United Nations Development Programme brief · public case note

Community Underwater Ordnance Mapper

An autonomous survey concept for contaminated waterways, built so a community can gather usable hazard evidence without a boat, a crew, or anyone on the water. Prepared by Mark Poxton, Independent Analytical Systems Consultant.

Requirement addressed	Outcome	System capex	Operating model	Survey output
Affordable tools to find and mark underwater explosive ordnance	**Taken to final-stage review; not taken forward**	**USD 600-700 target build**	**Launch, monitor, retrieve — nobody on contaminated water**	**Mapped suspect areas for mine-action handover**

The point of the work

The analysis did not argue that finding metal underwater was new. It argued that the operational package around the sensor was missing. Communities living beside contaminated waterways often know where boats sink, where nets snag, and which reaches are avoided — and have no practical way to turn that into a map a mine-action authority can act on.

So the technical claim was kept narrow and the system claim was made broad. A useful tool is not a sensor. It is a platform, an operator model, a data output, a safety protocol, a cost structure, and a way of proving it works.

> **Position of this document**
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> A public case note describing analytical work and the evidence discipline behind it. The work was produced independently, in response to a requirement the client organisation published openly, and offered to it for consideration; it was not a commissioned engagement. Nothing shared in confidence is reproduced here.

1. The operational gap

Most low-cost proposals in this field start with the instrument. This one started with the operation. A detection module costing a few dollars does not create a fieldable capability if it still needs a boat, a crew, fuel, daily hire charges, and a person on contaminated water.

The central question was therefore not whether a sensor can detect ferrous ordnance. It was what complete operating chain lets a community gather usable evidence at a cost and risk level a mine-action programme can actually repeat.

Failure mode	Effect on mine-action work	Design response
Boat dependency	A low-cost sensor becomes an expensive system once a vessel and crew are required.	Autonomous PVC catamaran with launch and retrieval from the bank.
Human exposure	Survey work puts operators on or near contaminated water.	No-water-entry rule; the operator stays ashore throughout.
Data handover gap	Local knowledge never becomes a structured map for clearance teams.	Position and track files that drop into common mine-action mapping workflows.
Over-claiming risk	A survey tool gets mistaken for clearance certification.	Defined as preliminary survey only; clearance stays a specialist task.

The analytical move

The boundary of the problem was widened. Logistics, personnel exposure, local repairability, map format, operating rhythm and validation were all treated as part of the system. That is where the work stopped being a note about a sensor.

2. The concept

Three configurations were proposed around the same sensing and software logic, so a programme could choose from its own local conditions rather than force every setting into one deployment model.

Configuration	Platform	Best used when
A — Clip-on	Sensor package mounted to a boat the community already uses.	A trusted boat is available and conditions suit supervised survey.
B — Autonomous vessel	Solar-assisted catamaran with autopilot, sensing, telemetry and return-to-home behaviour.	No safe or affordable boat exists, or systematic survey is needed with nobody on the water.
C — Shore probe	Fixed-position probe worked from a bank, bridge or jetty.	A known suspect location needs checking without water entry.

System components

Element	Role in the system
Surface vessel	Carries the payload across planned lanes and returns to shore on completion, low battery, or loss of link.
Passive sensing	Detects disturbances a buried metal object makes in the earth's magnetic field, without emitting anything of its own.
Depth-aware probe	Moves the sensor closer to the bed where towing it at the surface is not close enough.
Operator display	Shows lane completion and flagged points, from the bank.
Export file	Carries position, mode, time, signal strength and approximate depth into downstream mapping.

3. Detection framed honestly

The strongest part of the technical case was not pretending a cheap sensor could do everything. What a sensor towed along the surface can find was separated from what needs to be inspected close up. That made the smallest-target claim conditional, testable, and capable of being proved wrong.

Target class	Surface tow	Close-up probe	Claim discipline
Large bomb or naval mine	Primary detection mode.	Depth confirmation.	Mapped with high confidence.
Medium shell class	Area screen and flag.	Follow-up confirmation.	A useful flag, not clearance evidence.
Small mortar class	Not reliably found from the surface.	Needs the probe held close to the bed.	Claim depends on depth control and testing.
Non-metallic targets	Outside the method.	Outside the method.	Declared limitation, not a hidden weakness.

> **Why this matters**
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> A weaker piece of work would bury the surface-tow limitation. Here it was built into the logic of the system: rather than overstate the instrument, the deployment was designed around the part of the problem the instrument can actually solve.

4. Safety and operating doctrine

The public-interest value of the concept is safety as much as cost. In the autonomous configuration the operator does not enter the water and does not stop over a flagged point. The system records it and carries on. Investigation and clearance stay with authorised teams.

Rule	Operational reason
No water entry	The operator launches, monitors and retrieves from the bank.
No manual investigation	A flagged point is not touched, lifted, circled or inspected by the community operator.
Authority approval first	Deployment follows mine-action authority approval for the context and the method.
Geofence and return-to-home	The platform stays inside the approved area and comes back on any fault.
Clear marking	The vessel is visibly marked as an unarmed survey platform, in the local language where that is needed.

The system is positioned as an evidence-gathering bridge between local knowledge and professional clearance planning. It does not certify anywhere as safe. It improves the quality, coverage and cost of the evidence handed to the people who hold that authority.

5. Programme economics

The economic argument was made at programme level. In many contaminated regions the binding constraint is not whether an expensive survey vessel could collect better data. It is whether a programme can afford enough survey days to cover the waterways people actually use.

Approach	Capital cost	Daily operating cost	Operational consequence
Professional marine survey	High specialist equipment and vessel cost.	Crew, vessel, fuel, mobilisation.	Excellent where funded; little repeat coverage where budgets are thin.
Low-cost sensor on a hired boat	Low instrument cost.	Boat and operator costs remain.	Cheaper than professional survey, still boat-dependent.
This concept	Target build: USD 600-700.	No fuel, no boat hire, nobody on the water.	Repeatable systematic survey where conventional logistics are unaffordable.

> **The bigger claim**
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> The strongest point was not that one unit is cheap. It was that ten units create coverage density a conventional model cannot economically match in low-resource settings. That changes what can be attempted, not just what a survey day costs.

6. Data handover and community ownership

The concept was designed to leave a usable record behind. A completed survey produces a track showing where the platform went and records showing each flagged point, its mode, approximate depth, time and signal strength. That creates an audit trail: an authority can see what was covered, where the gaps are, and which points need specialist follow-up.

Community ownership matters because hazard data is leverage. A community that can document and share its evidence is in a stronger position to ask for prioritised clearance than one that can only report anecdote.

Output	Why it matters
Track completeness	Shows every surveyed lane and exposes missed coverage.
Timestamped points	Lets authorities inspect position and sequence.
Signal strength	Supports filtering and priority setting.
Mode flag	Shows whether a point came from surface tow, shallow probe or deep probe.
Local file ownership	No subscription, no cloud dependency, no vendor lock-in.

7. Limitations stated up front

Credible technical work says what would break it. These limitations stay visible because they are part of the quality of the analysis, not an apology for it.

Limitation	Practical meaning
Non-metallic ordnance	The method will not find aluminium-cased, plastic-bodied or very low-steel items.
Small ordnance	Individual grenades and very small targets sit below practical detection.
Deep burial	Material above the object weakens the signal and cuts detection range.
Strong current	Depth accuracy of the cabled probe degrades in a strong cross-current.
Open water	The autonomous platform suits sheltered and semi-sheltered waterways, not rough offshore conditions.
Not certification	The output supports preliminary survey and prioritisation only. It does not certify safety.

> **The difference this makes**
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> This is what separates an analytical document from a promotional one: the failure modes are not buried at the back. They are part of the operating boundary, and they were written down before anyone else could find them.

8. Validation pathway

The plan did not ask anyone to accept the concept on faith. It set out a low-cost route to proving or disproving it: bench-test the sensing, validate the tow and probe geometry, build the vessel, run controlled trials against known targets, then test the handover with a mock mapping workflow.

Stage	Purpose	Pass condition
Bench sensing	Confirm noise floor and detection behaviour against measured targets.	Measured ranges align with the physics envelope.
Probe control	Validate depth control and standoff accuracy.	Probe holds its defined clearance within tolerance.
Platform trial	Validate autonomous lanes, telemetry, return-to-home and operator workflow.	Survey grid completed with a recoverable track file.
Mapping handover	Export into a mapping workflow for inspection.	Coverage gaps and flagged points visible to the downstream team.
Risk review	Check missed detections, alert saturation, current limits and loss conditions.	Limits are scored before any field use.

> **What the work demonstrates**
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> The value is the systems thinking: identifying the true cost driver, designing around the operator's actual environment, bounding the physics, declaring the limitations, and turning a concept into a programme somebody could run.

9. Outcome

The concept was taken to final-stage review by the United Nations Development Programme and was not taken forward. That is recorded plainly because it is the honest record, and because reaching final-stage review means the work was strong enough to receive detailed consideration.

Intellectual property in the concept is retained in full.

What the work shows

Signal	Evidence in this case note
Problem reframing	Cost and risk were treated as part of the detection system rather than as somebody else's problem.
Evidence discipline	Claims were bounded by published sensor specifications, the literature on finding ordnance underwater, and proven autopilot capability.
Operational realism	Built around shore operation, local repairability, and handover to the teams who hold the authority.
Decision readiness	The document moves from problem to architecture, economics, limitations and validation.
Honest record	The result is stated, including the part that did not go the author's way.

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