CLUSTER MUNITION REMNANTS SURVEY

Best practice in South East Asia

MAG saves lives builds futures

Norwegian People's Aid

THE HALO TRUST

A team member excavating a cluster munition remnant identified utilising the CMRS methodology. © MAG

Abbreviations

CCM: Convention on Cluster Munitions

CHA: Confirmed hazardous area

CM: Cluster munition

CMR: Cluster munition remnants

CMRS: Cluster munition remnants survey

EO: Explosive ordnance

EOD: Explosive ordnance disposal

ERW: Explosive remnants of war

IM: Information management

IMAS: International Mine Action Standards

IMSMA: Information Management System for Mine Action

MAG: Mines Advisory Group

NMAA: National mine action authority

NMAS: National Mine Action Standards

NPA: Norwegian People’s Aid

NTS: Non-technical survey

PPE: Personal protective equipment

SEA: South East Asia

SOP: Standard Operating Procedures

TS: Technical survey

USAF: United States Air Force

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Cover: Cluster munition remnants found in southern Lao PDR. © NPA.

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Introduction

Efficient and effective land release is a core global priority for Norwegian People's Aid (NPA), Mines Advisory Group (MAG) and The HALO Trust (HALO), with significant and ongoing investment of resources and expertise made to continually improve procedures and approaches.

Within Lao PDR, Vietnam and Cambodia (hereafter referred to as South East Asia) there is predominant, long-standing contamination from cluster munition remnants (CMR). Based on operational experience within the region and a shared belief that a well-managed, locally-adapted response should be used to target survey and clearance of CMR, the three operators have worked closely on the development of a methodology known as cluster munition remnants survey (CMRS). This was first introduced in South East Asia (SEA) in 2008.

By sharing successes and challenges in implementation and discussing lessons learned, the CMRS process has, and can continue to be, incrementally improved to deliver more accurate results and provide a basis for more effective and efficient clearance operations. It is therefore important to identify, develop and share best practice with all CMRS stakeholders to significantly contribute to the application of an optimal land release process in SEA.

In this spirit, NPA, MAG and HALO present this paper in order to share principles that the three organisations consider to be best practice for the implementation of CMRS in SEA. These principles are reflected in country-specific Standard Operating Procedures (SOPs). Where absent, these principles should be included in National and International Mine Action Standards.

A searcher utilises the CMRS methodology to identify the boundaries of a confirmed hazardous area. © NPA

Cluster munition remnants

What are cluster munition remnants?

Unexploded submunitions are explosive submunitions that have been dispersed from a cluster munition and have failed to explode as intended.

Unexploded bomblets are similar to unexploded submunitions, but refer to 'explosive bomblets' which have been dispersed or released from a dispenser fixed to an aircraft wing and that failed to explode as intended.

Failed cluster munitions are cluster munitions that have been fired, dropped, launched or projected, and which should have dispersed explosive submunitions but failed to do so.[1]

An example of a typical cluster munition remnant found in South East Asia. © MAG

CMR include unexploded submunitions, unexploded bomblets and failed cluster munitions. CMR are also known as 'bombies' in SEA.

Submunitions have anti-personnel fragmentation features that can send hundreds of shards of steel at very fast speeds over a wide area, or fire shaped charges that can penetrate heavy armour. Many cluster munition canisters carry hundreds of submunitions. A drop of several canisters can easily create vast areas of CMR contamination.

The threat posed by landmines and CMR is not the same and as such demands a different response. Landmines are typically laid in patterns or clusters in areas of strategic military importance, and most are designed to be exploded by the presence or proximity of a person or vehicle. CMR are typically munitions that failed to explode after being fired from the ground or air dropped.

Unexploded submunitions are the most common threat in the contexts in which humanitarian mine action programmes are implemented in SEA. They also pose the greatest threat to civilians because of their appearance in terms of shape, colour and metal content, which often attracts tampering, playful attention or collection.

[1] Summarised from *Convention on Cluster Munitions*, Article 2 *Definitions*.

Cluster munitions in South East Asia

Contamination in SEA has some defining characteristics that present a specific context for operators to address. CMR found in SEA are typically BLU-type munitions between 40 and 65 years old, which have a high detonation failure rate of up to 30%. The heavy use of munitions combined with this high failure rate has resulted in dense, surface-level contamination from aged munitions.

The presence of contamination for many decades has also led to large amounts of historical data, including accident data and information on previous tasks from national and international operators, as well as bombing data released to support clearance efforts.

This context requires an evidence-based survey response, which led to the development of the CMRS methodology. This methodology is based on a comprehensive desk assessment to consider all historical data, thorough NTS to ensure all evidence is identified, and a technical survey targeted only where actual evidence is identified and not feared or suspected.

To demonstrate the relative scale of contamination in SEA, an overview of global contamination from CMR is provided in Table 1. Cambodia, Lao PDR and Vietnam comprise three of the four countries with the highest level of CMR contamination in the world. Application of CMRS in these three countries provides more reliable data, and ultimately results in a more accurate understanding of the scale of contamination and the time and resources required for clearance. Based on this data, authorities and operators are able to make more informed decisions when planning for efficient and effective clearance operations.

*Table 1: Overview of global cluster munition contamination**
Source: Clearing the Cluster Munitions, *Mine Action Review, 2019*

Massive (>1000km2)	Heavy (100 – 1000km2)	Medium (5 – 99km2)		Light (<5km2) or unclear	
Lao PDR	Cambodia	Azerbaijan**	Syria	**Afghanistan**	**Montenegro**
Vietnam	**Iraq**	**Chile**	Ukraine	Angola	Serbia
		Germany	Yemen	**Bosnia and Herzegovina**	**Somalia**
		Lebanon	Kosovo	**Chad**	Sudan
		Libya	Nagorno-Karabakh	**Croatia**	Tajikistan
		South Sudan		DR Congo	**United Kingdom*****
				Georgia	Western Sahara
				Iran	

* States parties to the CCM are in bold. ** In areas not under government control. *** Argentina may also be considered CMR contaminated by virtue of its assertion of sovereignty over the Falkland Islands/Malvinas. The United Kingdom also claims sovereignty over the Islands and exercises control over them.

Team members searching for cluster munition remnants. © The HALO Trust

What is CMRS?

CMRS is the application of all reasonable effort[2], through non-technical survey (NTS) and technical survey (TS) procedures, to identify and define a confirmed hazardous area (CHA)[3] from cluster munition remnant (CMR) contamination.

The key output of CMRS is a defined boundary of a CHA based on direct evidence[4] of CMR contamination, which will be used to support planning for and prioritisation of future battle area clearance[5] activities.

CMRS and the Convention on Cluster Munitions

NPA, MAG and HALO believe that, by virtue of the obligation under international human rights laws to protect life, all states should clear CMR as soon as possible. The Convention on Cluster Munitions (CCM) was created by interested parties to provide a framework for addressing the humanitarian consequences and unacceptable harm to civilians caused by cluster munition remnants.

In seeking to fulfill their clearance and destruction obligations under Article 4 of the Convention on Cluster Munitions (CCM), affected states parties are required to "survey, assess and record all evidence of the threat, making every effort to identify all contaminated areas under their jurisdiction or control"[6] within ten years.

CMRS was developed to support implementation Article 4 requirements by enabling an efficient, effective survey to inform and support planning and prioritisation of clearance activities.

While Lao PDR is the only State Party to the CCM in SEA, NPA, MAG and HALO adopt the principle of applying all reasonable effort to clear CMR contamination as soon as possible in all three countries. CMR contamination cannot be efficiently cleared without reliable data on the scale of contamination. As such, CMRS is a first, critical step in supporting governments to clear CMR as soon as possible and therefore forms a core component of NPA, MAG and HALO activities in SEA.

2 IMAS 04.10 *Glossary of mine action terms, definitions and abbreviations* defines 'all reasonable effort' as "what is considered a minimum acceptable level of effort to identify and document contaminated areas or to remove the presence or suspicion of explosive ordnance. All reasonable effort has been applied when the commitment of additional resources is considered to be unreasonable in relation to the results expected." IMAS 07.11 *Land Release* and 08.20 *Technical Survey* further explain the principle of 'all reasonable effort'.

3 'Confirmed hazardous area' refers to an area where the presence of CMR contamination has been confirmed on the basis of direct evidence during TS. This definition is for CMR only and has been adapted from IMAS 08.20 *Technical Survey*.

4 Based on IMAS 08.20 *Technical Survey*, 'direct evidence' may include, but is not limited to, historical data (where the reliability of such data has been confirmed during previous operations); visual observation of cluster munitions, CMR parts, fragmentation or craters; detonations during fires or by animals; mine/hazard signs, fencing, ancillary equipment (boxes, canisters) etc. associated with contamination; and/or accidents or incidents where the location of the event can be accurately determined. Direct evidence can generally be classified as offering greater confidence that indirect evidence. First-hand information is likely to offer greater confidence than second-hand, or more informal, information.

5 IMAS 04.10 *Glossary of mine action terms, definitions and abbreviations* defines 'battle area clearance' as "the systematic and controlled clearance of hazardous areas where the hazards are known not to include mines." For clarity, this document uses the term 'clearance' in place of 'battle area clearance'.

6 *Convention on Cluster Munitions,* Article 4 *Clearance and destruction of cluster munition remnants and risk reduction education.*

CMRS and Mine Action Standards

The CMRS methodology incorporates internationally-agreed mine action principles and standards and enables the most effective application of land release in a cluster munition context. The overriding focus of CMRS is on the utilisation of an evidence-based survey process that enables clearance only of areas with confirmed contamination.

CMRS is an example of how key land release principles can be applied in the context of different types of explosive ordnance (EO). CMRS is not currently included as a specific standard or technical note in IMAS. It is instead covered under more general principles in the following standards:

- IMAS 04.10: Glossary of mine action terms, definitions and abbreviations
- IMAS 05.10: Information Management for Mine Action
- IMAS 07.10: Guide for management of Land Release and Residual Contamination Operations
- IMAS 07.11: Land Release
- IMAS 08.10: Non-Technical Survey
- IMAS 08.20: Technical Survey

Variations in country contexts and operating environments mean defining a universal CMRS methodology is not possible. However, there is significant benefit to be obtained by formally recognising what constitutes CMRS best practice. This will ensure that where CMRS is implemented, it adheres to an agreed set of base criteria and principles. While this document is a starting point for this, it is recommended that a CMRS Technical Note for Mine Action is developed and submitted to the IMAS Review Board with a view to formal adoption.

The National Mine Action Standards (NMAS) of Cambodia, Lao PDR and Vietnam vary significantly, and as such the SOPs of operators have been developed differently to be in accordance with each country's NMAS. While there is scope to better align certain elements of NMAS across the three countries, there is no one-size-fits-all methodology for CMRS. Therefore, what are predominantly minor variations in application of the CMRS methodology across operators to allow for country- and context-specific variations are not covered in this document.

A team member excavating a cluster munition remnant. © MAG

Best practices in CMRS

All operators work with national authorities to ensure NMAS in SEA adhere to IMAS as closely as possible. Operators also encourage NMAS to outline and define key requirements specific to CMRS, to support differentiation between landmine and cluster munition threats, and to allow for flexibility in operator SOPs. NMAS and SOPs should be based on country-specific assessments and requirements.

1. Continued threat assessment is required during CMRS. The CMRS methodology cannot be used if anti-personnel mines, anti-tank mines or improvised explosive devices are a possible threat in the proposed survey area.
2. Quality assurance should be provided throughout CMRS by verifying decision making and the quality of reported data in each step of the CMRS process.
3. Close coordination with all stakeholders in country is critical to increasing ownership and understanding of the CMRS process.
4. The use of specifically-trained teams or multi-skilled teams, with appropriate experience, training and tools, increases efficiency and accuracy of CMRS. The teams take responsibility for all activities associated with the task, including desk assessments, community liaison, non-technical and technical survey, explosive ordnance disposal (EOD Level II) and impact assessment. Activities should be conducted in the most integrated and efficient way possible. The teams should not leave their operational area until all reasonable effort has been applied to identify CHAs.
    a. Teams must spend sufficient time in a village during the implementation of CMRS, which supports the development of stronger rapport and trust between team members and community members. This encourages more open sharing of information on the location and impact of CMR.
    b. TS should begin as soon as possible after NTS. This ensures that correct, up-to-date information is acted upon in one continuous process.
    c. Teams are able to conduct disposal of cluster munitions (CM) and other EO. This demonstrates that the information community members share with operational teams will be acted upon in an appropriate time frame, to avoid being delayed by months if NTS and TS are not conducted as close in time as possible. Demolitions also encourage more active information sharing by affected community members.
    d. Completion of desk assessment, NTS and TS processes should occur with minimal gap between the separate processes. This reduces the risk that information will be lost, misunderstood or miscommunicated.
    e. NTS can and should be ongoing throughout the survey process. Teams are able to swiftly change activities depending on the situation and information they are investigating. NTS can be conducted alongside TS over a longer period of time, which allows the team to make continued, informed assessments of results.

A CMRS team member using a compass to divide a search box into quadrants. © The HALO Trust

f. Intermediate care providers are incorporated into team structures to ensure that teams are supported by appropriately-trained medical staff when conducting CMRS activities.

5. Evidence-based decision making process is used throughout CMRS. Decisions should not be made based on fear or suspicions of CMR and instead should focus on a realistic threat assessment for each particular context or site.

6. Confidence and experience of the operational team is critical to implementation of CMRS. A team leader must have the training and resources available to make confident decisions and recommendations on each step of the CMRS process.

7. In principle, each stage within the CMRS process should inform and better define onward resource requirements. In order for this to be realised, appropriate information management systems need to be in place and staff need to be trained to correctly interpret the data collected.

8. CHA boundaries based on direct evidence will ultimately result in an evidence-based assessment of required clearance resources and assets, and a better-prioritised and more efficient clearance process.

9. A varied toolbox results in a more effective CMRS process. The teams need to be equipped to utilise a variety of tools, including different detectors and information and communication technologies.

10. Personal protective equipment (PPE) may not be required during CMRS in SEA due to the specific nature of the threat identified.

Best practices in non-technical survey

Through NTS, all reasonable effort is used to identify, collect, analyse and report information in order to identify direct evidence.[7] Village meetings, household interviews and individual interviews with key informants[8] shall be followed up until all reasonable effort has been applied to collect all information available.

The key outputs of non-technical survey are:

1. All available historical data is collected, evaluated and stored in the IMSMA database.
2. All relevant stakeholders in the target survey area have been consulted and any credible evidence of CMR is documented.
3. Evidence points are identified for use as starting points in technical survey.
4. Areas where there is no evidence of CMR are documented.

A team leader marking potential evidence points on a sketch map during NTS. © The HALO Trust

[7] Summarised from Section 4 of IMAS 08.10 *Non-Technical Survey*.

[8] IMAS 04.10 *Glossary of mine action terms, definitions and abbreviations* defines a 'key informant' as a man, woman, boy or girl who has "relatively good knowledge on the hazardous areas in and around their community".

NTS always includes a thorough desk assessment prior to any field deployment. The desk assessment should include:

a. Analysis of available United States Air Force (USAF) bombing data.
b. Analysis of all available historical data including previous survey data and overlaying this data on a map of the survey target area. This data may include, but is not limited to, previous survey data, previous clearance tasks, previous EOD spot tasks/roving tasks and accident locations.
c. Collection and analysis of other data that may be relevant to NTS, including but not limited to national/provincial/district/communal/village plans, and data from commercial or military operators.

USAF bombing data is not used as direct evidence, but can be a good basis for threat assessment and planning of CMRS. Useful information that can be extracted from USAF bombing data includes:

a. The type of cluster munition that was dropped, and therefore can be expected to be found.
b. The number of cluster munitions dropped on the area.
c. The target of the drop.

As well as CMR-related data, the desk assessment should also include an evaluation of all EO data stored in the Information Management System for Mine Action (IMSMA). All reasonable effort should be used to match historical data to the ground situation, especially when historical data may not have a GPS reference or uses different datum and/or coordinate systems. Comparisons of, and corrections to, any previous data errors reported into IMSMA are completed during desk assessment and NTS.

NTS may be the only activity applied to an area if no evidence of CMR is identified.

Strategies to encourage a high rate of community participation in NTS village meetings must be applied. Important factors to consider include:

a. The time of day when most community members are available, based on their usual daily activities. This may change depending on the season or time of year.
b. Multiple village meetings might be necessary to ensure that all reasonable effort has been used to collect relevant information. This may include separate meetings based on demographics.
c. No time limit should be used for village meetings. A team only ends the meeting when they are confident that all reasonable effort has been applied to gather the necessary information.

Evidence identified during NTS should be clearly marked and the EO disposed of as soon as possible. This demonstrates to communities that information shared by key informants will be acted upon as soon as possible, thereby increasing confidence in the CMRS process.

Best practices in technical survey

TS is a means of defining the boundaries of hazardous areas and the nature and distribution of their contents. TS uses appropriate technical interventions to define where CMR contamination is present, and where it is not, and to support land release prioritisation and decision making processes through the provision of evidence.[9]

The key outputs of technical survey[10] are:

1. A defined CHA containing cluster munition contamination.
2. Additional information for planning the initial clearance of any area identified as a CHA.
3. Evidence, gathered through all reasonable effort, which may be sufficient to determine and demonstrate, to the satisfaction of the land users, that no evidence of CMR has been identified.
4. Additional information for the establishment of priorities for future action.

A team member excavating on a detector signal. © NPA

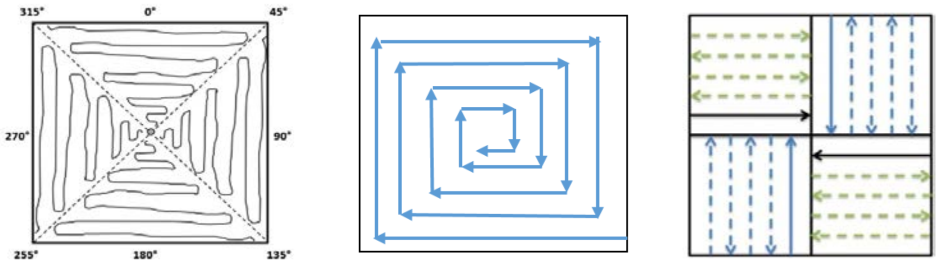
TS should be conducted as soon as possible after NTS is complete. In some cases it may be warranted that a new NTS is conducted before starting TS - for example, if new direct evidence is identified or the time between NTS completion and start of TS is considered too long.

TS should be conducted using a system of boxes based on a 1km x 1km grid map, with each box having its own individual identification number. The standard TS search box is 50m x 50m for a total of 2,500m^2.

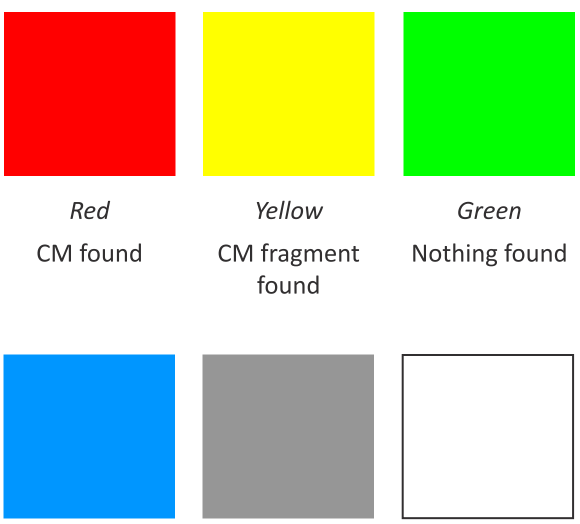
Dependent on the search pattern to be used, the box can be divided into four smaller areas/ quadrants. Ropes and/or flags may be used to assist with directions of the search if required. The search pattern used can vary, dependent on vegetation cover, topography, the detectors being used and soil mineral content. The main consideration is that the search pattern is systematic in approach (Image 1).

[9] Summarised from IMAS 08.20 *Technical Survey.*
[10] Summarised from IMAS 08.20 *Technical survey.*

Image 1: Example search patterns used in a CMRS box.



When the search of a box is completed, boxes should be given one of the following colours to map the presence of cluster munition remnants[11]:



Red CM found	*Yellow* CM fragment found	*Green* Nothing found
Blue Other ERW found	*Grey* Not surveyed due to inaccessibility	*Blank* Skipped box

Teams shall ensure that a minimum of 50% of the box will be covered by the search before defining a box as yellow, green or blue.

If a CM is found, the search in that box will stop and the box will be marked red on the map. The team will then move on to a new designated box. Excavation is conducted on each detector signal, with a standard exclusion distance of 10 meters being applied for each searcher carrying out excavation. A long-handled tool with a sharp blade is normally used for signal excavation, but this may vary among operators.

A team should consider the following conditions when searching for evidence:

- Soil magnetism - this may influence the performance of a metal detector and therefore may influence the speed and detection capability of the search.
- High levels of fragmentation or CM fragments, alone or mixed with other EO - this may cause a high number of detector signals, which may influence the team's ability to find direct evidence. When locating other EO, the team leader will mark and record it for disposal.
- Presence of debris - often key areas being searched, including former military camps, developed areas and roadsides, are littered with trash which may slow down the search.

[11] Boxes are marked red if a function cluster munition remnant is found. These definitions will be developed for inclusion in a Technical Note for Mine Action.

- Hard ground - this may make the investigation of signals more time consuming.
- Vegetation coverage - dense vegetation may mean the search time needs to be extended to ensure adequate coverage of the box.
- Historical data and type of cluster munition remnants expected to be found - if historical data indicates the presence of a high or low number of potential evidence points in the area, the team leader can continue the search until confident all evidence is found.

Boxes may be skipped in areas of dense contamination. In some areas of SEA, cluster munition strikes are so dense that strike footprints overlap, creating CHA that are millions of square meters in size. This can result in a large number of red boxes, particularly in the middle of dense or overlapping footprints. As such, it is permissible to skip the search of one or more boxes to speed up the TS process. When box skipping is carried out the following rules should apply:

a. The box beyond the boxes skipped must be searched.
b. If the searched box beyond the skipped box is red, TS may continue outwards including additional skipped boxes
c. If the searched box beyond the skipped box is green, yellow or blue, the previous skipped box is also to be searched.

Searching previous skipped boxes is to continue until a red box is encountered. This ensures that the CHA covers the area of CMR contamination, not the area of fragment contamination. There must never be a skipped box on the outer edge of a TS task.

Skipping boxes is advantageous as it requires less survey effort inside the footprints. The focus of CMRS should always remain on identification of the boundary of a CHA.

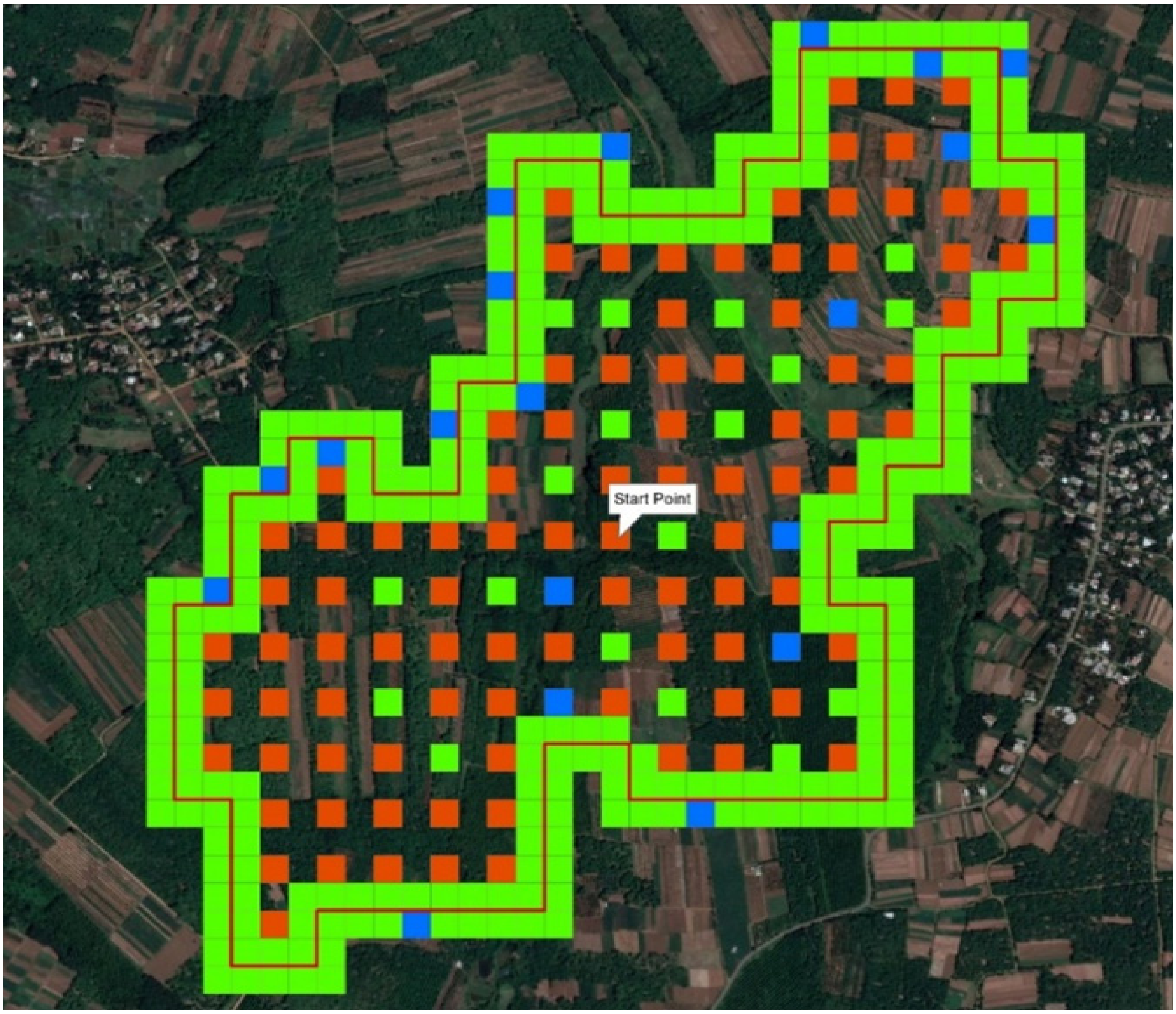
Boundaries of the CHA should be drawn 50m from the last item found during TS. This ensures an average fade out distance is included in the CHA, to support more accurate estimates for the amount of clearance required.

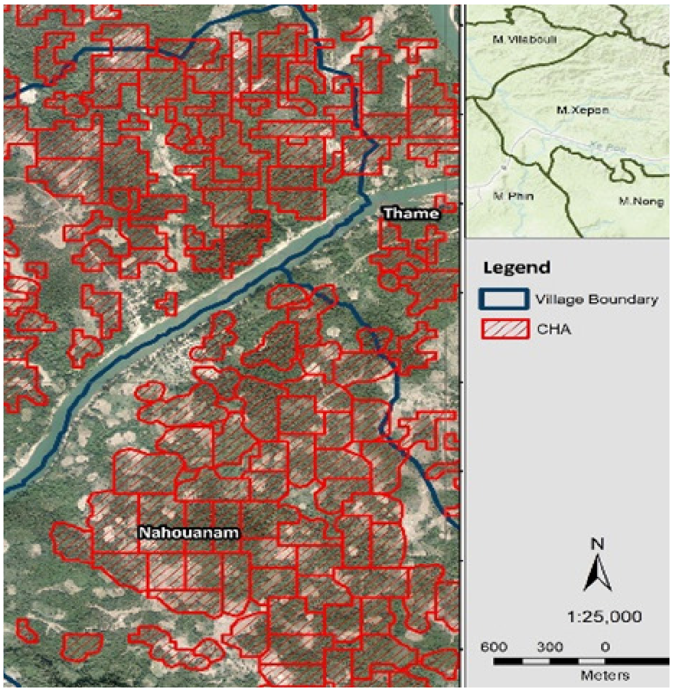
At the end of the CMRS process, a clear handover of all information to the affected community should be organised. This should include:

a. A briefing with the community leader, affected land owners and any other available community members.
b. Maps of areas surveyed and of the defined CHAs should be shared, and the community should be given an expected timeframe for clearance if possible.
c. A physical demonstration to the landowner of the boundary of the CHA.
d. Provision of a sketch map to the community indicating where CM and other EO were destroyed and where the boundaries of CHAs are located. Information on the location of any inaccessible CM evidence points should be included, as well as any plans for future survey of these areas.
e. An explanation of the specific activities conducted, including additional clarification that while the survey process has concluded, there is still a CM threat as no clearance has yet been carried out on their land
f. Detailed information on how to report any future discoveries of EO, and an explanation of how operators will respond.

CMRS is considered complete when an end-of-survey report is accepted by the National Mine Action Authority (NMAA). All information relating to survey activities should be stored on an IMSMA database, to ensure accessibility to all stakeholders. Ongoing assessment is critical to help prioritise the huge number of hazardous areas identified through CMRS, to ensure the limited available clearance resources are targeted to areas with the highest need and greatest impact.

Assuming CMRS has been conducted in line with approved national standards, operators should not be liable if new evidence is found inside or outside any defined CHA. If new evidence is identified, the national authorities can task operators to conduct additional survey.





Images 2, 3 and 4: Examples of maps produced during the CMRS process, demonstrating box skipping in dense areas of contamination and maps reported to NMAAs and communities upon completion of CMRS.

A team member searching for cluster munition remnants. © MAG

Importance of clearance as quality control in the CMRS process

Clearance is the best form of quality control of the CMRS process and of the accuracy of the CHA polygon produced. After analysing the results of clearance activities, CMRS procedures may be adjusted if CMRS results are not providing sufficient or accurate information to the clearance team.

The feedback loop between clearance and CMRS is critical to avoid under or overestimating the size of the CHA, and to verify the accuracy and quality of survey results. It also enables operators to improve their methodology to be able to conduct the survey in the most efficient and effective manner. For this feedback loop to be effective, clearance should be conducted as soon as possible after CMRS.

The close operational partnership between NPA and MAG in Quang Tri province, Vietnam, is an excellent example of this best practice.

Information management in CMRS

The information management process during CMRS should ensure that[12]:

1. Accurate, relevant and timely information products that can be supplied to all stakeholders in accordance with agreed requirements.
2. Well-defined and documented information management processes that lead to efficient use of resources and consistent results
3. Exploitation and implementation of opportunities to improve IM, which will lead to an increased capacity to meet stakeholder requirements and ultimately a more effective and efficient programme
4. Continual involvement of stakeholders in the IM process
5. Evidence-based decision making is supported by IM processes and products.


CMRS team members reviewing operational data together. © NPA

Operators should provide recommendations for NMAS that promote and support the implementation of a functional, accessible and transparent IM system to support CMRS operations. IMSMA is the key tool for reporting, storing and analysing data before, during and after the completion of CMRS. Cooperation between all stakeholders and a transparent information management system are essential to the availability and accessibility of information.

To properly conduct CMRS, and to ensure that all reasonable effort has been made to define the boundaries of a CHA based on all available direct evidence, a comprehensive information management system[13] must be established. At a minimum, there should be staff that can fulfil the following capacities: data entry, quality control, management and improvement of IM processes and products, data/GIS analysis, and system administration.

[12] Summarised from IMAS 05.10 *Information management for mine action*.
[13] IMAS 05.10 *Information management for mine action* defines 'Information management system' as "those persons, procedures, data, software or media that are used to carry out information management."

An example of a typical cluster munition remnant found in South East Asia. © NPA

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