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Central Dredging Association

TBT - TREATMENT AND DISPOSAL

Institution of Civil Engineers, 24 September 2007

DEFINING THE PROBLEM

Steve Challinor, Royal Haskoning
s.challinor@royalhaskoning.com

thinking in
all dimensions

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2. When is TBT a problem?
3. TBT Clean
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1. Why is TBT a problem?

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Licensing of disposal of dredged material at sea:

- Food & Environment Protection Act 1985
- Protection of the environment and human health
- Case by case assessment of licence applications
- Weight of evidence approach
- TBT = one of many potential contaminants

TBT is:

- Highly toxic, particularly to marine organisms such as molluscs, even at low concentrations

2. When is TBT a disposal problem?

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Defining TBT contamination for disposal at sea:

- Action Level 1 = 0.1mg/kg
- Action Level 2 = 1.0 mg/kg

Interpreting TBT contamination:

- <0.1mg/kg = disposal at sea likely
- 0.1 to 1.0mg/kg = disposal at sea possible
- >1.0mg/kg = disposal at sea unlikely

2. When is TBT a treatment problem?

Some factors affecting viability of treatment:

- Volume of contaminated dredged material
- Nature of the TBT contamination:

1. diffuse contamination absorbed to sediment particles
2. paint particles and flakes present in sediment matrix

- TBT distribution across sediment particle sizes
- TBT removal efficiency / target concentration
- Availability of treatment facility
- Cost

3. Treatment options – TBT Clean

TBT Clean:

- EU LIFE funded project - Antwerp Port Authority
- “Development of an integrated approach for the removal of tributyltin from harbours and waterways: prevention, treatment and reuse of TBT-contaminated sediments”
- www.portofantwerp.be/tbtclean/

Research topics:

- Screening of technologies
- Sediment characterisation
- Remediation, including dredged material
- Reuse of cleaned sediment
- Cost-benefit analysis

3. Treatment options – TBT Clean

Pre-treatment options:

- Fraction separation (e.g. hydrocyloning) to obtain sand for further treatment (e.g. density separation / floatation)

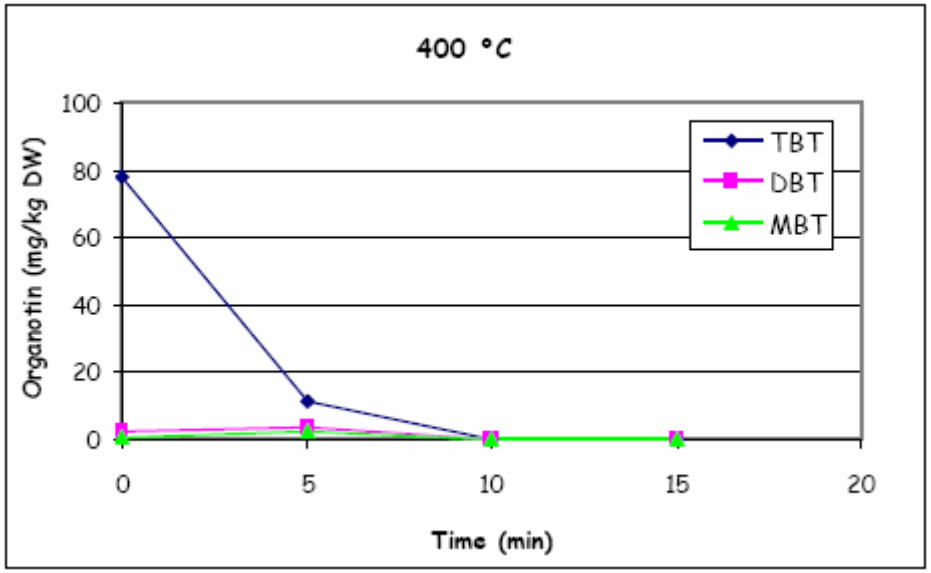
Remediation options:

- Thermal treatment for highly contaminated sediment (i.e. >10mg/kg TBT)
- Bioremediation for moderately contaminated sediment (i.e. 1-10mg/kg TBT)
- Other options generally not technically and/or economically feasible

3. Treatment options – TBT Clean

TBT removal efficiencies:

- Lagooning (dewatering) + biomediation = c.50-70% removal of TBT at 1-10mg/kg
- Mechanical dewatering + thermal treatment = c.90+% removal of TBT at >10mg/kg
- Hydrocyloning + mechanical washing (of sand fraction) + thermal treatment = c.90+% removal of TBT at 1-10mg/kg



3. Treatment options – TBT Clean

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Costs (based on 10,000 tonnes dry sediment):

- Lagooning and biomediation = 80 euros / tonne
- Mechanical dewatering + thermal treatment = 180 euros / tonne
- Hydrocyloning + mechanical washing + thermal treatment = 140 euros / tonne

Above costs exclude:

- Transport of dredged material to/from treatment facility
- Additional treatment for other contaminants (if necessary)
- Subsequent disposal

3. Treatment options – TBT Clean

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Conclusions:

- TBT is thermally unstable, so heat used to volatilise organic content = TBT degradation to DBT, MBT and inorganic tin
- At 450°C, degradation from 72.6mg/kg to 0.29mg/kg (TBT removal = 99%) takes up to 15 minutes
- Higher temperatures = higher TBT removal
- Thermal treatment is only feasible remediation technique for highly TBT contaminated sediments, with a high removal efficiency
- Thermal treatment also degrades other organic contaminants (e.g. PAHs)
- Thermal treatment does not degrade metal contaminants, but leaves a solid residue needing further treatment (e.g. stabilisation)

4. Case study - Falmouth

Location: Falmouth, Cornwall

Objective: navigation of larger cruise vessels and tankers

4. Case study - Falmouth

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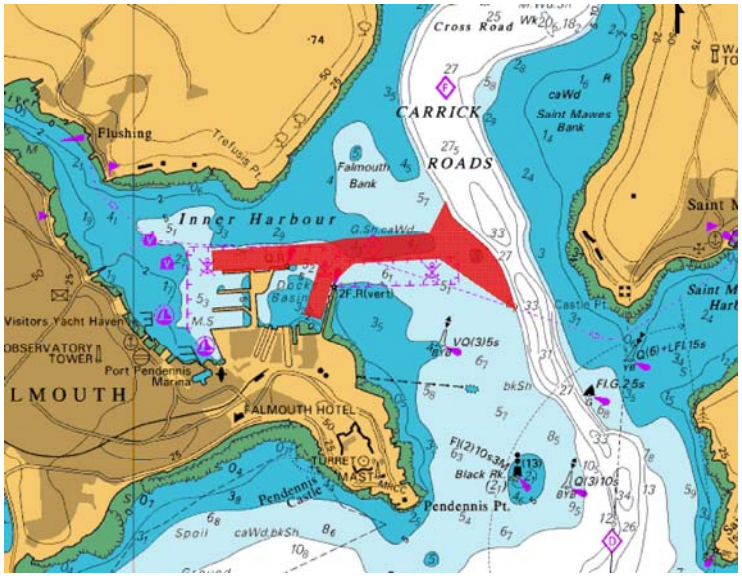
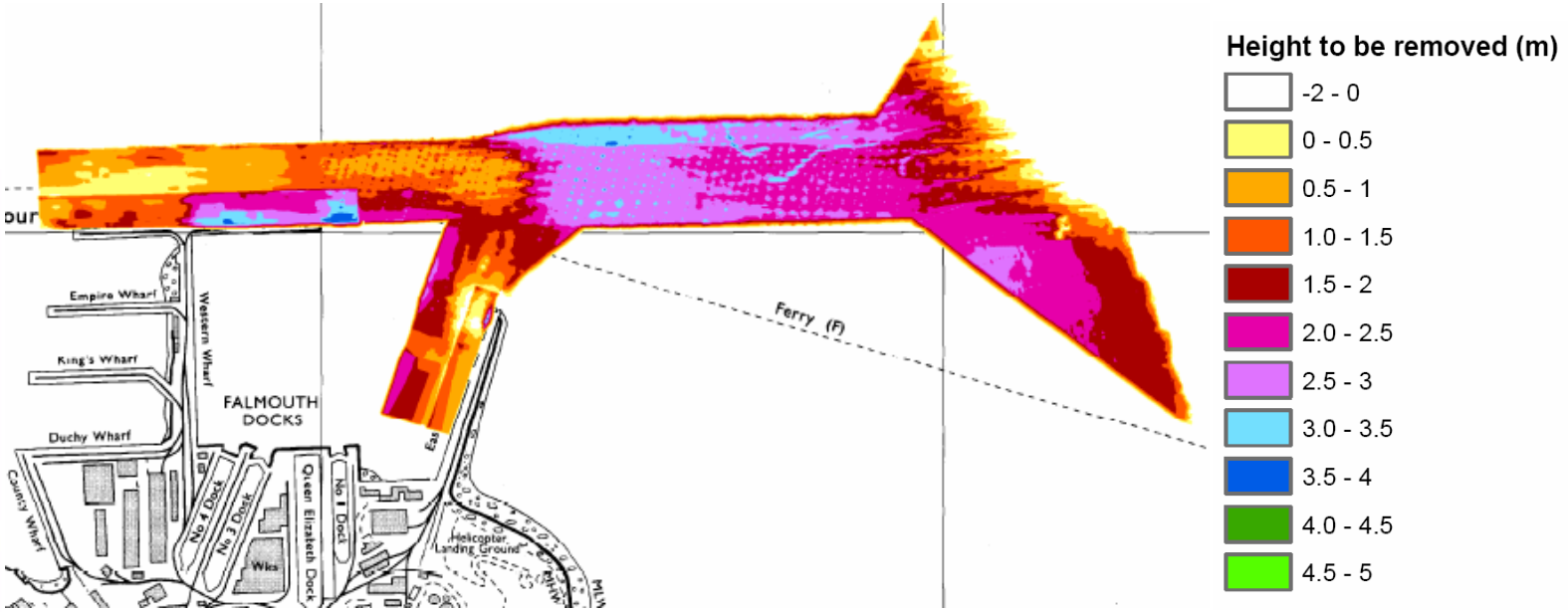
Proposed capital dredge:

- Approaches to -8.3mCD
- Berths to -9.5mCD





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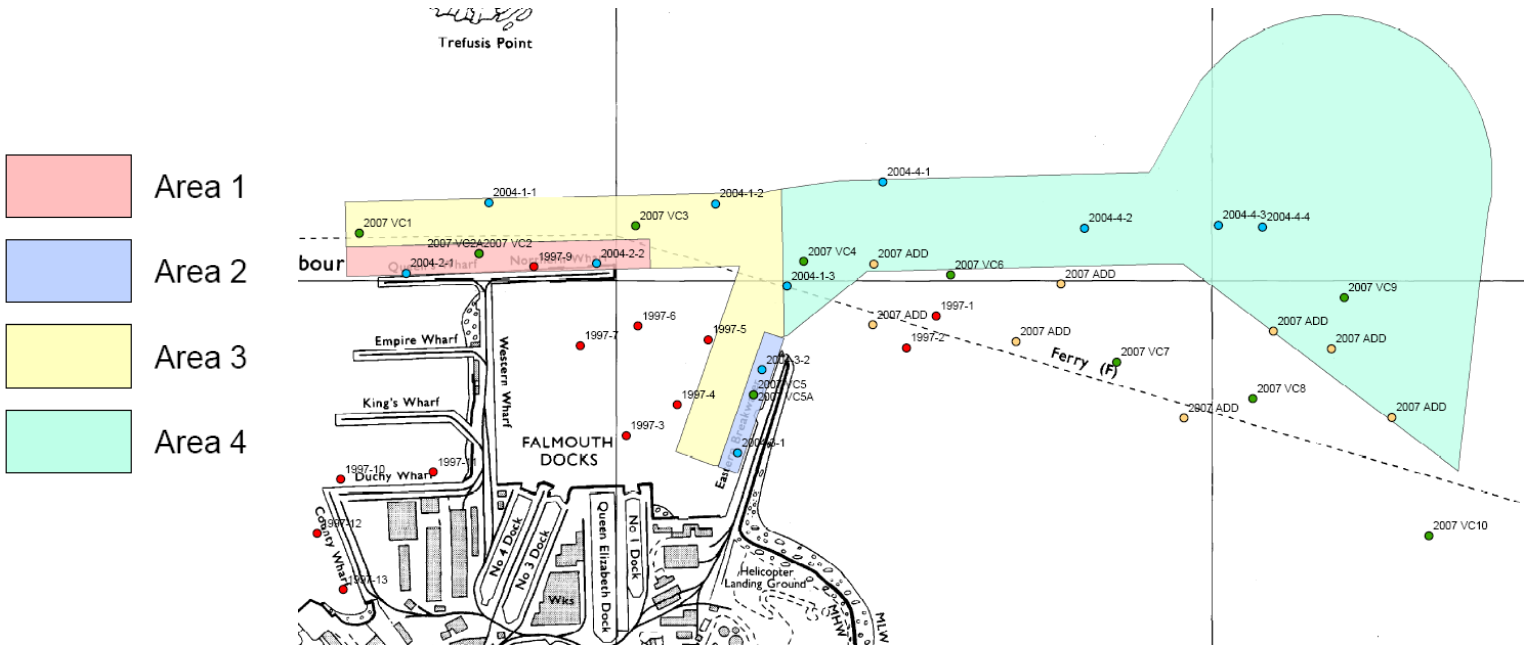
4. Case study - Falmouth

Predicted volume of dredged material:

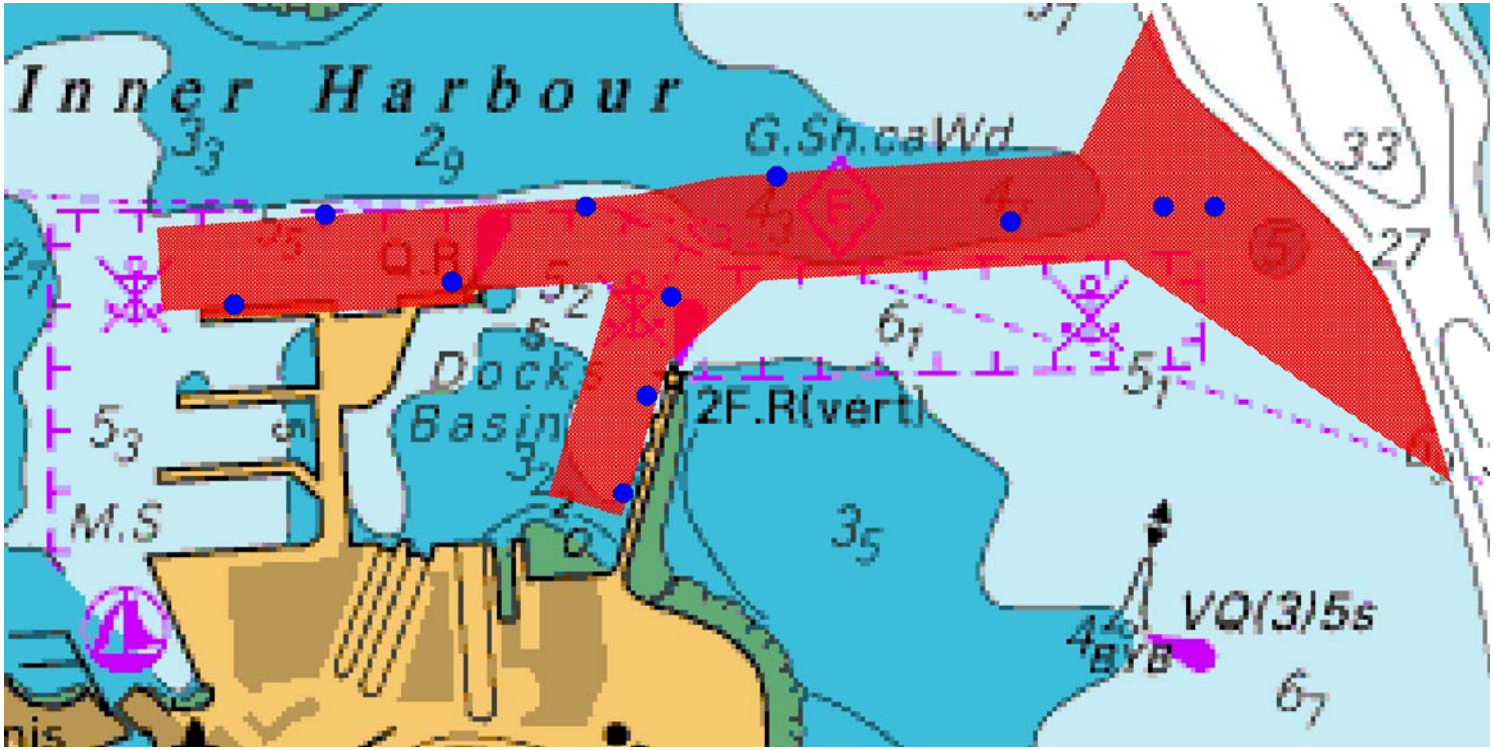
- Area 1 = 57,900m^3
- Area 2 = 9,000m^3
- Area 3 = 112,960m^3
- Area 4 = 480,680m^3
- Total = 660,540m^3



4. Case study - Falmouth

TBT concentrations: 2004 survey

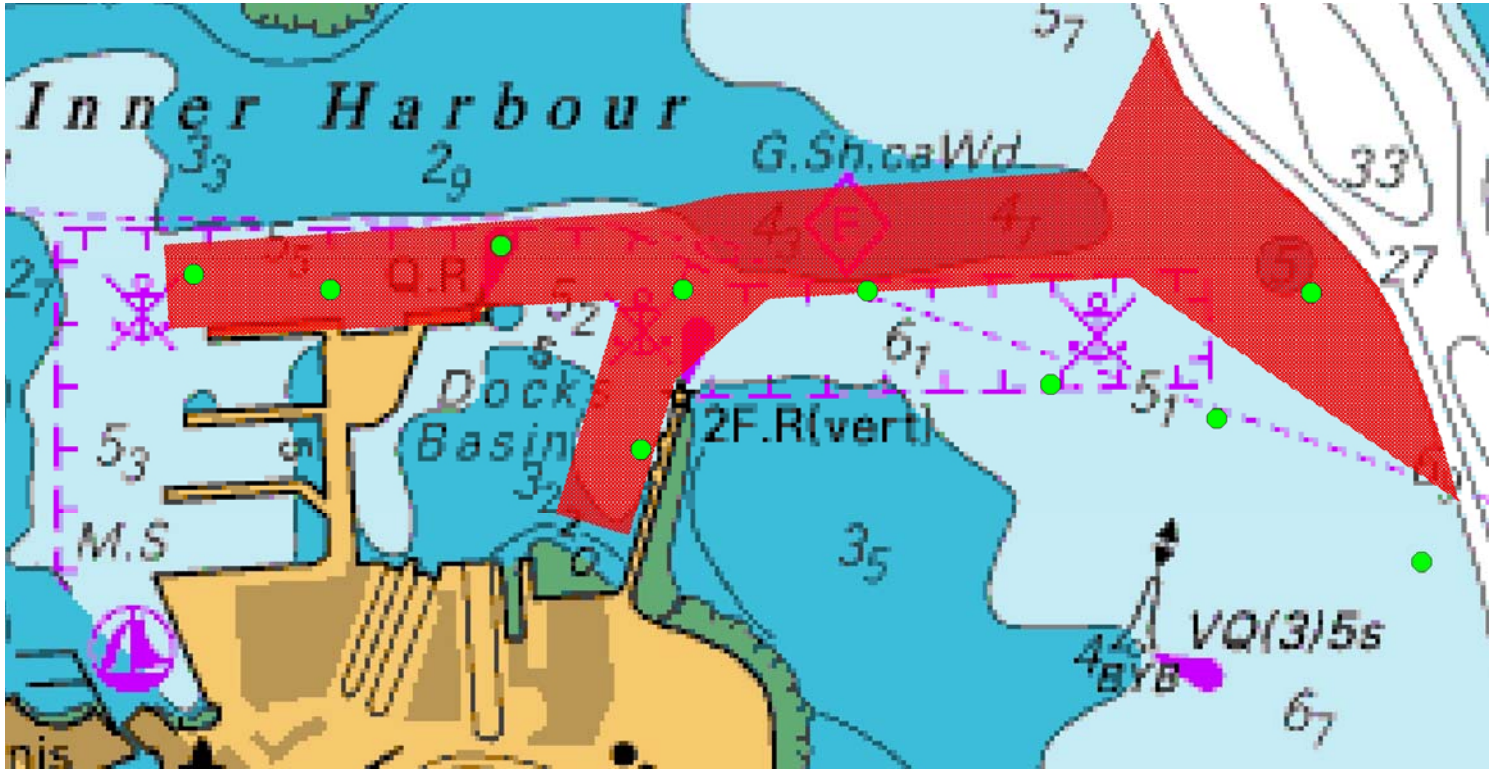
- Min. <0.002mg/kg
- Max. 18.5mg/kg



4. Case study - Falmouth

TBT concentrations: 2007 survey

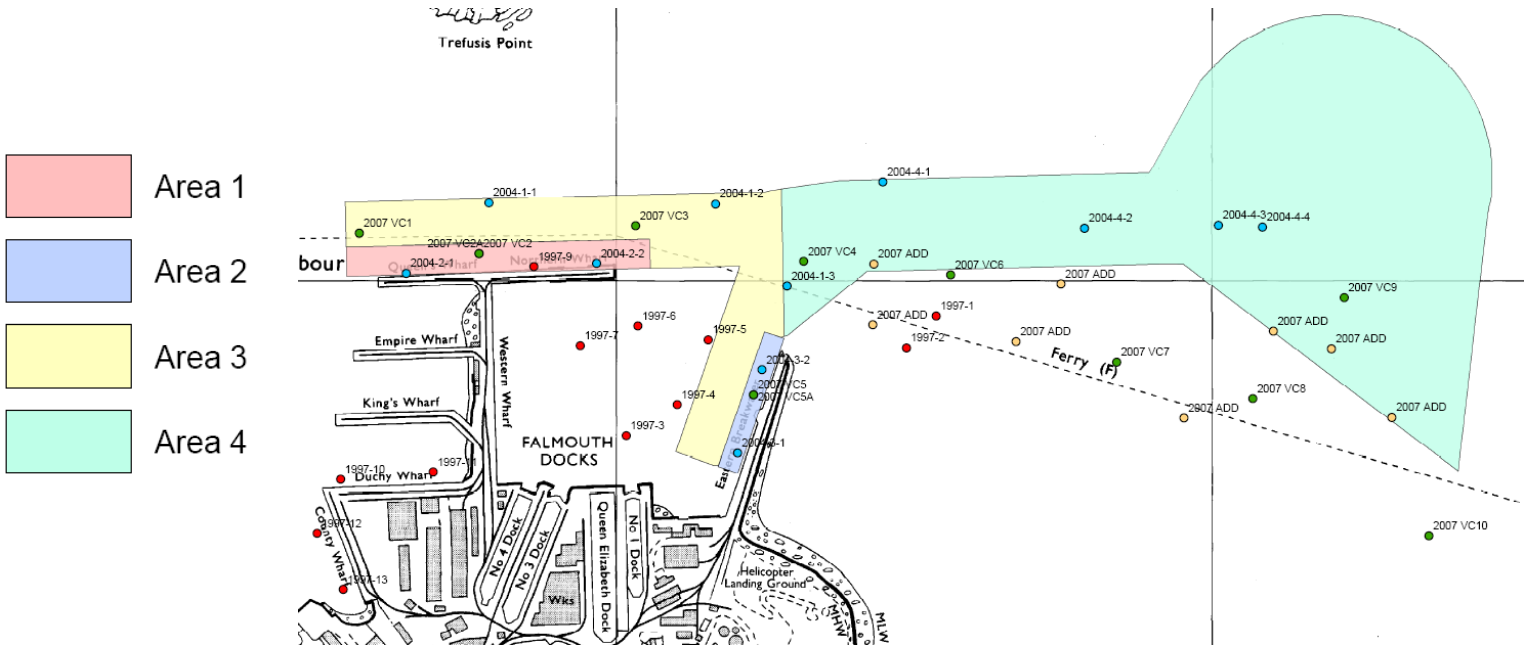
- Min. <0.001mg/kg
- Max. 12.3mg/kg



4. Case study - Falmouth

Scale of contamination: sediment unacceptable for disposal at sea following initial advice from Cefas, based on 2004 survey:

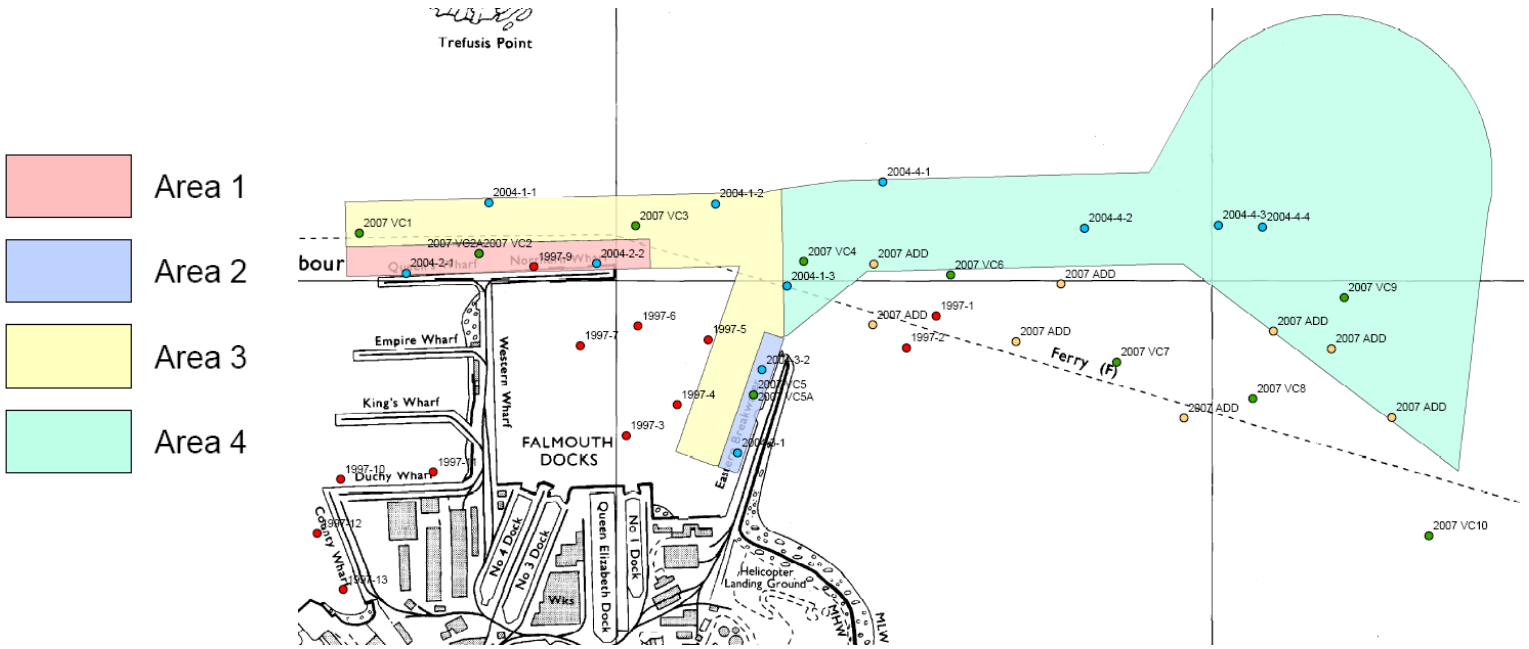
- Area 1 = unacceptable to 1m below seabed
- Area 2 = unacceptable to 2m below seabed
- Area 3 = unacceptable to 1.5m below seabed
- Area 4 = no sediment unacceptable



4. Case study - Falmouth

Predicted volume of TBT contaminated dredged material:

- Area 1 = 29,340m^3
- Area 2 = 6,540m^3
- Area 3 = 102,090m^3
- Area 4 = 0m^3
- Total = 137,970m^3



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Treatment to remediate TBT contaminated sediment?

Risks re findings of TBT Clean:

- Insufficient removal of TBT (to achieve <0.1mg/kg)
- Insufficient removal of metals
- Remediation not proven for large volumes of dredged material
- Availability / location of remediation facility (may be overseas)
- High costs associated with thermal treatment
- Disposal at sea may not be possible, even after after treatment

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Disposal options?

Option 1 - Disposal to a purpose built confined disposal facility within the docks estate:

- Initial chemical stabilisation and physical solidification (S/S) using cement to immobilise TBT and other contaminants (i.e. prevent leaching)
- Disposal to containment site
- e.g. Mylor Yacht Harbour and Newlyn

Option 2 - Disposal to confined disposal facility in sea:

- Disposal on sea bed
- Followed by capping
- e.g. River Tyne trial