-1 – Part 1: Method of specifying and guidance for the specifier.

6 BS 8500: Part 2: 2002: Concrete – Complementary British Standard to BS EN 206-1 – Part 2: Specification for constituent materials and concrete,

7 BS EN 206-1: 2000: Concrete – Part 1: Specification, performance, production and conformity.

8 BS EN 1008: 2002: Mixing water for concrete – Specification for sampling, testing and assessing the suitability of water, including water recovered from processes in the concrete industry, as mixing water for concrete.

9 BS EN 12620: 2002: Aggregates for concrete.

APPENDIX A
SPECIFICATION PROCESS

1. Selection of Designated Concrete

1 The Designated Concrete most appropriate for the intended application should be selected from Table A.1

2 The concrete workability (consistence class) should either be selected from the recommended values in Table A.1 (preferred), or from Table A.2.

2. Model Specification Clauses

Having identified the appropriate designated mix and consistence class the purchaser should then specify the required concrete to the concrete producer using the following model clauses:

7 Concrete shall be a Designated Concrete produced in accordance with BS EN 206-1/ BS 8500-2.

8 The concrete shall be Designated Concrete:.....(select from Table A.1 below).

9 The maximum aggregate size shall be:.....mm (only required if the maximum aggregate size is not 20mm).

10 The concrete consistence class shall be:.....(select from Tables A.1 or A.2 below).

11 The use of recycled materials (RCA or RA), if available, as coarse aggregate is the preferred option.

12 The proportion of RA or RCA (as a mass fraction of the total coarse aggregate) is permitted to exceed 20%.

Table A.1: Guidance on selection of appropriate designated mixes

Application[1]	Recommended Designated Concrete	Recommended Consistence Class
General Applications:		
Kerb bedding and backing	GEN 0	S1
Drainage works to give immediate support	GEN 1	S1
Other drainage works[2]	GEN 1	S3
Oversite below suspended slabs	GEN 1	S3
Paving[3]		
House drives, domestic parking and external parking	PAV 1	S2
Heavy duty external paving[4]	PAV 2	S2[5]
Floors:		
House floors containing no embedded metal and which will receive a permanent finish (e.g. a screed or floating floor)	GEN 1	S2
House floors containing no embedded metal and which will not receive a permanent finish (e.g. only to be carpeted)	GEN 2	S2
Garage floors containing no embedded metal	GEN 3	S2
Wearing surface: light foot and trolley traffic	RC 30	S2
Wearing surface: general industrial	RC 40	S2
Wearing surface: heavy industrial[4]	RC 50	S2
Foundations in non aggressive soils only (DC-1 conditions):		
Blinding and mass concrete fill	GEN 1	S3
Strip footings	GEN 1	S3
Mass concrete foundations	GEN 1	S3
Trench fill foundations	GEN 1	S4
Fully buried reinforced foundations	RC30	S3

Notes:

1. ***All concrete containing embedded metal should be treated as reinforced***
2. ***Only in conditions where DC-1 concrete is appropriate***
3. ***Freeze-thaw resistance of aggregates must be established for PAV concretes***
4. ***For extreme applications e.g. foundry floors or busy public roads, seek specialist advice***
5. ***Depends on method of placing***

Table A.2: Equivalent slump and consistence classes

Consistence Class	Slump (mm)
S1	10 to 40
S2	50 to 90
S3	100 to 150
S4	160 to 210

3. Example Specification

Specification for an un-reinforced strip foundation in non-aggressive (DC-1) soil:

13 Concrete shall be a Designated Concrete produced in accordance with BS EN 206-1/ BS 8500-2.
14 The concrete shall be Designated Concrete: GEN 1.
15 The maximum aggregate size shall be: 40 mm.
16 The concrete consistence class shall be: S3
17 The use of recycled materials (RCA or RA), if available, as coarse aggregate is the preferred option.
18 The proportion of RA or RCA (as a mass fraction of the total coarse aggregate) is permitted to exceed 20%.

APPENDIX B
FREQUENTLY ASKED QUESTIONS

Q. What are recycled aggregates?
A. Recycled aggregates are produced from the processing of previously used construction materials, such as concrete or masonry.

Q. What are secondary aggregates?
A. These are aggregates produced by processing of by products of other industries e.g. blast-furnace slag.

Q. Are these materials as good as natural aggregates?
A. In many situations, recycled aggregates can produce concrete that is as strong as concrete made with natural aggregates. However, this will depend on the specified strength of the concrete, the source of the recycled aggregate and the proportion of recycled material used to replace natural aggregates.

Q. What about concrete durability?
A. Where the concrete is not exposed to a severe environment (such as sea water or freezing and thawing), concrete containing recycled aggregates can provide a similar level of durability to concrete containing natural aggregates.

Q. Are recycled aggregates covered by British or European Standards?
A. There are no current standards for recycled *aggregates*, but for use in concrete, they are covered by the new British Standard for *concrete*, BS 8500. This standard gives limits on the permitted composition of recycled coarse aggregates as well as guidance on where and how their use in concrete is permitted. The use of concrete containing recycled coarse aggregates is restricted to the least severe exposure classes.

Q. Can I use recycled fine aggregates as well as coarse aggregates?
A. The use of fine recycled aggregates is **not** covered by BS 8500. Experience has shown that fine recycled materials are difficult to use in practice and significantly increase the water demand of concrete, leading to low strength concrete.

Q. Can I use recycled aggregate in site-batched concrete?
A. No ! Because the quality of recycled aggregates can be much more variable than natural aggregates, the use of site batched Prescribed or Standard mixes (now called Standardised Prescribed Concrete in BS 8500) is not recommended. Designed and Designated concretes, which require strength tests to be carried out, are more appropriate and will enable quality to be maintained.

Q. What is the best way to specify and order concrete containing recycled materials?
A. The simplest way of specifying concrete containing recycled aggregates (if available) is by ordering a BS 8500 Designated Concrete as described in the main report.

Q. Is concrete containing recycled aggregate readily available?
A. Most commercial ready mixed concrete producers can offer concrete containing recycled aggregates. **But,** recycled aggregates are currently of limited availability and may not be available at the right time, in the right place or in the required quantities. Consequently it is not possible to insist on their use for every project, the type of specification suggested in the report is designed to allow for and encourage the use of recycled aggregates in concrete if the materials are available.

Q. How are these materials actually used in concrete?
A. Recycled and secondary aggregates are produced in similar gradings to natural aggregate and can be used in concrete in the same way. No special storage or mixing procedures are required. Concrete can be placed, compacted and finished on site in the same way as any other conventional concrete.

APPENDIX 4

Geology Reports

AZTECH LAND SURVEYS & CIVIL ENGINEERING LTD.
5, The Grove, Gleann Na Rí, Tower, Cork.
Tel: 021-4383802 Fax: 021-4383938 Mobile: 087- 8133862
email: aztechls@indigo.ie

Mr Martin O'Regan,
O'Regan Group,
Cork.

20th July 2004

RE: Disused Quarry at Tullig, Dripsey, Co Cork.

Dear Sirs,
We have recently carried out a volumetric survey of disused quarry at Tullig, Dripsey, Co Cork. We have taken a sample survey of approx 21 acres and have determined that to excavate to the following levels below trial pit height would yield the following results.

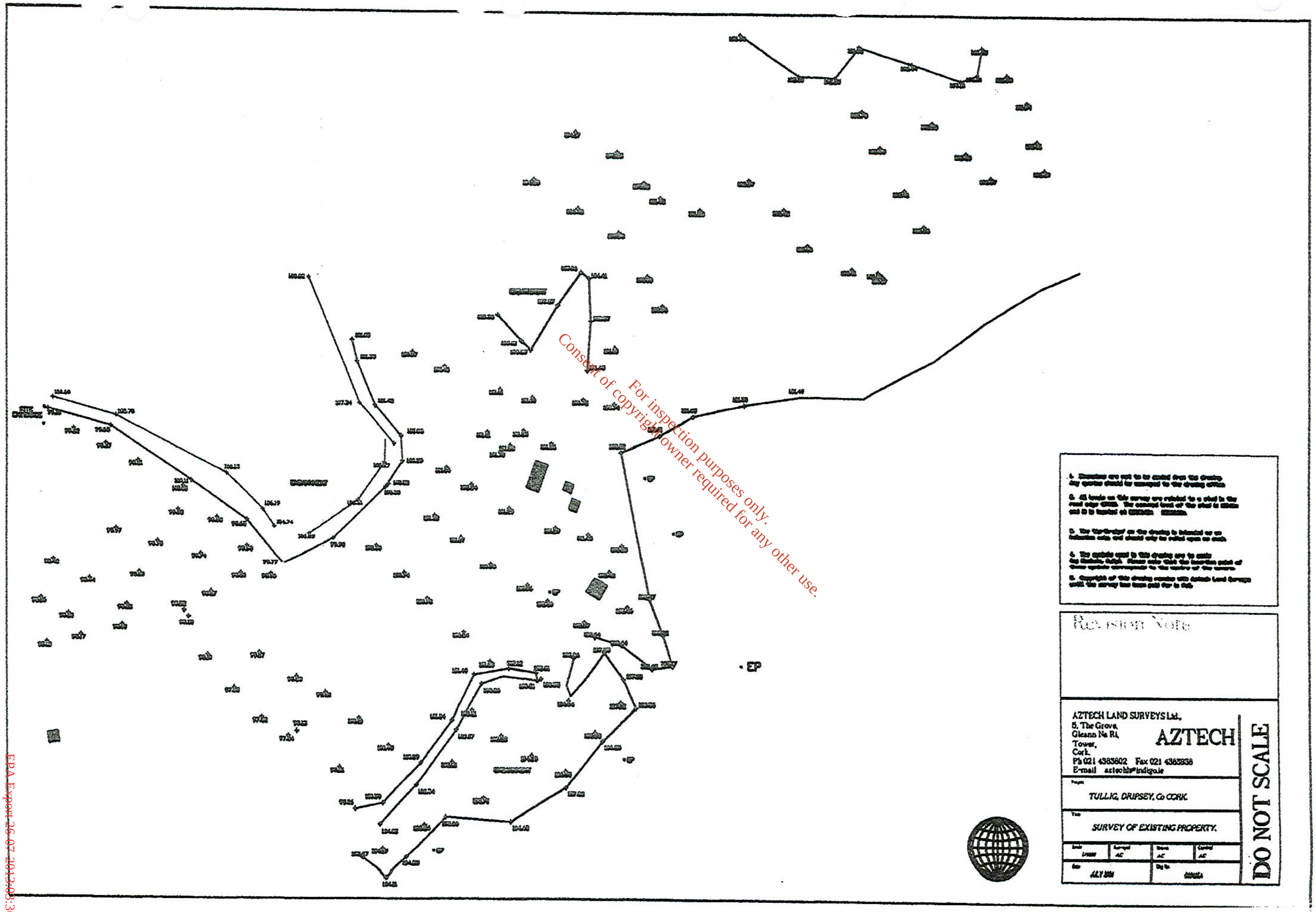
EXCATATION DEPTH	VOLUME	TONNES
9 meters	762370 cu.m	1.673 million
10 meters	846327 cu.m	1.857 million
12 meters	1014242 cu.m	2.226 million
14 meters	1182156 cu.m	2.594 million
16 meters	1350070 cu.m	2.963 million
18 meters	1517985 cu.m	3.331 million

Eight trial holes have been dug on site, to a depth of 9 meters. There is, in all likelihood, gravel on site, to a depth greater than nine meters. The above table shows the estimate quantities for excavation to continue below the existing trial pit depth of nine meters.

If you have any queries, do not hesitate to call me.

Regards,

Alan Connolly MIS



Irbhéireacht Gheolaíochta Éireann
or an Bhacaigh
óthar Hadington
Baile Átha Cliath 4

Geological Survey of Ireland
Beggars Bush
Haddington Road
Dublin 4
Tel. +353 1 6041454
Fax. +353 1 6681782
http://www.gsi.ie

Ms.Orla Freyne,
O'Callaghan Moran and Assoc.
Granary House,
Rutland Street,
Cork.

31st of March 2003.

Re: South Cork site.

Dear Ms Freyne,

Thank you for your enquiry on the 25/03/2003 requesting a vulnerability rating and an aquifer classification for your site in County Cork.

The area is located at Tullig cross roads, County Cork. Please note that until a Groundwater Protection Scheme has been completed for Co.Cork that the classification below is provisional only. It is based on our current understanding of the hydrogeology of the area and on available hydrogeological data. The provisional aquifer classification is given below.

Site	Rock unit	Vulnerability	Aquifer classification
Tullig cross roads, County Cork	Ballytrasna Formation (BS)	High	Ll

Please see attached pages for descriptions of the aquifer classification and additional hydrogeological information.

If you have any further questions please do not hesitate to call Joanne Gavigan at (01) 678 2782.

Yours sincerely,

Vincent Fitzsimons,
Groundwater Section

Aquifer Categories

The aquifer classification system used by the GSI has three main aquifer categories, with each category sub-divided into two or three classes. These are based on the publication 'Groundwater Protection Schemes' (DELG/EPA/GSI, 1999).

Regionally Important (R) Aquifers

(i) Karstified aquifers (Rk)
(ii) Fissured bedrock aquifers (Rf)
(iii) Extensive sand/gravel (Rg)

Locally Important (L) Aquifers

(i) Sand/gravel (Lg)
(ii) Bedrock which is generally moderately productive (Lm)
(iii) Bedrock which is moderately productive only in local zones (Ll)

Poor (P) Aquifers

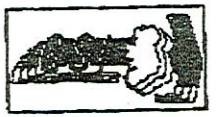
(i) Bedrock which is generally unproductive except for local zones (Pl)
(ii) Bedrock which is generally unproductive (Pu)

These aquifer categories take account of the following factors:

- the overall potential groundwater resources in each rock unit
- the area of each rock unit
- the localised nature of the higher permeability zones (e.g. fractures) in many of our bedrock units;
- the highly karstic nature of some of the limestones

the fact that all bedrock types give enough water for domestic supplies (therefore all are called 'aquifers').

Geological survey of Ireland borehole database.



Enquiry Ref:
Enquiry Date:

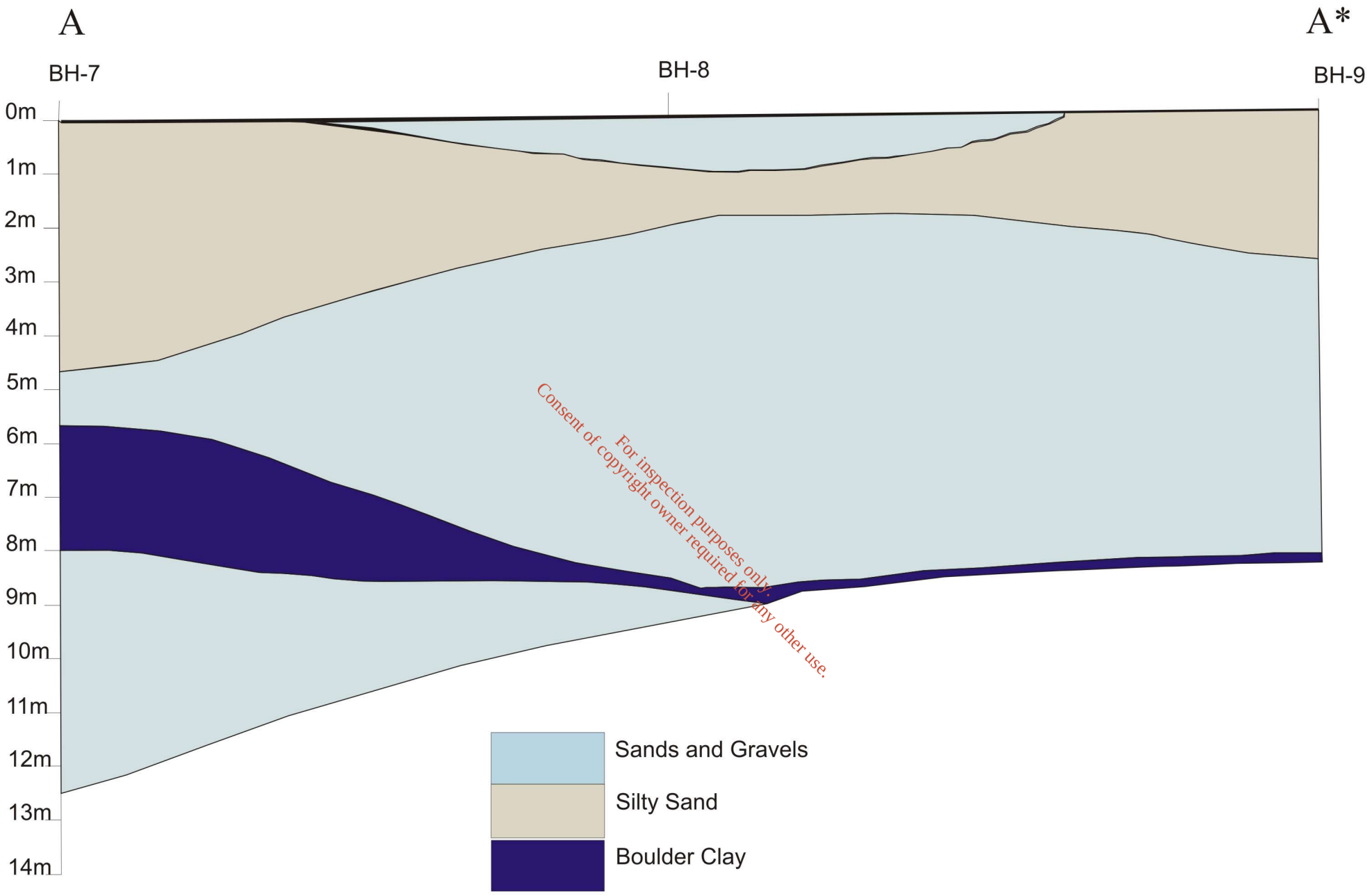
Summary of main search criteria:

Notes: 1) Dtb= depth to bedrock
2) Well Type: WS-'spring'. WB-'bored well'. WD-'Dug well'. Blank-'Not specified. Includes site investigation holes'
3) Grid Accuracy: 1= 10m, 2= 20m, 3= 50m, 4= 100m, 5= 200m.
4) Usage: A= Agricultural, B= Agricultural and Domestic, D= Domestic, G= Group scheme, I= Industrual, P= Public supply, O= Other, blank= unspecified.
5) Yield Class: E (well >435 m3/d). G (well 110-435 m3/d). M (well 44-110 m3/d). P (well <44 m3/d). F (failed),
H (spring >2160 m3/d), I (spring 430 - 2160 m3/d), L (spring <430 m3/d).
6) Productivity: 5 classes (I to V) relating pumped discharge to specific capacity. Class I is the most productive.
7) Specific Capacity: relates pumped discharge to the resulting water level drawdown in a well.

The information listed below comes from the GSI database. It is in no way a complete list of wells in the area, and should not be treated as such. It is important to note that in many cases this data has not been verified, and that the accuracy of the data cannot be guaranteed.

2KM WELL SEARCH OF 14800-07720 Co.Cork

DTB	DEPTH	GSIHOLENAME	INVTYPE	EASTING	NORTHING	GRID_ACC	TOWNLAND	SIXINCH	USAGE	YIELD	YIELDCLASS
4.6	21.3	1407SWW053	WB	14990	7722	8	LISLADEEN	61	U	27.3	P
7.6	30.8	1407SWW056	WB	14684	7784	8	OLDCASTLE	61	U	21.8	P
9.1	29.6	1407SWW021	WB	14890	7699	7	KNOCKANE	61	U	27.3	P
3.7	47.2	1407SWW022	WB	14885	7844	8	DERRY	61	U	21.8	P
1.2	25.9	1407SWW026	WB	14995	7909	7	REAGRELLAGH	61	U	21.8	P
3	20.7	1407SWW027	WB	14995	7900	7	REAGRELLAGH	61	U	27.3	P
4.3	8.5	1407SWW036	WD	14785	7746	8	TULLIGMORE	61	U	13.1	P
9.1	25.6	1407SWW037	WB	14785	7747	8	TULLIG MORE	61	U	16.4	P
18.3	35.4	1407SWW038	WB	14785	7729	8	TULLIG	61	U	21.8	P
		1407SWW142	WB	14713	7568	3	KILCOLMAN	61	U		U
6.7	44.2	1407SWW143	WB	14709	7620	3	KILCOLMAN	61	B		U
1.5	1.5	1407SWW148	WB	14711	7661	2	RATHRANANGLE	72	O		U
0.5	0.5	1407SWW180	WB	14856	7853	1	DERRY	61			
7.5	7.5	1407SWW181	WB	14856	7872	1	DERRY	61			
8.5	85.3	1407SWW189	WB	14852	7580	3	MEESHAL	61	B	32.7	P
4.6	55.5	1407SWW181	WB	14686	7536	3	PEAKE	72	B	32.7	P



O' Callaghan Moran & Associates.
Granary House, Rutland Street,
Cork Ireland.
Tel. (021) 4321521 Fax. (021) 4321522
email : info@ocallaghanmoran.com

CLIENT
Dripsey Green Partnership

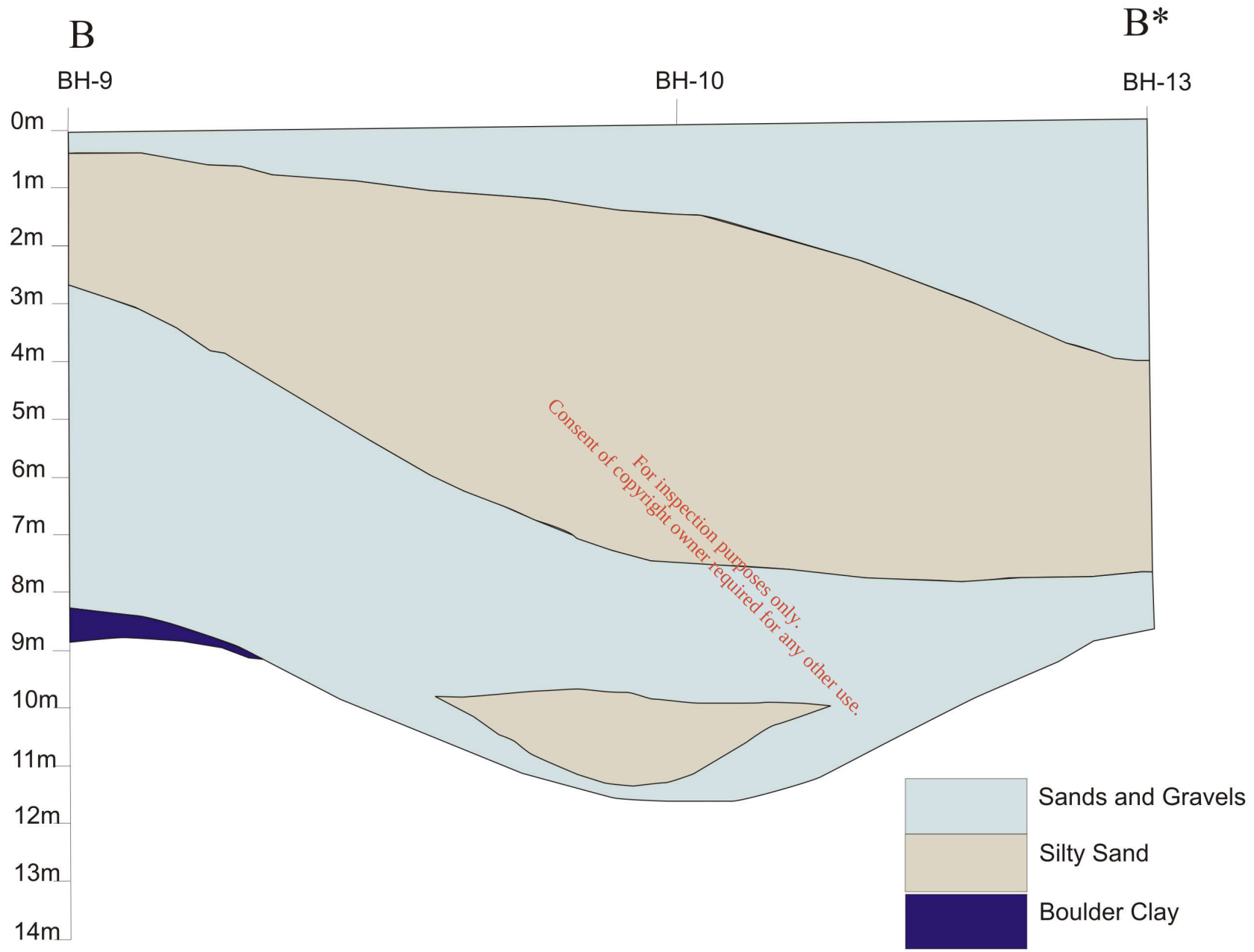
TITLE
Cross Section A-A* (7-8-9)

Details

FIGURE NUMBER

Scale
Not To Scale

Revision



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CLIENT
Dripsey Green Partnership

TITLE
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Details

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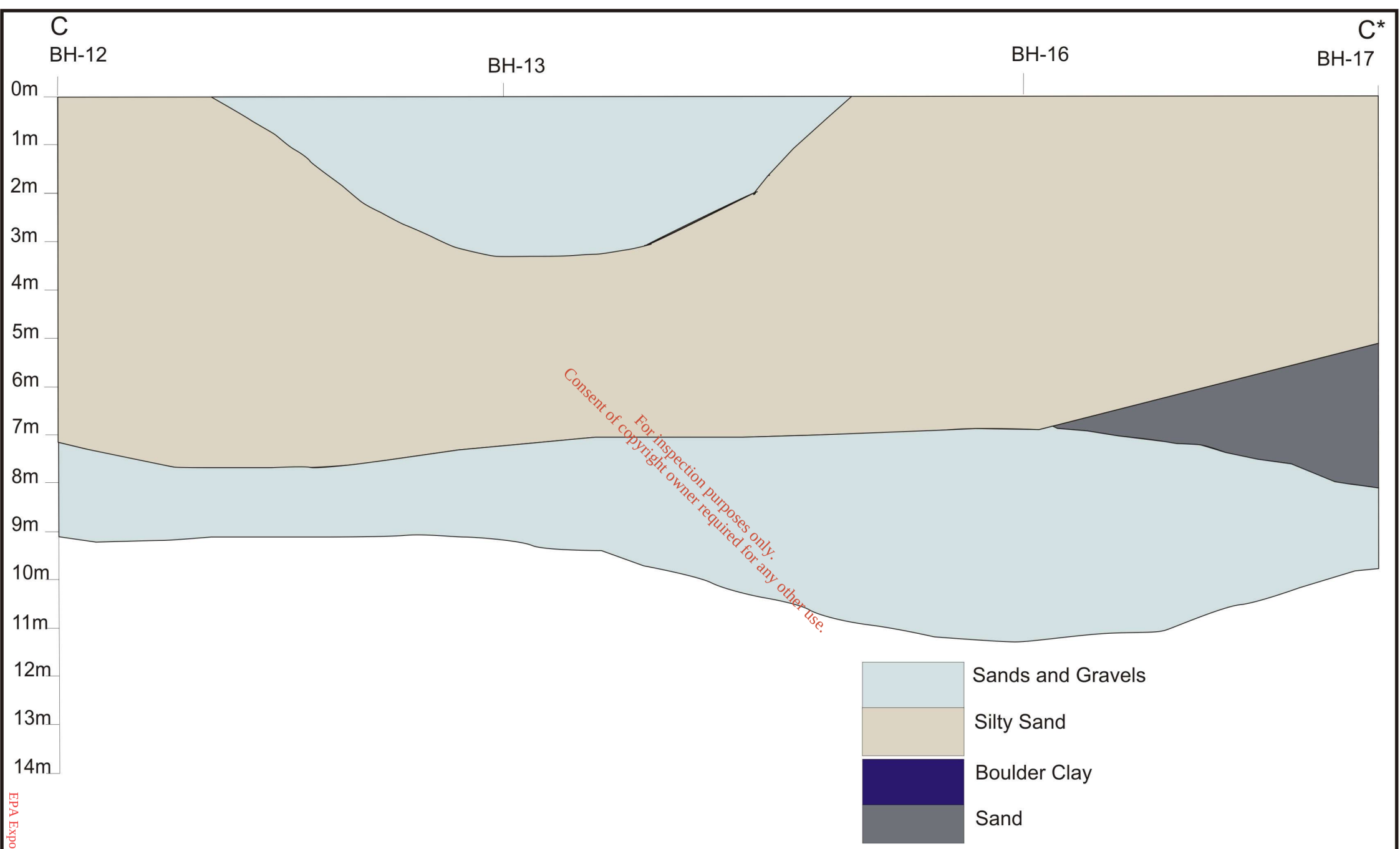

O' Callaghan Moran & Associates.
Granary House, Rutland Street,
Cork Ireland.
Tel. (021) 4321521 Fax. (021) 4321522
email : info@ocallaghanmoran.com

CLIENT
Dripsey Green Partnership

TITLE
Cross Section 12-13-16-17

Details

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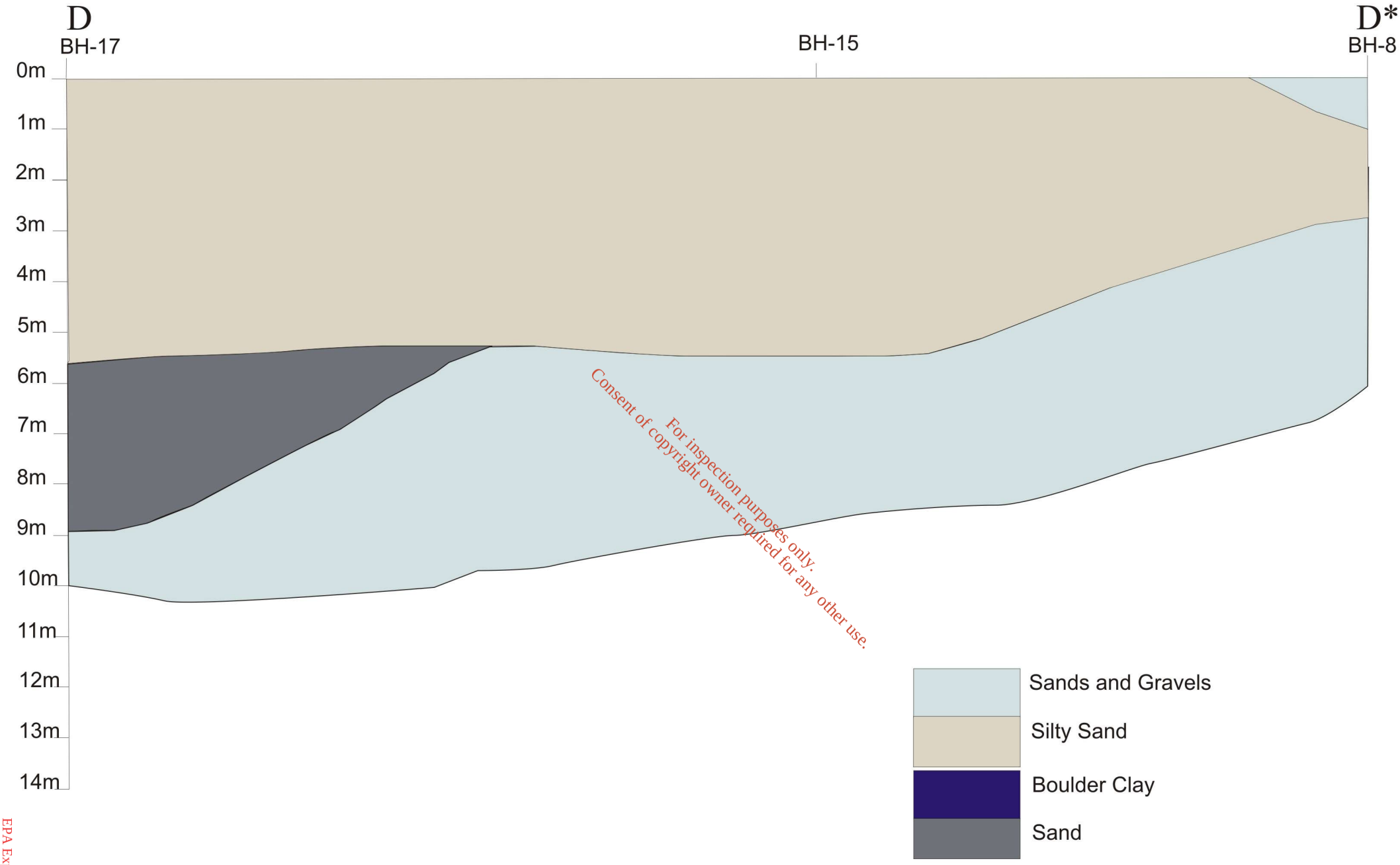

O' Callaghan Moran & Associates.
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Cork Ireland.
Tel. (021) 4321521 Fax. (021) 4321522
email : info@ocallaghanmoran.com

CLIENT
Dripsey Green Partnership

TITLE
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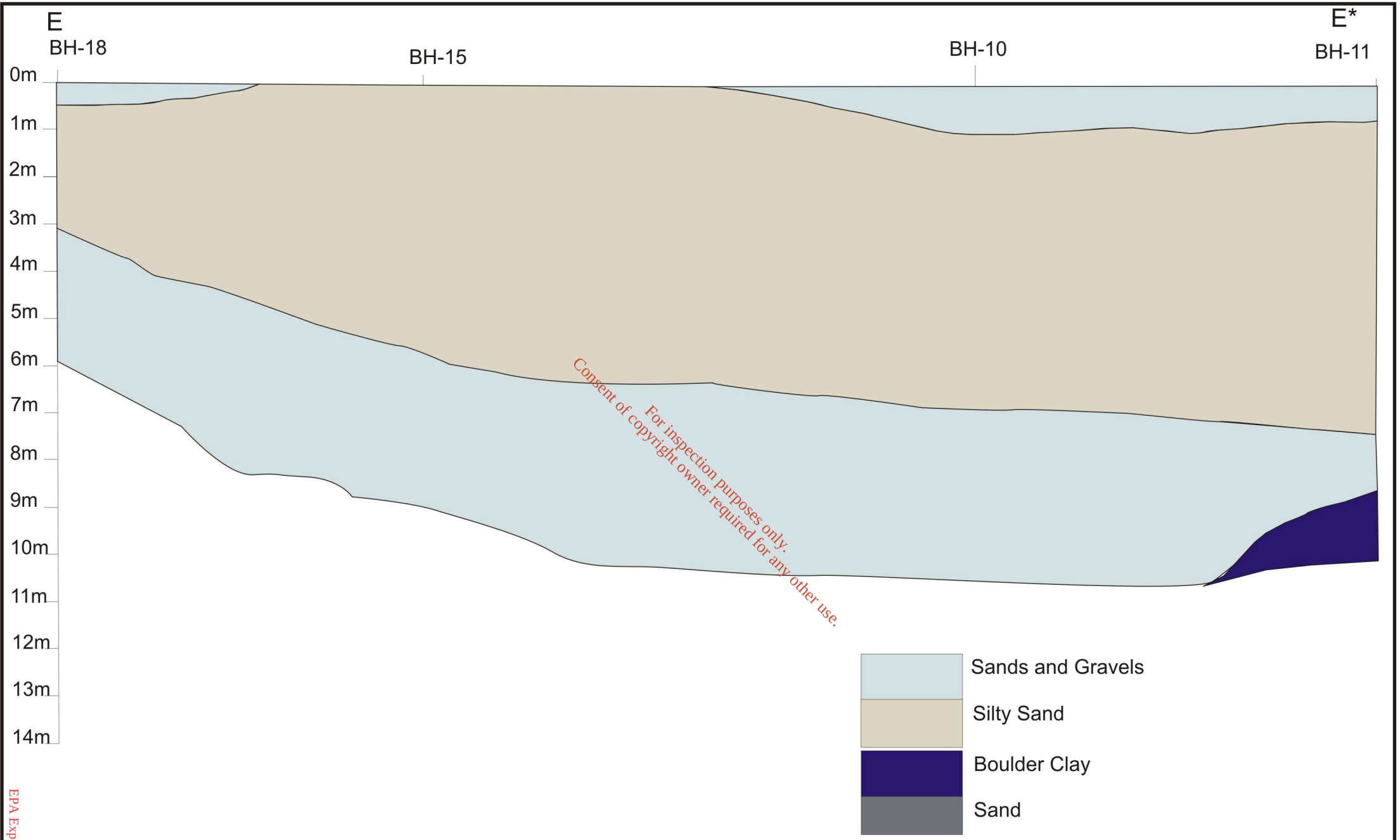

O' Callaghan Moran & Associates.
Granary House, Rutland Street,
Cork Ireland.
Tel. (021) 4321521 Fax. (021) 4321522
email : info@ocallaghanmoran.com

CLIENT: Dripsey Green Partnership

TITLE: Cross Section 18-15-10-11

Details

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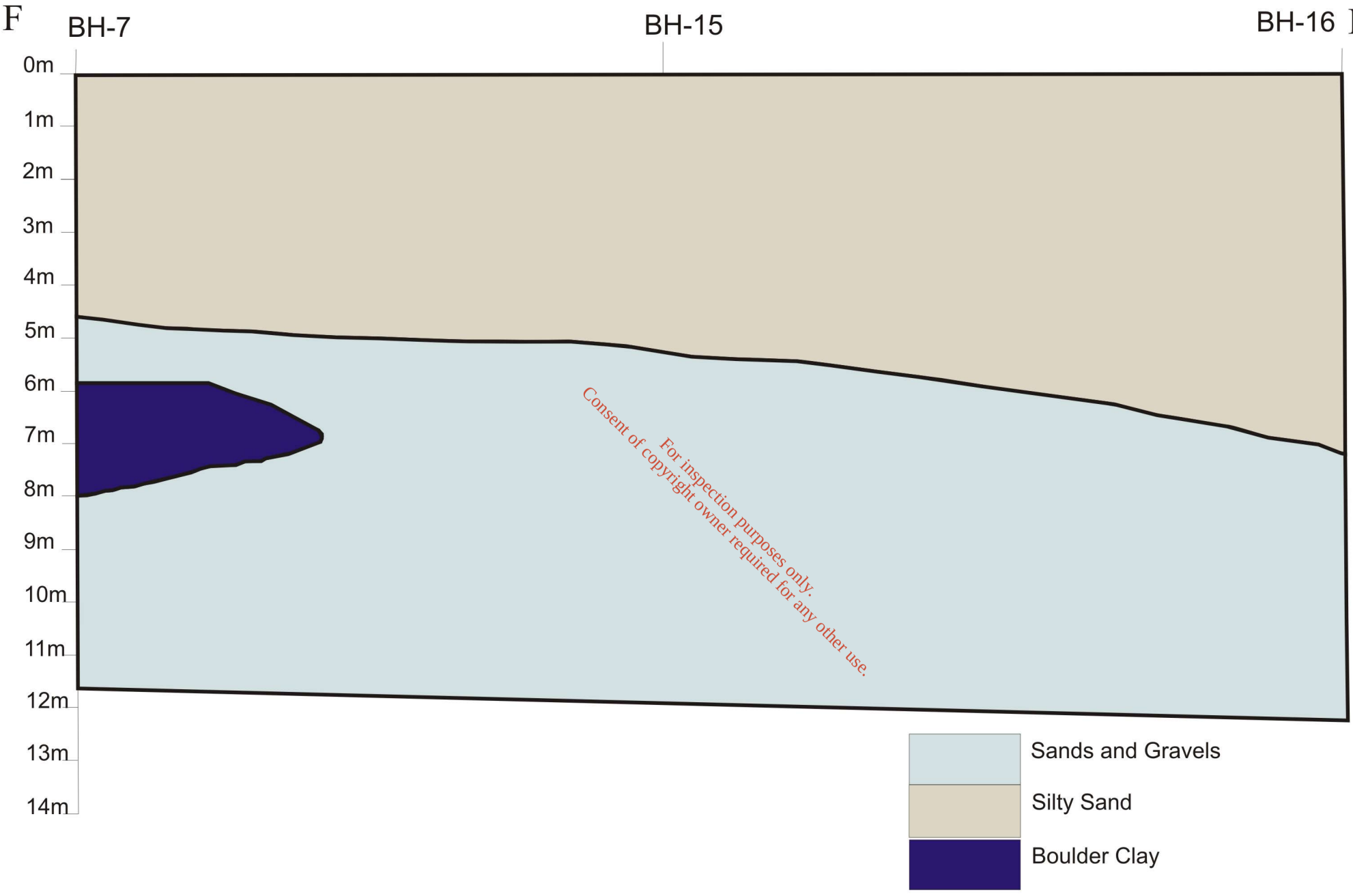

O' Callaghan Moran & Associates.
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Cork Ireland.
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email : info@ocallaghanmoran.com

CLIENT
Dripsey Green Partnership

TITLE
Cross Section F-F* (7-15-16)

Details

FIGURE NUMBER

Scale
Not To Scale

Revision

APPENDIX 5

Surface Water / Groundwater / Dust Monitoring Results

ALcontrol Laboratories (Dublin)

18a Rosemount Business Park,
Ballycoolin,
Dublin 11
Ireland
Tel: +353 (0) 1 8829893
Fax: +353 (0) 1 8829895

CERTIFICATE OF ANALYSIS

Client: O Callaghan Moran Associates (Cork)

Granary House
Rutland Street
Cork
Ireland

Attention: Michael Watson

Date: 30 August, 2006

Our Reference: 06-B05040/01

Your Reference: 513901

Location: 513901

A total of 2 samples was received for analysis on Tuesday, 15 August 2006. Accredited laboratory tests are defined in the log sheet, but opinions, interpretations and on-site data expressed herein are outside the scope of ISO 17025 accreditation. We are pleased to enclose our final report, it was a pleasure to be of service to you, and we look forward to our continuing association.

Should this report require incorporation into client reports, it must be used in its entirety and not simply with the data sections alone.

Signed

Ken Scally
General Manager, Ireland

Lorraine McNamara
Laboratory Technical Manager

Compiled By

Marie O'Connell

UKAS TESTING
1291
GROUP

Printed at 12:41 on 08/09/2006

ALcontrol Laboratories Ireland

Test Schedule

Ref Number: 06-B05040/01

Client: O Callaghan Moran Associates (Cork)

Date of Receipt: 15/08/2006

Sample Type: WATER

Location: 513901

Client Contact: Michael Watson

Client Ref: 513901

Detection Method				5 DAY ATU	ICP MS	KONE	KONE	METER	METER	METER	SPECTRO	SPECTRO	TITRATION				
UKAS Accredited [Testing Laboratory] No. 1291				✓		✓	✓	✓		✓	✓	✓	✓				
ALcontrol Reference	Sample Identity	Other ID	P / V	BOD Unfiltered	Total Hardness (ICP MS)	Chloride	Nitrate as NO3	Conductivity	Dissolved Oxygen	pH (Liquid)	Ammoniacal Nitrogen	COD Unfiltered	Total Alkalinity				
06-B05040-S0037-A01	SW 1	UNKNOWN	Plastic Bottle + H2SO4	-	-	-	-	-	-	-	X	-	-				
06-B05040-S0037-A03	SW 1	UNKNOWN	Plastic Bottle	X	X	X	X	X	X	X	-	X	X				
06-B05040-S0038-A01	SW 2	UNKNOWN	Plastic Bottle + H2SO4	-	-	-	-	-	-	-	X	-	-				
06-B05040-S0038-A03	SW 2	UNKNOWN	Plastic Bottle	X	X	X	X	X	X	X	-	X	X				

Notes : NUMERIC VALUES INDICATE ADDITIONAL SCHEDULING

* SUBCONTRACTED TO OTHER LABORATORY / ** SAMPLES ANALYSED AT THE CHESTER LABORATORY

ALcontrol Laboratories Ireland

Test Schedule Summary

Ref Number: **06-B05040/01** **Sample Type:** **WATER**
Client: O Callaghan Moran Associates (Cork) Location: 513901
Date of Receipt: 15/08/2006 Client Contact: Michael Watson
Client Ref: 513901

* SUBCONTRACTED TO OTHER LABORATORY / ** SAMPLES ANALYSED AT THE CHESTER LABORATORY

SCHEDULE	METHOD	TEST NAME	TOTAL
X	5 DAY ATU	BOD Unfiltered	2
X	ICP MS	Total Hardness (ICP MS)	2
X	KONE	Chloride	2
X	KONE	Nitrate as NO3	2
X	METER	Conductivity	2
X	METER	Dissolved Oxygen	2
X	METER	pH (Liquid)	2
X	SPECTRO	Ammoniacal Nitrogen	2
X	SPECTRO	COD Unfiltered	2
X	TITRATION	Total Alkalinity	2

☐ Interim
☑ Validated

ALcontrol Laboratories Ireland

Table Of Results

Ref Number: 06-B05040/01
Client: O Callaghan Moran Associates (Cork)
Date of Receipt: 15/08/2006
(of first sample)

Sample Type: WATER
Location: 513901
Client Contact: Michael Watson
Client Ref: 513901

	Detection Method	5 DAY ATU	ICP MS	KONE	KONE	METER	METER	METER	SPECTRO	SPECTRO	TITRATION					
	Method Detection Limit	<2mg/l	<1mg/l	<1mg/l	<0.3mg/l	<0.014mS/cm	<0.1mg/l	napH Units	<0.2mg/l	<15mg/l	<1mg/l					
UKAS Accredited [Testing Laboratory] No. 1291		✓		✓	✓	✓		✓	✓	✓	✓					
ALcontrol Reference	Sample Identity	Other ID	BOD Unfiltered	Total Hardness	Chloride	Nitrate as NO3	Conductivity (at 25 deg. C)	Dissolved Oxygen	pH	Ammoniacal Nitrogen as N	COD Unfiltered	Total Alkalinity as CaCO3					
			mg/l	mg/l	mg/l	mg/l	mS/cm	mg/l	pH Units	mg/l	mg/l	mg/l					
06-B05040-S0037	SW 1	UNKNOWN	2	67	21	18.7	0.213	6.9	7.72	0.2	<15	60					
06-B05040-S0038	SW 2	UNKNOWN	<2	67	20	17.9	0.211	5.7	7.85	<0.2	<15	50					

Notes : METHOD DETECTION LIMITS ARE NOT ALWAYS ACHIEVABLE DUE TO VARIOUS CIRCUMSTANCES BEYOND OUR CONTROL.

NDP = NO DETERMINATION POSSIBLE

Checked By : Marie O'Connell

* SUBCONTRACTED TO OTHER LABORATORY / ** SAMPLES ANALYSED AT THE CHESTER LABORATORY

APPENDIX

APPENDIX

1. Results are expressed as mg/kg dry weight (dried at 30°C) on all soil analyses except for the following: NRA Leach tests, flash point, and ammoniacal N_2 by the BRE method, VOC, PRO, Cyanide, Acid Soluble Sulphide, SVOC, DRO, PAH, PCB, TPH CWG ,TPH by IR, OFGs and SEM.

2. Samples will be run in duplicate upon request, but an additional charge may be incurred.

3. A sub sample of all samples received will be retained free of charge for one month for soils and one month for waters (sample size permitting), but may then be discarded unless we are instructed to the contrary. Once the initial period has expired, a storage charge will be applied for each month or part thereof until the client cancels the request for sample storage.

4. With respect to turnaround, we will always endeavour to meet client requirements wherever possible, but turnaround times cannot be absolutely guaranteed due to so many variables beyond our control.

5. We take responsibility for any test performed by sub-contractors (marked with an asterisk). We endeavour to use UKAS Accredited Laboratories, who either complete a quality questionnaire or are audited by ourselves. For some determinands there are no UKAS Accredited Laboratories, in this instance a laboratory with a known track record will be utilised.

6. When requested, an asbestos screen is done in-house on soils and if no fibres are found will be reported as NFD – no fibres detected. If fibres are detected, then identification and quantification is carried out by ALcontrol Technichem or Alcontrol Shutlers in the UK. If a sample is suspected of containing asbestos, then drying and crushing will be suspended on that sample until the asbestos results are known. If asbestos is present, then no analysis requiring dry sample are undertaken.

7. If no separate volatile sample is supplied by the client, the integrity of the data may be compromised if the laboratory is required to create a sub-sample from the bulk sample – similarly, if a headspace is present in the volatile sample.

8. NDP – No Determination Possible due to insufficient/unsuitable sample.

9. Metals in water are performed on a filtered sample, and therefore represent dissolved metals – total metals must be requested separately.

10. A table containing the date of analysis for each parameter is not routinely included with the report, but is available upon request.

Last updated February 2005

ALcontrol Laboratories
Unit 18a, Rosemount Business Park,
Ballycoolin, Dublin 11
e-mail: Ireland.schedulers@alcontrol.ie
Tel: 01 8829893 Fax: 01 8829895

Client: OCM
Address: Granary Hse Rutland St. Cork
Contact name: Michael Watson
Tel: 0868255965 Fax:
Project/Site Name: 05/3901
Project Code: 05/3901
Quote Reference:

Date of Despatched:
Sampler:
Email schedule to:
Email results to: michael@occallaghanmore.com
Job Continuation - yes / no

Sheet ..... of .....

Date of Sampling:	Sample Ref. ID	Depth in metres	Sample Preservation Y/N	(S)oil or (W)ater (specify if other	Sample Concentration Low, Medium or High (L, M, H)	Suite Name/Analysis Required
14.8.06	SW1					pH, EC, DO, BOD, COD, Chloride, ammonia, alkalinity + hardness, nitrate
	SW2					
	[illegible]					pH, EC, DO, BOD, COD, Chloride, ammonia, alkalinity, Hardness, Nitrate, Potassium, Sodium, Sulphate

Turnaround - please tick
10 day t/a
5 day t/a
3 day t/a
1 day t/a
date results required by:
Comments

Report format
Standard

Sampler Signature

Special Instructions/Known Hazards:
(Please inform the lab of any known hazards in the sample, ie Asbestos)

P.O. Number 05/3901

Invoice address if different from above:

Date Received: Time: Temp Signature:

southern scientific services ltd.

OUR REF: RP 2006, O' CALLAGHAN MORAN 36 [REV 01 / 04.10.06]

ANALYSIS REPORT

CUSTOMER:	O' CALLAGHAN MORAN & ASSOCIATES	SAMPLE TYPE:	DUST
ADDRESS:	Granary House, Rutland Street, Cork	DATE SAMPLED:	30 Days
		DATE RECEIVED:	13 September 2006
REPORT TO:	MARTINA GLEESON	DATE ANALYSED:	15 - 19 September 2006
ORDER NO:		DATE REPORTED:	21 September 2006
SAMPLING PT:	DRIPSEY [05-139-01]	WORK NO.:	15755 C

TABLE OF RESULTS

LAB REF:	YOUR REF:	TOTAL DUST mg/m²/Day	ORGANIC DUST mg/m²/Day	INORGANIC DUST mg/m²/Day
C06-Sep 253	D1	1610	93	1517
C06-Sep 255	D2	210	65	145
C06-Sep 256	D3	188	79	109
C06-Sep 257	D4	178	99	79

Jennifer Keane
Chemistry Laboratory

- The results relate only to the items tested.
- The analysis report shall not be reproduced except in full without written approval of the laboratory.