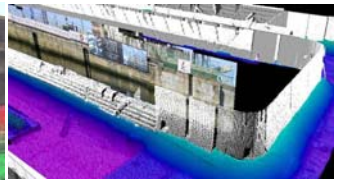

High Resolution Hydrographic Surveying at The Port of London

John Dillon-Leetch, *Port of London Authority*

Objectives

- Overview of Port of London.
- Presentation of results achieved to date with Multibeam (MBES)
- How MBES can be used for submarine Structural Surveys.
- New Developments
- Conclusions.

Port of London

- Trust Port
- Self funding
- Top 3 UK Ports
- 70 operational berths
- 50 million T p.a.
- 30,000 movements
- 140 Km river & estuary – 400 sq. miles
- London Gateway Port Development 2008

PLA Hydrographic Department

- 6 surveyors: 5 Chartered/Cat “A”
  - Experience from Port , Offshore Survey, and Merchant Marine Sectors.
- Produce 500 surveys per year (35% under contract)
- Multibeam Capability since 2004
  - National and International Recognition in the development of MBES for High Resolution surveys

Continue

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New MBES Vessel
Galloper

- **Transportable by trailer** – project or chartered work further from base.
- **High Speed (28 knots)** – **Shallow Draft**
- **Moonpool** for deployment allows flexibility of equipment deployment (MBES/ADCP)

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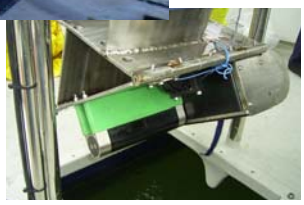
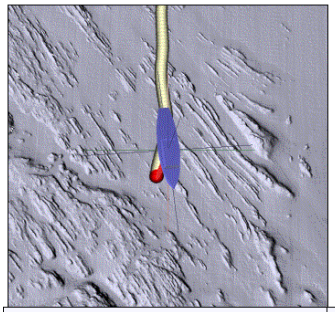
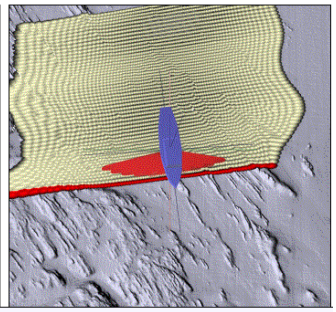
MBES Equipment

- **Verifier: – Reson SeaBat 8101 240KHz system**. Beam width of 1.5° x 1.5° covering a 150° swath.
- **Yantlet: – Reson SeaBat 8125 425KHz system**. Beam width of 0.5° x 1.0° covering a 120° swath.
- **Galloper Reson SeaBat 7125 400KHz** In the 400kHz configuration, the receiver forms 256 equi-angle focused 0.5° receive beams or 512 in equi-distant mode, to cover a 128° swath,
- **Position fixing:** : Applanix PosMV Inertial navigation unit providing positional and orientation data. **POSPac** post processing s/w to Centimetric Accuracy
- **Processing: Hypack/Hysweep and Fledermaus.**



Multibeam Technology





Single Beam

- grossly under samples
- minimum slant range only
  - (assumes vertical)

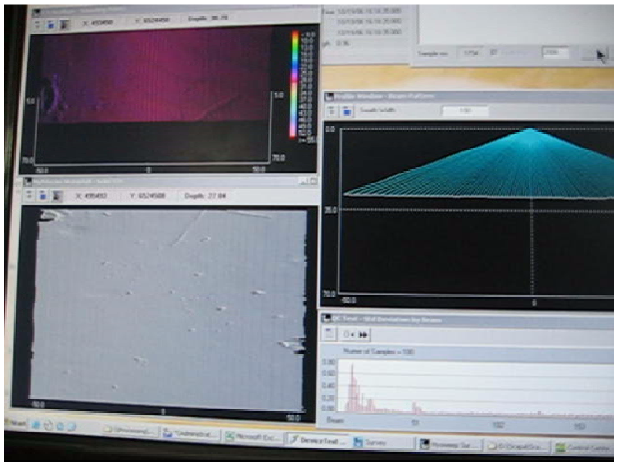
MultiBeam

- multiple solutions per ping
  (estimates azimuth and depression angle)
- close to 100% coverage
- resolves shorter horizontal wavelengths
  BUT still limited to beam footprint/spacing

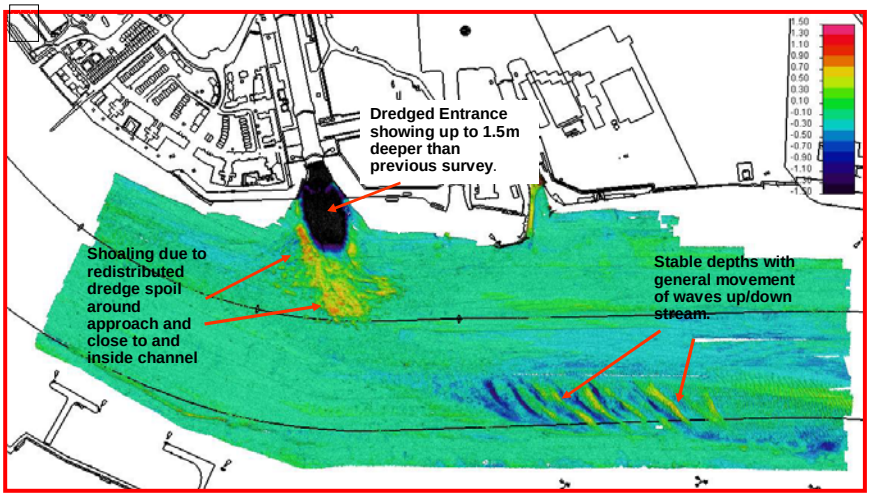
University of New Brunswick CANADA

© J.E. Hughes Clarke, OMG/UNB

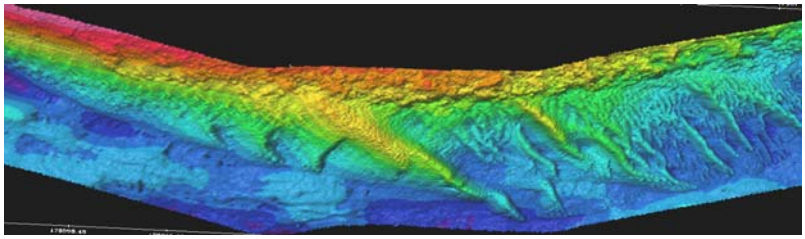
Multibeam Technology



Riverbed/ Dynamics

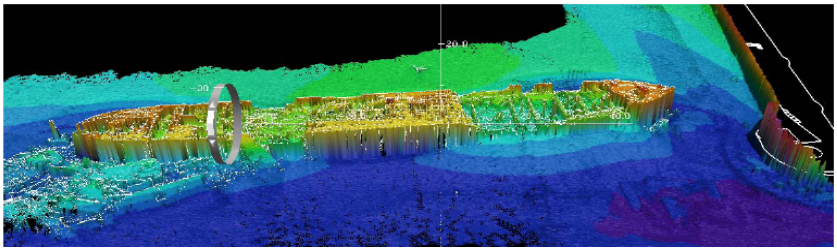


Riverbed Dynamics: Visualisations



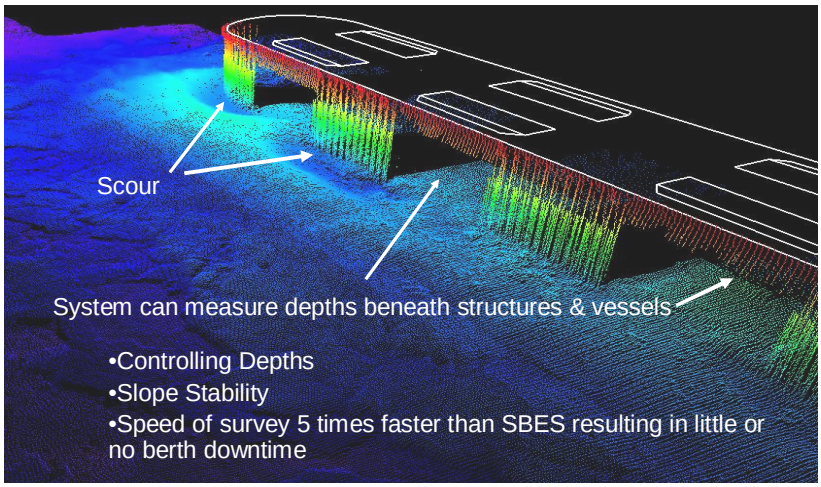
- Free-viewing software methodologies
- Powerful Project support capability.
- Value Added particularly to non-surveyors

New Deliverables for Existing & New Customers



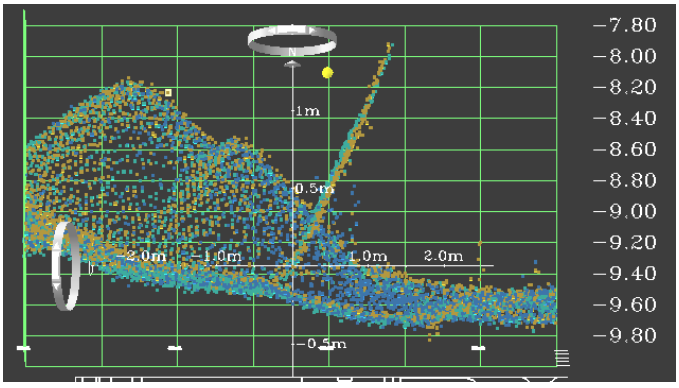
- New Technologies New Software
- New Visualisations/delivery
- Investment to be justified

Berth Survey – High Resolution .



Visualisation Capability

Obstruction Detection XL-XS



- Pre and Post works survey – terms of specification
- Ensuring berth safe for vessels

Data Clients

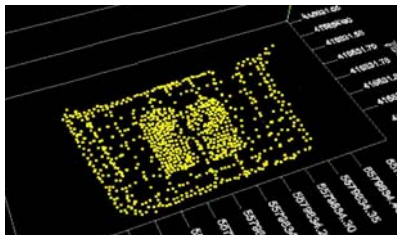
- Harbour Masters ,Berth Owners & Mariners
- Environmentalists
- Geologists
- Archaeologists
- Salvors / Divers
- Police/ Security
- **Engineers – Hydrodynamic & Civil**

Civil Engineering Support

- Baseline Surveying
- Structure examination
- Site Investigation
- Wall Condition Surveys: Pre/Post Works

Assessing the System Capabilities

8125: Could it do what it said on the tin?



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Civil Engineering Support -Proving The System

- Land Survey
- Chart datum Tie-in
- Checks for accuracy and precision

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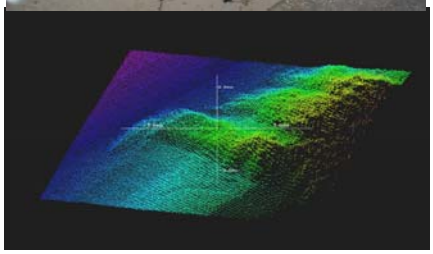
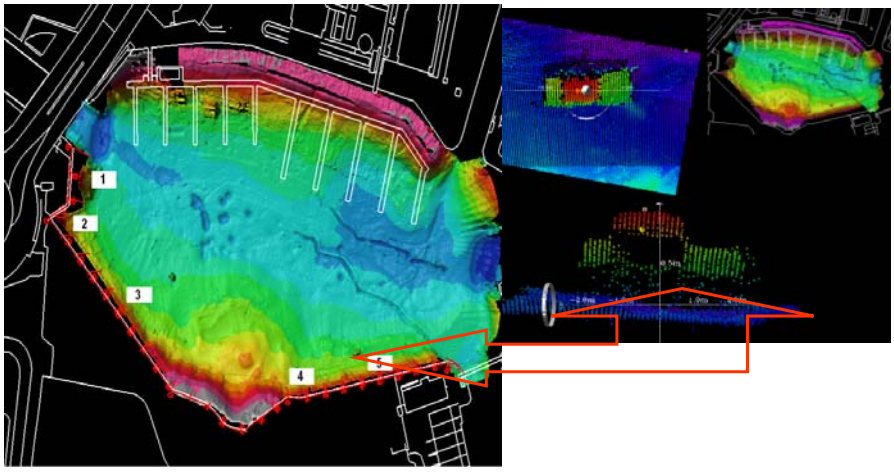
Proving The System

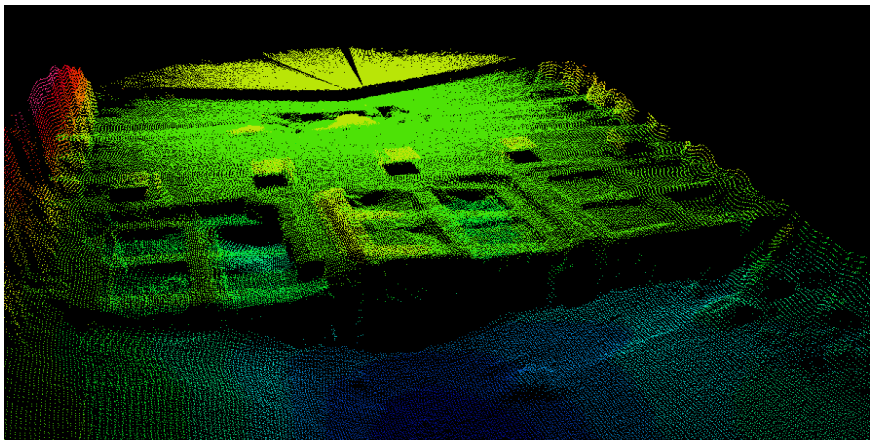


- Horizontal Position accuracy
- DGPS +/- 0.25m ,
- RTK GPS 0.03m horizontal
- Vertical repeatable accuracy 0.04 to 0.10m

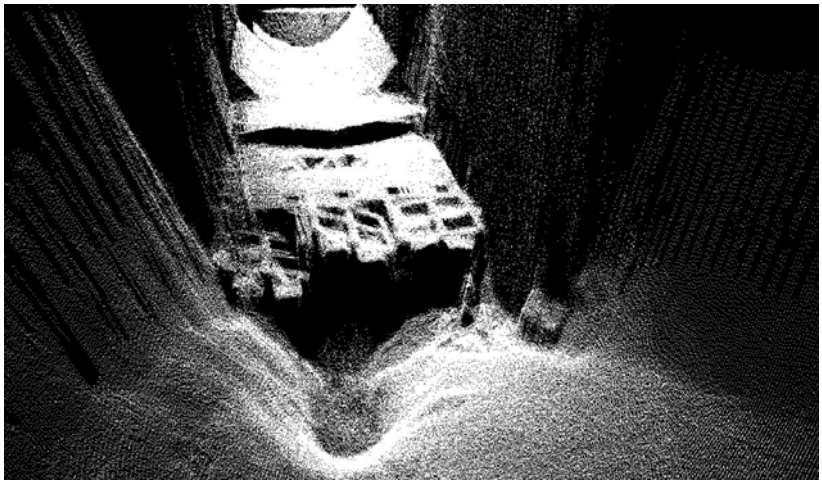
Baseline Surveying/Monitoring



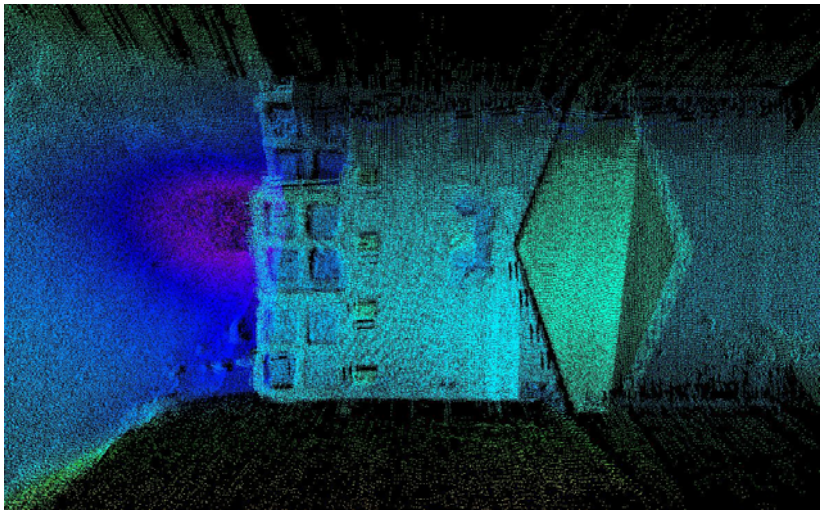
Structure Monitoring



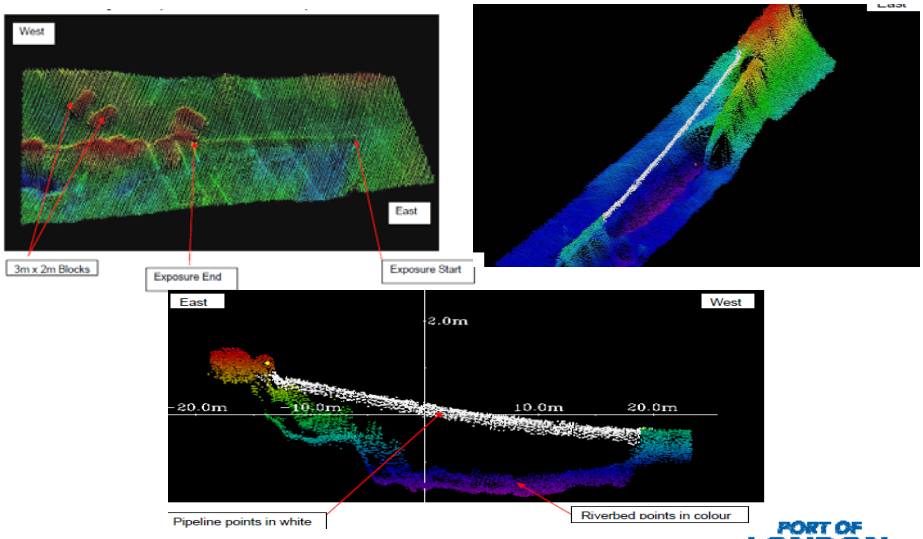
Structure Monitoring-Scour Damage



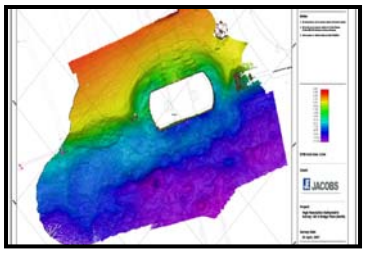
Plan View Showing Undercutting

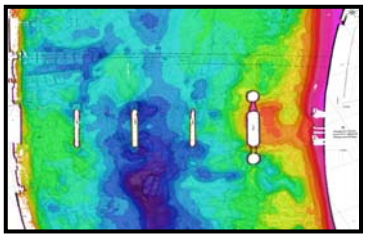


Pipeline Scour



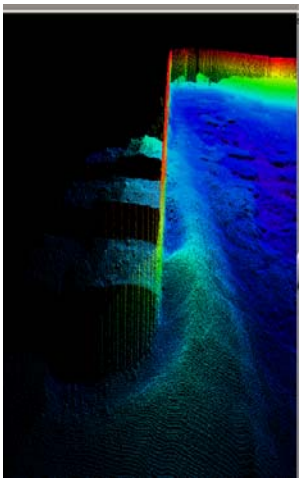
Bridge Pier Monitoring

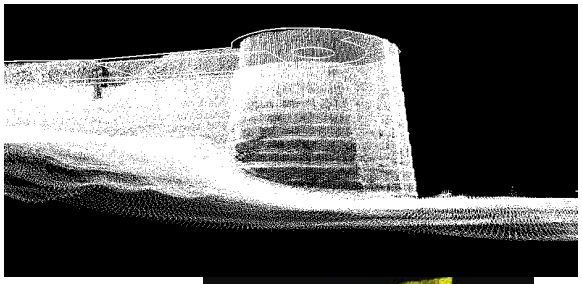


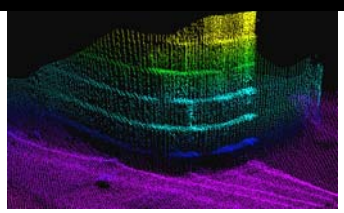


- Baseline Assessment
- Post Works Clearance
- Inspection
- Scour Monitoring
- Bed Protection Assessment & Volume calculations
- Reporting

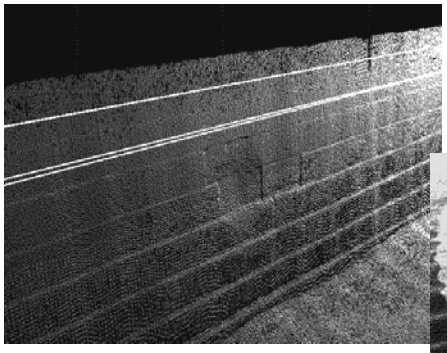
Site Investigation/Monitoring – Vertical Surfaces



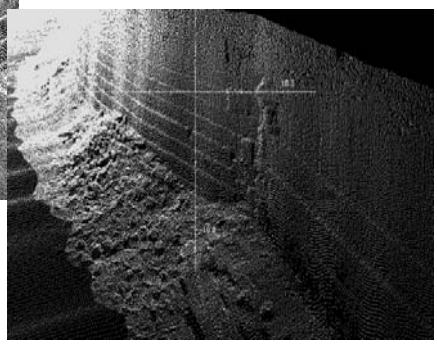




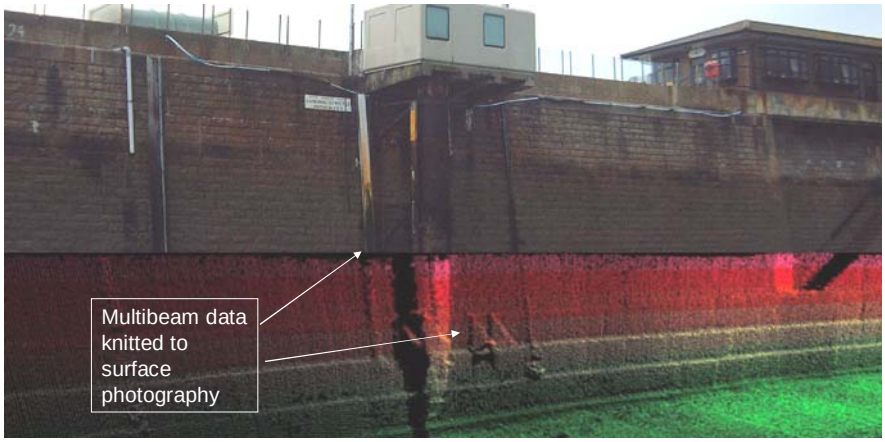
Quay Wall Survey Monitoring



- From Minor erosion to major deformation



Amalgamation with other data sources.



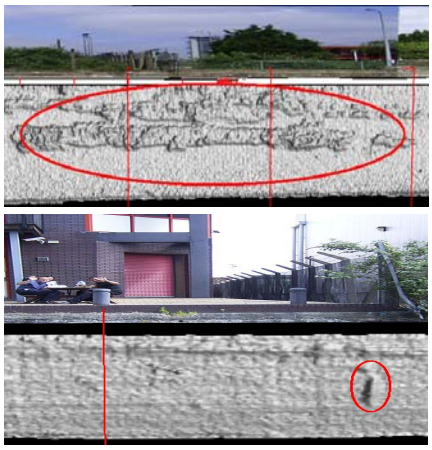
- Proves system & makes data interpretation easier for non-surveying client.
- Reduced re-work

Diver Replacement/Augmentation

The Problems of Surveying in Ports

Canary Wharf: July 2007

- Joint Venture with Engineering Diving Company
- General Diver survey replaced by MBES.
- Detailed Diver Survey: *99% correlation between MBES and Diver survey for all quay walls*.



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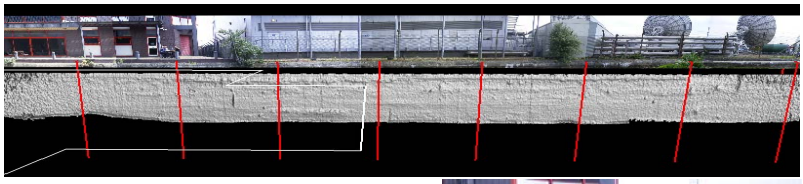
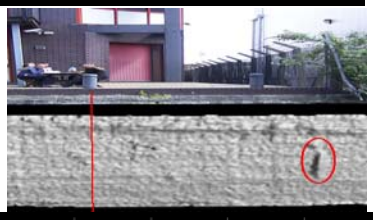
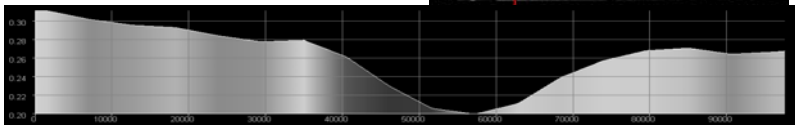
Small Feature Detection (Missing Bricks)



- **Feature Information**
- Feature ID: WWharf_021
- Wall: Wood Wharf 5
- Easting: 537961.44mE
- Northing: 180134.27mN
- Chainage: 65m
- Depth: 2.75-3.80m
- Recess: **0.10m**
- Length: **0.20m**
- Notes: Vertical recess in wall





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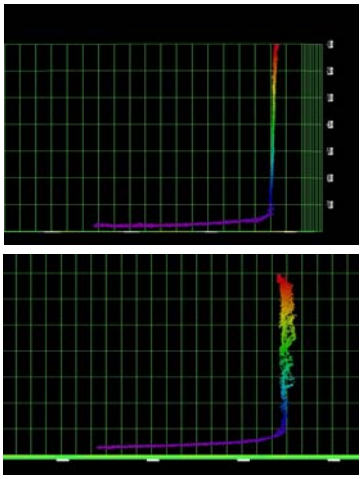
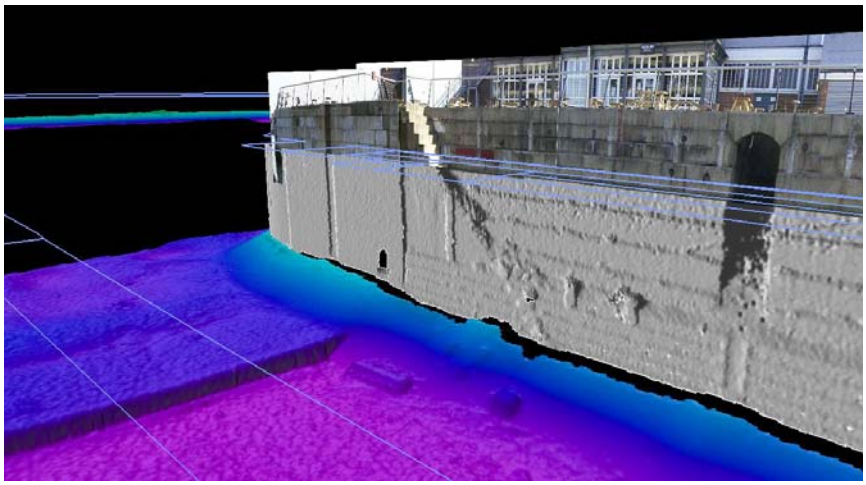
High Resolution Data X-Sections



- **Profile Information**
- Profile ID: WWharf_P02
- Wall: Wood Wharf 2
- Chainage: 20m
- Gradient: 88 degs
- Notes: Wall in good condition.

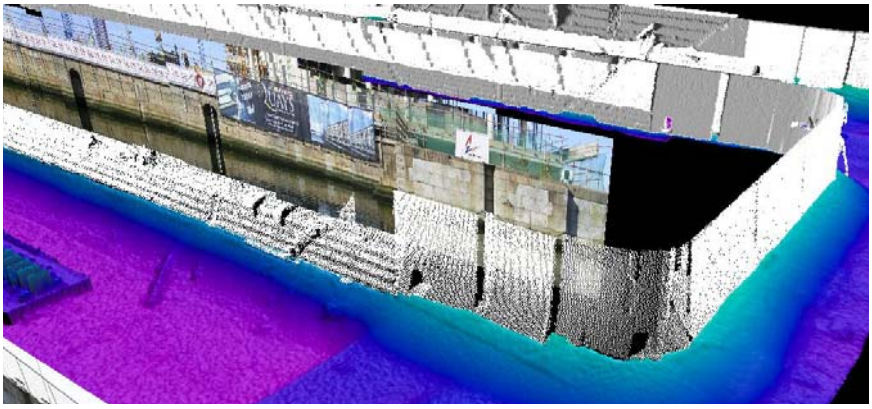
- **Profile Information**
- Profile ID: WWharf_P05
- Wall: Wood Wharf 2
- Chainage: 119m
- Gradient: 92 degs
- Notes: This wall section is just to the west of the ladder and has severe damage to the top two-thirds with recesses of up to 0.4 m. The wall is also overhanging slightly at this point which might indicate that it is being pushed from behind.

Chatham Maritime – Listed Dock Walls & Baseline Assessment



Wall Surveys

Fledermaus 3D Scene



Projects- 2008-2009

Projects:

- **ARUP** - London Eye & Canary Wharf Development
- **Dover** – Breakwater Outer and Inner Surveys
- **HYDER** – CX Rail and Waterloo Bridges
- **Mott MacDonald** – Medway Road Tunnel
- **Mouchel Parkman** – Blackwall & Rotherhithe Tunnels
- **Jacobs** - QE II Bridge and Dartford Tunnels.
- **Southern Water** – Outfalls High Resolution Surveys
- **Chatham Maritime** – Full Dock basin and Flooded Dry Docks
- **Cemex** –Cement Terminal - dock structural integrity
- **Southern Water** – Outfalls off South Coast of UK
- **Centrica** – Humber Pipeline Crossing

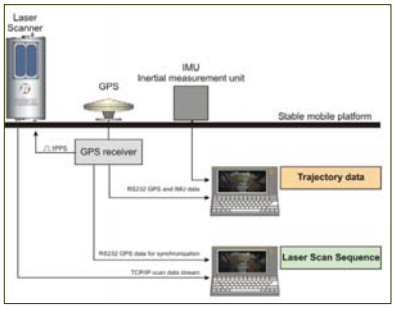
Engineering Project Support – (Hydrodynamic & Civil)

MBES Surveys deliver:-

- Tangible Results.
- Powerful Project Support Capability.
- Safe & Non Intrusive methodology
- Augment or replace Dive Surveys.
- Fast Turnaround & Delivery
- Excellent value for money.

Laser Scanning – 2008

- **Laser Scanning Schematic**

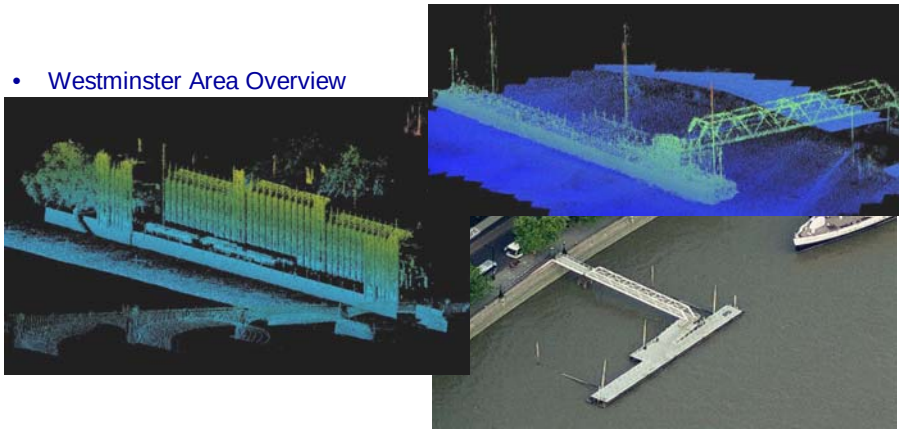


Riegl Laser mobilised to PLA survey vessel Galloper (Aug '08)

Laser Data Examples

Savoy Pier Scan Imagery

- Westminster Area Overview



CONCLUSIONS

- Performing dock wall surveys using multibeam technology significantly reduces the time it takes to inspect and survey dock walls.
- Data is collected at a much higher resolution than is possible using general diver surveys.
- There are much lower HSE risks associated than with Diver Surveys.
- Dock wall surveys can be performed at the same time as other dredge or charting survey activities and can form part of an annual inspection
- Accuracy, Precision and repeatability reaching structural survey levels
- 3D visualisation significantly enhances the products produced and aids the analysis and presentation of the data'
- New Developments: Integration of Terrestrial Laser systems?

- **Technology only as good as the surveyor acquiring & processing the data – not push button systems**

Any Questions?