



**Hydraulics Research**  
Wallingford

COHESIVE SEDIMENT RESEARCH

A database of UK projects

Report SR 217  
March 1989

Registered Office: Hydraulics Research Limited,  
Wallingford, Oxfordshire OX10 8BA.  
Telephone: 0491 35381. Telex: 848552

## CONTRACT

This report describes work funded by Hydraulics Research and by the Department of the Environment under Research Contract PECD 7/6/110 for which the nominated officer was Dr R P Thorogood. It is published on behalf of the Department of the Environment, but any opinions expressed in this report are not necessarily those of the Department of the Environment. The report was produced by Dr E A Delo in the Tidal Engineering Department, under the management of Mr M F C Thorn.

© Crown Copyright 1989

Published by permission of the Controller of Her Majesty's Stationery Office.

## ABSTRACT

Hydraulics Research (HR) and the Department of the Environment (DoE) have jointly funded research with the objective of collaborating with University and Polytechnic researchers in the field of cohesive sediments.

To ensure that HR were fully aware of ongoing and recent past research on cohesive sediments in the UK, a questionnaire was circulated in a letter dated 29 November 1989 to many researchers at UK institutions. Information was requested on project timing, funding organisation, scope of work, progress and publications to date. The returned completed forms were collated and distributed to respondents and other interested parties.

This report comprises the completed questionnaire forms and a one page summary of projects.



# COHESIVE SEDIMENTS RESEARCH

Page	Investigator	Institution	Title	Sponsor(s)	Start	Finish
1	Sills G C	University of Oxford	Sediment behaviour in the Irish Sea	DoE / MAFF	01-Oct-83	31-Mar-88
2	Sills G C	University of Oxford	Properties of surface layers of sediment beds	SERC	01-Mar-85	31-Aug-88
3	Burt T N	Hydraulics Research	Estuarine muds	DoE (CID)	01-Apr-85	31-Mar-88
4	Odd N V M O	Hydraulics Research	Fluid mud processes	DoE (CID)	01-Apr-85	31-Mar-88
5	Burt T N	Hydraulics Research	Siltation and stability of dredged channels	DoE (CID)	01-Apr-86	31-Mar-88
6	DeLo E A	Hydraulics Research	Engineering application of academic research in cohesive sediments	DoE (CID)	01-Apr-87	31-Mar-90
7	Evans E M	IMS Plymouth Polytechnic	Modelling cohesive sediment transport	WRC	01-May-87	30-Apr-90
8	Webber N B	University of Southampton	Field investigation of siltation	SERC	01-Jul-87	30-Jun-89
9	Jones T E R	Plymouth Polytechnic	Response of cohesive beds to fluid shear	SERC / HR	01-Nov-87	31-Oct-90
10	Dyer K R	IMS Plymouth Polytechnic	The interaction of suspended cohesive sediments with turbulent flow	MERC / PML	01-Jan-88	01-Jan-90
11	Alani S	IMS Plymouth Polytechnic	The strength, density and settling velocity of cohesive flocs	MERC	01-Jan-88	01-Jan-90
12	Hardman T M	University of Reading	Physical chemistry of cohesive sediments	SERC	01-Jan-88	31-Dec-90
13	DeLo E A	Hydraulics Research	Fluidisation of settled mud by wave action	DoE (CID)	01-Oct-88	31-Mar-92
14	Dyer K R	IMS Plymouth Polytechnic	Residence time and cycling of particles within a turbidity maximum	MERC (Case)	01-Oct-88	30-Sep-91
15	O'Connor B A	University of Liverpool	Mud process modelling	SERC / HR	01-Oct-88	30-Sep-90
16	Paterson D M	University of Bristol	Biogenic stabilisation of estuarine tidal flats	RS	01-Dec-88	01-Dec-93
17	Sills G C	University of Oxford	Consolidation of phosphatic muds	?	01-Jan-89	30-Sep-89
18	Falconer	University of Bradford	Mathematical modelling of flow and solute and sediment transport	ECSTC, China	01-Mar-89	01-Mar-92
19	Odd N V M O	Hydraulics Research	Extrapolating tidal model predictions to long term siltation effects	DoE (CID)	01-Apr-89	31-Mar-92
20	Burt T N	Hydraulics Research	Flocculation of cohesive sediment	DoE (CID)	01-Apr-89	31-Mar-92
21	DeLo E A	Hydraulics Research	Estuarine sediments: near-bed processes	DoE (CID)	01-Apr-89	31-Mar-92
22	Odd N V M O	Hydraulics Research	Fluid mud processes	ETSU	01-Jul-89	30-Jun-92
23	McCave I N	University of Cambridge	North East Coast Cohesive Sediment Dynamics Study (NECCESEDS)	DoE / MAFF	01-Jun-88	30-Apr-91
	Vincent C E	University of East Anglia	North East Coast Cohesive Sediment Dynamics Study (NECCESEDS)	DoE / MAFF	01-Jun-88	30-Apr-91
	Dickson R R	MAFF Lowestoft	North East Coast Cohesive Sediment Dynamics Study (NECCESEDS)	DoE / MAFF	01-Jun-88	30-Apr-91



## COHESIVE SEDIMENTS RESEARCH

**INVESTIGATOR(S):**

G. C. Sills

**INSTITUTION:**

Oxford University Engineering Department

**TITLE:**

Sediment behaviour in the Irish Sea

**SPONSOR(S):** D.o.E./M.A.F.F.

**START DATE:** 1st October 1983

**COMPLETION DATE:** 31st March 1988

**DESCRIPTION OF PROJECT:**

Field and laboratory study of sea-bed parameters. Settling column simulations of in situ deposition and consolidation progress are compared with in situ measurements and those made on cores recovered from the sea-bed.

**OUTLINE OF PROGRESS UP TO END 1988:**

Project completed. Three cruises on M.A.F.F. Research Vessel Cirolana allowed in situ pore pressures and density to be measured. Loss of sediment during coring was examined, and found to be significant for a barrel core with liner. Strengths and densities were measured on samples recovered from good cores, and compared with strengths and densities of laboratory sediment beds. The comparison provided evidence that creep had occurred in situ, and could be significant.

**PUBLICATIONS:**

G. C. SILLS and M. J. EDGE (1986) Sediment behaviour in the Irish Sea. DoE Report No. DOE/RW/87.090.

W. R. PARKER and G. C. SILLS (1985) Observation of corer penetration and sample entry during gravity coring.

## COHESIVE SEDIMENTS RESEARCH

**INVESTIGATOR(S) :**

G. C. Sills

**INSTITUTION:**

Oxford University Engineering Department

**TITLE:**

Properties of surface layers of sediment beds

**SPONSOR(S) :** S.E.R.C.

**START DATE:** 1st March 1985

**COMPLETION DATE:** 31st August 1988

**DESCRIPTION OF PROJECT:**

Laboratory-based study of sediment deposited in settling columns, consolidating under its own weight. The effects of initial salinity, initial concentration and time are examined, with relation to the development of erosion resistance.

**OUTLINE OF PROGRESS UP TO END 1988:**

Project completed. At initial concentrations of sediment lower than those at which effective stresses exist (i.e. before a supporting structure develops in the bed), the consolidation process shows little evidence of creep. This is in contrast to an earlier study at higher initial concentrations. In both studies, an aging effect was noted in the increase of shear strength with time at constant effective stress. In this study, there was little dependence of salinity level in the range 0.2 - 5ppt

**PUBLICATIONS:**

In preparation.

The following publications from the earlier S.E.R.C. supported study may be noted:

D.McG. ELDER and G.C. SILLS Time and stress dependent compression in soft sediments. ASCE Symp. Prediction and Validation of Consolidation, San Francisco, October 1984.

G. C. SILLS and D.McG. ELDER The transition from sediment suspension to settled bed. Proc. Workshop Estuarine Cohesive Sediment Dynamics, from series 'Lecture Notes on Coastal and Estuarine Studies', Ed. A. J. Mehta, Springer-Verlag, November 1984, Tampa, Florida.



## COHESIVE SEDIMENTS RESEARCH

**INVESTIGATOR(S) :**

Dr E A Delo  
Mr T N Burt

**INSTITUTION:**

Hydraulics Research Ltd

**TITLE:** Estuarine Muds

**SPONSOR(S):** Department of the Environment (CID)

**START DATE:** April 1985      **COMPLETION DATE:** March 1988

**DESCRIPTION OF PROJECT:**

To review the literature and produce a working manual on the engineering behaviour of mud. To determine by experiment in the HR carousel the factors governing erosion and deposition in the tidal cycle. To study the consolidation of mud beds in the laboratory and to construct a mathematical model. To quantify the effect on the erosion characteristics of various proportions of sand in a mud bed.

**OUTLINE OF PROGRESS UP TO END 1988:**

The project has been completed as described above. See the report list below.

**PUBLICATIONS:**

HR Report SR 77 The hydraulic engineering characteristics of estuarine muds. Dec 1986.  
HR Report SR 95 Simulation and experimental determination of a consolidating mud deposit. July 1987.  
HR Report SR 138 The behaviour of estuarine muds during tidal cycles. February 1988.  
HR Report SR 149 Consolidation and erosion of estuarine mud and sand mixtures. February 1988.  
HR Report SR 164 Estuarine muds manual. February 1988.

## COHESIVE SEDIMENTS RESEARCH

**INVESTIGATOR(S):**

Mr N V M Odd  
Mrs M P Kendrick

**INSTITUTION:**

Hydraulics Research Ltd

**TITLE:** Fluid mud processes

**SPONSOR(S):** Department of the Environment (CID)

**START DATE:** April 1985

**COMPLETION DATE:** March 1988

**DESCRIPTION OF PROJECT:**

To establish by experiment the range of wave and tidal conditions under which near-bed fluid mud suspensions are created and transported. To develop a general theory which describes the motion of a fluid mud layer and incorporate it in an existing computational mud transport model. To formulate, through laboratory studies, engineering solutions to fluid mud flow. To construct field instruments to measure the flow of fluid mud layers.

**OUTLINE OF PROGRESS UP TO END 1988:**

The project has been completed as described above. See the report list below.

**PUBLICATIONS:**

HR Report SR 84 An analysis of the behaviour of fluid mud in estuaries. March 1986.

HR Report SR 88 Laboratory experiments on a near-bed turbid layer. June 1987.

HR Report SR 129 Measurement of fluid mud layers - field instrument developments. March 1987.

HR Report SR 147 A two-dimensional model of the movement of fluid mud in a high energy turbid estuary. January 1988.

HR Report SR 162 Laboratory investigation of measures to reduce fluid mud siltation in dredged navigation channels. February 1988.

## COHESIVE SEDIMENTS RESEARCH

**INVESTIGATOR(S):**

Dr E A Delo  
Mr T N Burt

**INSTITUTION:**

Hydraulics Research Ltd

**TITLE:** Siltation and stability of dredged channels

**SPONSOR(S):** Department of the Environment (CID)

**START DATE:** April 1986      **COMPLETION DATE:** March 1988

**DESCRIPTION OF PROJECT:**

To use HR experimental facilities to define more precisely the mechanism of siltation of dredged channels by settlement of sediment from suspension, so that maintenance dredging quantities can be more accurately forecast.

To determine through literature review and laboratory experiment, the stable angle of repose of channel side slopes under flowing water for mud at different densities.

**OUTLINE OF PROGRESS UP TO END 1988:**

The project has been completed as described above. See the report list below.

**PUBLICATIONS:**

HR Report SR 117 The stability of cohesive dredged slopes. August 1987.

HR Report SR 154 The stability of cohesive dredged slopes under wave action. February 1988.

HR Report SR 180 Siltation of cohesive dredged slopes manual. June 1988.

## COHESIVE SEDIMENTS RESEARCH

**INVESTIGATOR(S):**

Dr E A Delo  
Mr T N Burt

**INSTITUTION:**

Hydraulics Research Ltd

**TITLE:** Engineering application of academic research in cohesive sediments

**SPONSOR(S):** Department of the Environment (CID)  
Hydraulics Research Ltd

**START DATE:** April 1987      **COMPLETION DATE:** March 1990

**DESCRIPTION OF PROJECT:**

To collaborate with university and polytechnic researchers carrying out research on cohesive sediments with other financial support, by providing staff support, experimental facilities at HR and services.

To collate and interpret cohesive sediment research carried out by universities, collaboratively or otherwise, so as to make it available for practical engineering applications.

**OUTLINE OF PROGRESS UP TO END 1988:**

Response of cohesive beds to fluid shear. HR is working in collaboration with Plymouth Polytechnic. Measurement of the velocities in three dimensions in the HR carousel flume have been conducted and used to verify a 3D model of the flow set up by Plymouth.

Cohesive sediment modelling. HR is working with Liverpool University. Laboratory tests have been conducted at HR on mud from Grangemouth Docks to determine its erosional, consolidation, entrainment and settling on slopes properties.

**PUBLICATIONS:**

None to date.

## COHESIVE SEDIMENTS RESEARCH

**INVESTIGATOR(S):** Dr. E.M. EVANS  
and Professor K.R. DYER

**INSTITUTION:**  
Institute of Marine Studies  
Plymouth Polytechnic

**TITLE:** "Modelling cohesive sediment transport."

**SPONSOR(S):** Water Research Centre

**START DATE:** May 1987

**COMPLETION DATE:** 1989

**DESCRIPTION OF PROJECT:** The parameterisation of sedimentary processes within estuaries is being investigated from the basis of up-to-date research findings. These processes include settling, erosion and consolidation. These parameterisations are being tested in simple estuarine models to investigate the relative importances of the various processes to estuarine sedimentation. These parameterisations will be developed for use in regional scale models.

**OUTLINE OF PROGRESS UP TO END 1988:** Various parameterisations have been tested in a one-dimensional model estuary to examine the relationship between the tidal flows, and the response of the sediment. The inherent lags are important in causing the residual transport of sediment, and it is apparent that the ebb flood dominance of the water flow is displaced relative to that for the suspended sediment flux.

**PUBLICATIONS:** Dyer, K.R. and Evans, E.M. A study of the dynamics of the turbidity maximum in a homogenous tidal channel. Journal of Coastal Research (In press).

## COHESIVE SEDIMENTS RESEARCH

**INVESTIGATOR(S) :**

N. B. WEBBER  
DR. P. TOSSWELL

**INSTITUTION:**

DEPT. OF CIVIL ENGINEERING  
UNIVERSITY OF SOUTHAMPTON

**TITLE:** Field investigation of siltation

**SPONSOR(S) :** SERC

**START DATE:** JULY 1987

**COMPLETION DATE:** 1989

**DESCRIPTION OF PROJECT:** A silt monitoring rig was developed and installed in a quiescent berth at Port Hamble Marina. It was equipped with electro-magnetic current meters, suspended solids monitors and a temperature/salinity sensor. Recording was over a period of 17 months. Sediment traps were also installed and separately monitored.

**OUTLINE OF PROGRESS UP TO END 1988:** All the instruments performed well except the suspended solids monitors, in spite of prodigious efforts to modify and further develop them. Calibration drift was attributed to lens contamination - a serious problem in such low background concentrations (50mg/l).

Field results from cylindrical sediment traps have been encouraging. Their performance has been investigated in a large laboratory flume.

Overall, the research indicates strong correlation between silt suspension and tidal range, with higher concentrations (up to 200mg/l) being mainly associated with storm surges.

Two Ph.D. theses (mathematical modelling and sediment traps) are being finalised.

**PUBLICATIONS:**

P. Tossell and N.B. Webber, 'The Development of a Silt Monitoring Rig', Proc.Int.Conf. on Measuring Techniques of Hydraulics Phenomena, BHRA, 1986.

P. Tossell and N.B. Webber, 'Siltation in Marinas; The Case History of Port Hamble', Paper to be presented at Int.Conf.: Marina '89.

J. White, 'The Use of Sediment Traps to Monitor Marina Siltation', Paper to be presented at Int.Conf.: Marina '89.

① MFLT ② EAD

## COHESIVE SEDIMENTS RESEARCH

**INVESTIGATOR(S) :**

Dr.T.E.R.Jones

**INSTITUTION:**

PLYMOUTH POLYTECHNIC

**TITLE:**

Response of cohesive sediment beds to fluid shear

**SPONSOR(S) :**

S.E.R.C & H.R.L.

**START DATE:** 1/11/87

**COMPLETION DATE:** 1/11/90

**DESCRIPTION OF PROJECT:**

This project will be concerned with a theoretical and experimental study of the flow behaviour of cohesive sediments. The proposed theory will enable more accurate predictions to be made of critical stress levels in the H.R.flume and hence in real estuarine flow situations. The controlled stress and circular flume experimental program will produce a characterization of cohesive sediments which will lead to an improved understanding of the flow mechanisms

**OUTLINE OF PROGRESS UP TO END 1988:**

Preliminary flow experiments have been carried out to determine the low shear properties of test cohesive sediments. A calibration rig has been constructed to test shear stress probes which will be inserted in the test section at H.R.L. in the near future. The theoretical program of work, to characterize the turbulent flow of water in the Carousel, was started in September 1988 and obviously is at a very early stage. However preliminary <sup>results</sup> are encouraging and predict the primary flow quite accurately

**PUBLICATIONS:**

## COHESIVE SEDIMENTS RESEARCH

**INVESTIGATOR(S):** J. McCABE  
(Professor K.R. Dyer and  
Professor D.A. Huntley -  
Supervisors)

**INSTITUTION:**  
Institute of Marine Studies  
Plymouth Polytechnic

**TITLE:** "The interaction of suspended cohesive sediments  
with turbulent flow"

**SPONSOR(S):** NERC. Collaborative with Plymouth Marine Lab.

**START DATE:** January 1988      **COMPLETION DATE:** 1990

### DESCRIPTION OF PROJECT:

Measurements of the relationship between floc size, density, and settling velocity with turbulent parameters, such as turbulent kinetic energy, and concentration. Comparison with laboratory measurements, and interpretation in the light of analytical theory. Parameterisation of the results for inclusion into estuarine models.

### OUTLINE OF PROGRESS UP TO END 1988:

A field experiment was carried out in the Tamar Estuary during which a Malvern particle size analyser was deployed in-situ to measure the floc size and size distribution, together with two EM flow meters measuring the turbulent characteristics. Optical backscatter sensors were used to measure the concentration field. Analysis of the results is progressing, with presentation in terms of spectra, turbulence parameters and stratification, for comparison with the floc size data.

### PUBLICATIONS:

None to date.



**COHESIVE SEDIMENTS RESEARCH**

**INVESTIGATOR(S):** Dr. S. ALANI

**INSTITUTION:**  
Institute of Marine Studies  
Plymouth Polytechnic

**TITLE:** "The strength, density and settling velocity of cohesive flocs"

**SPONSOR(S):** NERC.

**START DATE:** January 1988

**COMPLETION DATE:** 1990

**DESCRIPTION OF PROJECT:** Laboratory measurements are being carried out of the interaction between natural flocs, and a turbulent field of known intensity. These are being carried out within a laboratory mixing chamber by visualisation techniques. The relationship between the floc break-up and the turbulent energies can be calculated, together with the floc sizes and settling velocities. Comparison will be carried out with field measurements.

**OUTLINE OF PROGRESS UP TO END 1988:** A series of measurements have been carried out relating the strength and density of flocs to salinity. Measurements are planned on a series of samples taken from a longitudinal section through the turbidity maximum in the Tamar Estuary.

**PUBLICATIONS:** None to date.

**COHESIVE SEDIMENTS RESEARCH**

**INVESTIGATOR(S):**

T.M.HARDMAN

J.C.WATTS.

**INSTITUTION:**

CHEMISTRY DEPARTMENT, UNIVERSITY OF  
READING.

**TITLE:**

PHYSICAL CHEMISTRY OF COHESIVE SEDIMENTS.

**SPONSOR(S):** SERC

**START DATE:** 1.1.88.

**COMPLETION DATE:** 31.12.90.

**DESCRIPTION OF PROJECT:**

Study of the surface chemistry, flocculation sedimentation and rheology of cohesive sediments.

**OUTLINE OF PROGRESS UP TO END 1988:**

Characterisation and rheological properties of natural and synthetic (model) river sediments. Flocculation studies effect of shear.

**PUBLICATIONS:**

None so far.

**COHESIVE SEDIMENTS RESEARCH**

**INVESTIGATOR(S):**  
Dr E A Delo

**INSTITUTION:**  
Hydraulics Research Ltd

**TITLE:** Fluidisation of settled mud by wave action

**SPONSOR(S):** Department of the Environment (CID)

**START DATE:** October 1988      **COMPLETION DATE:** March 1992

**DESCRIPTION OF PROJECT:**

To design and construct a stable platform and field instrumentation to measure the generation of fluid mud in the field. To construct a natural wave generator for an existing flume and conduct tests on mud beds under natural waves. To develop theory to describe the fluidisation process and incorporate it into numerical models. To communicate the findings of the research to industry through a working manual.

**OUTLINE OF PROGRESS UP TO END 1988:**

The project has run for three months. A natural wave generator has been designed and construction has commenced. Some preliminary tests on beds under mono frequency waves have been conducted to develop new measurement techniques. These include the in-situ measurement of the density of the mud bed during a test and the accurate measurement of surface vertical deflections of the mud bed under the passage of the wave.

**PUBLICATIONS:**

## COHESIVE SEDIMENTS RESEARCH

**INVESTIGATOR(S):** J. MARSH  
(Professor K.R. Dyer and  
Dr. A.J. Bale - Supervisors)

**INSTITUTION:**  
Institute of Marine Studies  
Plymouth Polytechnic

**TITLE:** "The residence time and cycling of particles within a turbidity maximum"

**SPONSOR(S):** NERC (Case studentship)

**START DATE:** October 1988      **COMPLETION DATE:** 1991

**DESCRIPTION OF PROJECT:** Techniques are being developed to label estuarine particles with fluorescent tracer. Labelled particles will then be released at various places within the turbidity maximum, and detected using a flow cytometer. From the results the residence time of particles within the turbidity maximum can be calculated, as well as the timescales involved in the exchange of cohesive sediment between the bed and suspension.

**OUTLINE OF PROGRESS UP TO END 1988:** A preliminary literature survey has been completed. Initial experiments with the flow cytometer have shown the detectability limits, and sampling errors that have to be taken into account when designing field experiments.

**PUBLICATIONS:**      None to date.

**COHESIVE SEDIMENTS RESEARCH**

**INVESTIGATOR(S):**  
Prof. B A O'Connor  
Dr. K H M Ali

**INSTITUTION:**  
Liverpool University

**TITLE:** Mud process modelling

**SPONSOR(S):** SERC / HRL

**START DATE:** October 1988

**COMPLETION DATE:** September 1990

**DESCRIPTION OF PROJECT:**

To contact existing researchers in order to provide information for the updating of the existing models and guidance for the future laboratory and field research. To start updating and testing the existing models.

**OUTLINE OF PROGRESS UP TO END 1988:**

The carrying out of laboratory tests on fluid mud processes at Hydraulics Research in connection with the updating of the existing models.

**PUBLICATIONS:** Relevant publications connected with research - Nicholson and O'Connor, "Cohesive Sediment Transport Model", Jour. Hydr. Engrg., Vol 112, No 7, July 1986.  
O'Connor and Nicholson, "Mud transport modelling", Physical Processes in Estuaries, Dronkers and van Leussen (eds.), Springer-Verlag, Berlin, 1988.

## **COHESIVE SEDIMENTS RESEARCH**

**INVESTIGATOR(S):** Dr D M Paterson  
Dr C Little  
Dr R M Crawford

**INSTITUTION:**  
University of Bristol

**TITLE:** Biogenic Stabilisation of Estuarine Tidal Flats

**SPONSOR(S):** Royal Society

**START DATE:** 1.12.88

Provisionally  
**COMPLETION DATE:** 1.12.93

### **DESCRIPTION OF PROJECT:**

Examining the relationship between microbial communities and the surface cohesive strength of inter-tidal cohesive sediments over diurnal monthly and annual cycles.

### **OUTLINE OF PROGRESS UP TO END 1988:**

Mainly development of techniques for measurement of sediment stability and the examination of sediments frozen in situ to provide an accurate visualisation of surface sediment communities.

### **PUBLICATIONS:**

**COHESIVE SEDIMENTS RESEARCH**

**INVESTIGATOR(S) :**

G. C. Sills

**INSTITUTION:**

Oxford University Engineering Department

**TITLE:**

Consolidation of phosphatic muds

**SPONSOR(S) :**

**START DATE:** January 1989

**COMPLETION DATE:** September 1989

**DESCRIPTION OF PROJECT:**

Laboratory-based study of settlement and consolidation behaviour of a mud produced as waste during mining operations in Brazil.

**OUTLINE OF PROGRESS UP TO END 1988:**

None

**PUBLICATIONS:**

None

## COHESIVE SEDIMENTS RESEARCH

**INVESTIGATOR(S) :**

Professor R.A. Falconer  
Dr. P. Goodwin

**INSTITUTION:**

University of Bradford

**TITLE:** Mathematical Modelling of Flow and Solute and Sediment Transport in Coastal Waters, Estuaries and Rivers

**SPONSOR(S) :** European Community and Science and Technology Commission, China

**START DATE:** March, 1989

**COMPLETION DATE:** March, 1992

**DESCRIPTION OF PROJECT:** The main objectives of the study are to develop refined mathematical models of flow and solute and sediment transport due to tidal action in coastal and estuarine waters. In connection with the sediment transport aspects of the study, a two-dimensional hydrodynamic model will be linked to a three-dimensional representation of the advective-diffusion equation. The model will be applied to the Humber Estuary (UK) and, in particular, site specific studies in the People's Republic of China

**OUTLINE OF PROGRESS UP TO END 1988:**

Nil - project starts in 1989

**PUBLICATIONS:**

See attached list



**COHESIVE SEDIMENTS RESEARCH**

**INVESTIGATOR(S):**  
Mr N V M Odd

**INSTITUTION:**  
Hydraulics Research Ltd

**TITLE:** A review of methods of extrapolating tidal model predictions to long term siltation effects in estuaries.

**SPONSOR(S):** ETSU (approved in principle)

**START DATE:** April 1989      **COMPLETION DATE:** March 1990

**DESCRIPTION OF PROJECT:**

To review past and existing methods of predicting the effect of engineering works on long term siltation and erosion patterns in estuaries. In particular the extrapolation of results from tidal mathematical models.

**OUTLINE OF PROGRESS UP TO END 1988:**

This project is due to start in April 1989.

**PUBLICATIONS:**

None.

**COHESIVE SEDIMENTS RESEARCH**

**INVESTIGATOR(S):**  
Mr T N Burt

**INSTITUTION:**  
Hydraulics Research Ltd

**TITLE:** Flocculation of cohesive sediment

**SPONSOR(S):** Department of the Environment (CID) (yet to be approved)

**START DATE:** April 1989

**COMPLETION DATE:** March 1992

**DESCRIPTION OF PROJECT:**

To investigate the factors controlling the formation and size of mud flocs in estuaries. To investigate instrumentation for measuring floc size in both the laboratory and field. To correlate field and laboratory floc settling velocities. To investigate the validity of applying a differential settling correction to field settling velocity measurements. To investigate the effect of turbulence on floc size by experiment in the HR mud carousel.

**OUTLINE OF PROGRESS UP TO END 1988:**

This project is yet to be approved by DoE.

**PUBLICATIONS:**

None.

**COHESIVE SEDIMENTS RESEARCH**

**INVESTIGATOR(S):**  
Dr E A Delo

**INSTITUTION:**  
Hydraulics Research Ltd

**TITLE:** Estuarine sediments : near-bed processes

**SPONSOR(S):** Department of the Environment (CID) (yet to be approved)

**START DATE:** April 1989      **COMPLETION DATE:** March 1992

**DESCRIPTION OF PROJECT:**

To measure in the field the near-bed processes associated with cohesive sediment transport in an estuarine environment.  
To determine in the laboratory the mud properties and to simulate its behaviour during tidal cycles.  
To refine and calibrate the cohesive sediment algorithms used in predictive computer models.

**OUTLINE OF PROGRESS UP TO END 1988:**

This project is yet to be approved by DoE.

**PUBLICATIONS:**  
None to date.

**COHESIVE SEDIMENTS RESEARCH**

**INVESTIGATOR(S) :**  
Mr N V M Odd

**INSTITUTION:**  
Hydraulics Research Ltd

**TITLE:** Fluid mud processes

**SPONSOR(S):** ETSU (approved in principle)

**START DATE:** July 1989

**COMPLETION DATE:** June 1991

**DESCRIPTION OF PROJECT:**

To collect and analyse field data and to carry out laboratory experiments to test theories describing the formation and movement and shearing of thick layers of fluid mud in high energy estuaries. The Parrett Estuary will be the field site and the results will be used to possibly derive universal coefficients for incorporation into computational models. A pilot model of the Severn Estuary will be used to demonstrate the effect of fluid mud with and without a tidal barrage.

**OUTLINE OF PROGRESS UP TO END 1988:**

This project is due to start in July 1989.

**PUBLICATIONS:**

None.

## COHESIVE SEDIMENTS RESEARCH

### INVESTIGATOR(S):

P.I. Professor I.N. McCave,  
Mr. T.R.E. Owen, Dr. M.O. Green,

Dr. C. E. Vincent,  
Dr. A.E. James

Dr. R. R. Dickson & staff

### INSTITUTION

Dept. of Earth Sciences,  
Cambridge University.

School of Environmental Sciences,  
University of East Anglia.

MAFF Fisheries Lab., Lowestoft

### TITLE

North East Coast Cohesive Sediment Dynamics Study (NECCESEDS)

SPONSOR(S): DOE and MAFF

START DATE: 1st June, 1988 COMPLETION DATE: 30th April 1991

### DESCRIPTION OF PROJECT:

Field study of wave-current interaction and resulting stresses and sediment resuspension over sandy mud beds in the near shore region between the Tyne and the Tees. Study of the mechanical properties of the sediment, their geochemistry and radiochemistry in order to assess contaminant loadings and rates of accumulation and bioturbation. Study of the hydrography of the region and the dispersal of fine suspended sediment trapped inshore of the Flamborough Front. Development of new instrumentation for study of the wave-current boundary layer, bed roughness and sediment setting velocity distribution.

### OUTLINE OF PROGRESS UP TO END 1988:

Site selection: areas between Tyne and Tees surveyed and sampled to find area of mud bed in water shallower than 30 m where wave action will be great in storms.

Trial deployment of MAFF tetrapod with e.m. and pressure sensors and 0.25 m transmissometer over 25 hour periods. Data have been used to examine structure-flow interferences, sensor performance and spectral characteristics of flow with and without wave action.

Trial deployments of new settling tube (redesign of Owen tube), the QUISSET (Quasi in situ settling tube). Median settling velocity is  $6 \times 10^{-3}$  mm/s with a modal value of  $7 \times 10^{-2}$  mm/s.

Grant-Madsen-Glen (GMG) model for the sediment stratified wave-current boundary layer set up and numerical experiments run on conditions likely to be encountered off N.E. coast.

Models of spectral windows for Reynolds Stress estimation in sediment stratified flows investigated to provide guidance in instrument and experimental design. We will be measuring stress both from  $u'w'$  and dissipation-region data.

### PUBLICATIONS:

No publications yet

