

Terrain, Terminology, and Insights: A Thematic Review of Conceptual and Spatial Reasoning in Land Search and Rescue New Zealand

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Abstract

This study presents an empirical qualitative thematic analysis of SAR practitioner responses collected during a structured workshop-based assessment at the New Zealand Land Search and Rescue Hui (Conference) in Tamaki Makaurau, Auckland. The workshop aimed at exploring Search and Rescue (SAR) personnel's understanding of key SAR planning concepts. A structured 15-minute quiz was administered to 70 participants, divided into 16 groups, to assess their knowledge of terminology and operational concepts related to search theory. The analysis revealed a general consensus on fundamental terms such as "Search," "Rescue," and "Recovery," with minor variations in the interpretation of terms like "Lost" versus "Missing" and the relationship between Initial Planning Points (IPP), Place Last Seen (PLS) and Last Known Points (LKP). Additionally, the study highlighted SAR personnel's preferences for specific search strategies and operational decision-making, such as prioritising localised search efforts over broader expansions. The findings highlight the importance of standardising terminology, improving conceptual Search Theory understanding and refining training approaches to enhance consistency and efficiency in SAR operations. Recommendations include developing a shared lexicon, scenario-based training, and ongoing stakeholder engagement to improve the application of research insights in operational settings. This analysis contributes to the refinement of SAR training and operational strategies, aiming to increase the effectiveness and adaptability of SAR teams in Aotearoa New Zealand.

KEY WORDS: *Search and Rescue, Terrain-based Probability, Human Factor, Decision-making, Thematic Analysis.*

Introduction

This paper presents a thematic analysis of responses gathered from the "Terrain-based Probability in SAR" workshop at the New Zealand Land Search and Rescue Hui (Conference) in Tamaki Makaurau, Auckland that took place on Saturday 15th March 2025 (Cook & Curd, 2025). The primary aim of this study was to examine how Search and Rescue (SAR) personnel understand and apply key concepts in Search Theory, particularly in relation to common SAR terminology and operational procedures. By analysing the recurring themes and identifying variations in understanding, the researchers aim to

uncover both areas of consensus and divergence within the SAR community. These insights can guide improvements in SAR training, enhance operational consistency, and help inform future research. Furthermore, this analysis provides an opportunity to refine the communication of research findings within the SAR sector, ensuring that terminology and concepts are accessible and applicable to SAR teams at all levels. The results offer valuable perspectives on the challenges faced by SAR practitioners, emphasising the importance of clear definitions, adaptability in real-world decision-making, and ongoing refinement of SAR practices to align with evolving operational needs (Entwistle & Smith, 2010).

Method

This study utilised a structured, time-limited quiz to collect data from participants during the “Terrain-based Probability in SAR” presentation at the Land Search and Rescue Hui (Conference) in Tāmaki Makaurau Auckland that took place on Saturday 15th March 2025. The quiz, designed to assess operational understanding of key Search Theory concepts, consisted of 14 questions spanning multiple-choice, open-ended, and four map-based scenario questions.

Participant Grouping and Instructions

Seventy SAR professionals participated, divided into 16 groups. Grouping was intentional, reflecting the collaborative nature of SAR operations where decisions are rarely made in isolation (Vijayaratham, 2012). Before commencing, participants were given minimal instructions beyond being told that the quiz was anonymous, and that no names or distinguishing features were to be recorded on the answer sheets. The instruction given was simply: “Work together to answer the following 14 rapid-fire questions”. This approach aimed to minimise social desirability bias and reduce the influence of individual status within the group dynamic (Gordon, 1987).

Groups received blank sheets of paper for written answers rather than structured answer forms. This decision was grounded in cognitive research suggesting that free-form response formats reduce anchoring effects that may occur when individuals are presented with structured layouts (Jensen, Whiles, & Mirza, 2025). For the four map-based questions, separate answer sheets with maps were provided. Participants were instructed to mark or highlight directly onto these maps as part of their responses.

Each question was allocated a one-minute time limit to simulate the time-pressured conditions under which SAR personnel operate. This approach reflects real-world environments where rapid interpretation of incomplete information is required (Epstein & Katz, 1992; Fig & Recker, 2016; Goldhammer, 2015). The quiz was conducted directly following a brief presentation introducing the concept of Terrain-Based Probability (TBP) in SAR. No additional instruction or training was provided, to ensure that responses reflected participants' pre-existing knowledge, intuitive understanding, and immediate interpretation of TBP concepts as presented.

The design of the quiz was intentionally aligned with operational realities of SAR environments. The one-minute time constraint reinforced these time-pressured decision-making conditions characteristic

of SAR operations. Group-based responses were selected to reflect the collaborative nature of SAR planning, where decisions are typically made within teams rather than by individuals. The use of free-form responses, rather than structured answer sheets, was intended to minimise anchoring effects and allow participants to express their conceptual understanding in their own terms. Collectively, these design choices aimed to increase ecological validity by approximating the cognitive and social conditions of real-world SAR operations.

Data Collection and Analysis

All responses were collated and entered into a spreadsheet for analysis. A qualitative thematic analysis approach was used to identify patterns in how participants understood and applied SAR concepts. Coding was conducted independently by the authors using an inductive approach, allowing themes to emerge from the data rather than being imposed from predefined categories (Delve, 2025; Perenara-Wilkinson, 2025).

Data familiarisation involved repeated reading of responses prior to coding to ensure depth of interpretation. Initial codes were generated through close reading of the responses and were iteratively refined into broader themes through comparison across participant groups. Particular attention was given to areas of consensus, variation, and ambiguity in terminology and decision-making.

To enhance analytical rigour, coding decisions were discussed and reviewed between the authors to ensure consistency in interpretation. While formal inter-rater reliability statistics were not calculated, an iterative consensus-based approach was used to strengthen the credibility of the findings.

Map-based responses were analysed separately as a distinct dataset, focusing on spatial reasoning, terrain interpretation, and the clarity of visual communication. These responses were compared against model answers to assess alignment with expected SAR planning principles.

The analysis was primarily inductive, but was informed by established SAR concepts including Lost Person Behaviour (Koester, 2008) and applied search theory frameworks. This allowed findings to be interpreted in relation to both emergent participant understanding and existing operational doctrine.

As the data were collected within a workshop setting facilitated by the authors, it is acknowledged that the context may have influenced participant responses. However, the use of anonymous, time-limited, and group-based responses was intended to minimise individual bias and better reflect operational decision-making conditions.

Results

This section presents the findings from the quiz responses, analysed through thematic analysis to identify recurring themes and insights. The responses to each question are examined to highlight common understandings and areas of divergence among SAR personnel. By interpreting these responses, we aim to uncover key patterns in how SAR Search Theory concepts are understood and applied in practice. This analysis provides a foundation for refining SAR training, improving operational consistency, and developing clearer communication within the SAR community.

Definitions of "Search," "Rescue," and "Recovery"

Participants were asked to provide their definitions of the terms "Search," "Rescue," and "Recovery" within the context of search and rescue operations. The aim was to capture how these core concepts are commonly understood and interpreted by practitioners in the field. The majority of responses define:

- Search as the act of locating a missing person.
- Rescue as bringing a person to safety, often requiring specialised skills and resources.
- Recovery as retrieving a deceased individual from a search area.

Some responses also emphasise the procedural aspects of search operations, highlighting that searching involves organised efforts rather than random exploration. Additionally, a few groups mention the emotional and logistical challenges associated with recovery operations, which can impact SAR personnel.

Difference Between "Lost" and "Missing"

Participants were asked to explain how they differentiate between the terms "Lost" and "Missing" in the context of search and rescue operations. This question sought to understand the operational and conceptual distinctions made by practitioners when categorising incidents or individuals. A clear distinction emerges between these terms:

- Lost is typically described as when an individual is disoriented and unable to navigate back to a known location.
- Missing refers to an individual whose whereabouts are unknown to others, even if the person themselves does not feel lost.

While most groups align on this distinction, some responses indicate that in real-world scenarios, there can be overlap, as individuals who are "missing" often also perceive themselves as "lost." This suggests a need for standardised definitions in operational guidelines (Stoffle & Stoffle, 2017).

Differentiating IPP, LKP, and PLS

Participants were asked to describe the differences between the Initial Planning Point (IPP), Last Known Point (LKP), and Point Last Seen (PLS), three critical reference locations in the planning and execution of search operations. Clarifying these distinctions is important for ensuring consistency in how search areas are defined and prioritised. Most responses define:

- IPP: The designated starting point for search operations, typically based on statistical models, last known intentions, or reported sightings.
- LKP: The last confirmed location of the missing person based on verifiable evidence, such as witness accounts or physical clues (e.g., footprints, dropped gear).
- PLS: The precise location where the subject was visually observed before disappearing.

While there is broad consensus on these terms, discrepancies exist in how groups describe the relationship between IPP and LKP. Some responses suggest that IPP is dynamic and can be adjusted as new information arises, whereas others state it is fixed. Training reinforcement could help clarify this distinction (Mansfield, Carlson, Merrifield, Rosenberg, Swanson, & Templin, 2024).

Hunter vs. Trampler

Participants were asked to explain the difference between a “hunter” and a “trampler,” recognising that subject profile influences search behaviour predictions, mobility patterns, and risk assessment. Most groups classify:

- Hunters as individuals navigating terrain based on game tracking, often moving off established trails and possessing survival skills related to their activity.
- Trampers as recreational walkers who follow designated tracks and typically plan their routes in advance.

Some responses suggest that hunters are better prepared for survival situations due to their knowledge of the environment and gear (e.g., firearms, knives, and navigation tools). However, other responses indicate that preparedness levels vary widely among both hunters and trampers, with some trampers being well-equipped and experienced in navigation.

Categorisation of a "Daywalker" Carrying a Rifle

Participants were presented with a scenario in which they are responding to a callout involving a daywalker who is carrying a rifle. They were asked to determine whether this individual should be categorised as a “hunter” or a “trampler” for the purposes of search planning and subject profiling. This question aimed to explore how SAR personnel interpret hybrid or ambiguous subject behaviours, and which cues they prioritise when assigning a category. Responses to this scenario were mixed, highlighting the complexity of classification in real-world SAR operations:

- Some groups strictly categorised the individual as a hunter, given the presence of a rifle and the implication of game tracking.
- Others acknowledged that a person could be both a hunter and a trampler, depending on their intent and movement patterns.
- A few groups noted that context matters, if the individual was following a track and not actively hunting, they might fit the trampler category more closely.

These variations suggest that SAR teams must assess multiple contextual factors when identifying subjects. As such, it is recommended that SAR training include targeted refreshers and scenario-based exercises to reinforce the application of LPB principles in complex or ambiguous cases. This variability reflects a well-documented challenge in applying Lost Person Behaviour (LPB) categories in operational settings, particularly where subject intent and behaviour are ambiguous or overlapping (Koester, 2008). While LPB provides a structured framework for predicting subject movement, its application in real-world scenarios often requires interpretation under uncertainty, which can lead to inconsistencies in classification and subsequent planning decisions.

Definition of “Injured” vs “Uninjured”

Participants were asked to define what constitutes an “injured” versus an “uninjured” subject in a SAR context. This question was designed to clarify how SAR personnel interpret these classifications and

how such distinctions influence the urgency, resource allocation, and tactical approach of an operation.

The definitions of injured/uninjured from participant responses reflect a clear understanding centred on physical and medical status, as well as the need for assistance. The key themes identified include:

- **Physical or Medical Impairment:** Injured individuals have sustained injuries or medical conditions that affect their physical or mental capacity.
- **Need for Assistance:** Injured subjects often require first aid, medical treatment, or help with mobility.
- **Mobility:** Injured persons are frequently less mobile or immobile, while uninjured individuals retain full mobility.
- **Severity of Injury:** Minor or trivial injuries that do not impair the subject's ability to move, make decisions, or self-evacuate, typically fall under the uninjured category.
- **Operational Implications:** Injured subjects usually demand urgent medical attention and prioritised resource allocation, whereas uninjured subjects are generally capable of self-rescue.

These distinctions are important for SAR operations, influencing how subjects are prioritised and the resources allocated (Stoffle & Stoffle, 2017). Overall, the injured/uninjured classification helps shape the immediate reflex response and informs search area priorities, extraction planning, and resource deployment.

Definition of the "Water Recreation" Subject Group

Participants were asked to define the "water recreation" subject group, a common classification used in SAR operations. The aim was to understand how SAR personnel interpret this category, including the types of activities, behaviours, and risks typically associated with individuals engaged in recreational use of water environments such as rivers, lakes, or coastal areas. Responses indicate that the "Water Recreation" subject group includes individuals engaging in water-based activities such as kayaking, canoeing, boating, fishing, and swimming. Key characteristics of this group include:

- **Environment Exposure:** These individuals are often in dynamic environments, including lakes, rivers, and coastal areas, which can lead to rapid changes in situational risk.
- **Potential Hazards:** Drowning, hypothermia, and getting swept away by currents are primary concerns associated with this group.
- **Varying Levels of Preparedness:** Some participants noted that individuals in this group range from highly experienced water users with proper safety equipment (e.g., lifejackets, radios) to casual users who may lack necessary precautions.

This classification is important for SAR teams to determine the likelihood of survival, possible drift patterns, and the urgency of response efforts in water-based searches.

Response to High-Probability Clue in the 95th Percentile

Participants were presented with a scenario where a high-probability clue was found in the 95th percentile, and it was confirmed that the IPP was not the LKP. The response distribution was as follows:

- 12 participants selected option C: Plan a tasking area around the clue (close-in search) while maintaining the current search boundary.
- 2 participants selected option B: Keep the IPP where the search initially started but redraw probability rings.
- No participants selected option A: Move the IPP to the LKP (the clue location).

The overwhelming preference for option C suggests that SAR practitioners prioritise immediate and focused tasking around high-probability clues rather than altering fundamental search parameters mid-operation. This aligns with best practices in SAR, where a critical clue in a high-probability zone warrants a concentrated search effort to maximise the likelihood of finding additional evidence or the missing person nearby.

The lack of support for option A highlights a key operational principle: while the LKP is important for refining search efforts, the IPP remains an anchor point for overall search planning. Moving the IPP entirely to the LKP might undermine prior probability calculations and disrupt broader search strategies. The minor support for option B (redrawing probability rings but keeping the IPP static) indicates that some practitioners recognise the importance of recalibrating search parameters but may prefer a broader adjustment rather than a localised focus. However, the low number of responses selecting this option suggests that most participants prioritised immediate tactical response over strategic reconfiguration.

These results highlight a strong consensus on operational decision-making in SAR when confronted with high-probability clues. The emphasis on localised search intensification over structural realignment suggests that experienced SAR practitioners prefer to capitalise on concrete evidence before making significant modifications to the broader search plan.

Ranking of Extended Search Options



CHOICE QUESTION



14) A search review from NZ Police and a neighbouring SAR group have given suggested options for an extended search. Rank these in order of preference.

- A. **Expand Search Area:** Increase the radius of the search beyond the initial probability zones, considering potential movement patterns of the missing person
- B. **Revisit and Reassess High-Probability Areas:** Conduct a more thorough re-search of key areas already covered, using different search teams, technology, or methods.
- C. **Introduce Specialist Search Resources:** Deploy drones, FLIR (thermal imaging), SAR dogs, or aerial assets for enhanced coverage.
- D. **Review Missing Person Profile and Lost Person Behavioural Data:** Reanalyse the missing person's habits, survival skills, medical needs, and potential decision-making tendencies.
- E. **Search Suspension Criteria Review:** Establish clear thresholds for when the search would transition into a recovery or investigative phase.

Figure 1: Quiz slide presented at the LandSAR Hui (Conference) - ranking of extended search options

Participants were asked to rank five search expansion strategies (A, B, C, D, and E) in order of preference. The most frequently occurring sequences were:

- DBCAE (6 times) and DBACE (1 time)
- CBDEA (1 time) and DBCEA (1 time)
- DCBEA (1 time) and BDCAE (2 times)
- BDACE (1 time) and BCDAE (1 time)

A strong preference emerges in favour of options D (Review Missing Person Profile and Lost Person Behavioural Data) and B (Revisit and Reassess High-Probability Areas) as primary steps before expanding search boundaries or introducing specialised resources. This prioritisation aligns with applied Search Theory frameworks that emphasise iterative refinement of POA through behavioural reassessment and re-evaluation of high-probability areas before expanding the search footprint (Mansfield et al., 2023). Rather than treating search expansion as a primary response, this approach reinforces a structured decision-making process grounded in evidence and probability management.

The dominance of option D (Review Missing Person Profile and Behavioural Data) in the rankings highlights the importance of understanding the individual's characteristics before committing additional resources. In almost all cases, this option appeared in the first or second position, reflecting the belief that profiling the missing person's likely actions and decision-making can refine search strategies more effectively than expanding search zones blindly. This aligns with contemporary SAR methodology, which emphasizes behavioural analysis as a key factor in predicting movement patterns and improving search efficiency (Koester, 2008).

A strong priority was also placed on option B (Revisiting High-Probability Areas), which consistently appeared in the top two positions. This suggests a widespread belief in the value of re-examining

previously searched areas, recognising that missed clues, environmental changes, or searcher oversight can lead to important evidence being overlooked in the initial sweep. The use of different teams, technologies, or search techniques is seen as an essential step before committing to resource-intensive expansions, ensuring that high-probability zones are thoroughly covered before moving outward (Mansfield, Carlson, Merrifield, Rosenberg, Swanson, & Templin, 2024).

Option C (Specialist Search Resources), which includes deploying drones, FLIR, SAR dogs, or aerial assets, was consistently ranked as a mid-priority step. While these resources are considered valuable, the fact that they typically appeared after reviewing behavioural data and reassessing high-probability areas suggests that SAR practitioners view them as enhancements rather than primary search tools (Stoffle, 2006). This pragmatic approach ensures that fundamental search efforts are maximised before incorporating more complex and sometimes costly resources.

A lower preference for option A (Expanding the Search Area) was evident, with most rankings placing it later in the list. This suggests a reluctance to extend search boundaries without solid justification, aligning with best practices in probability-driven SAR (Stoffle, 2006). Rather than immediately broadening the search, planners prioritise refining existing search efforts to maximise efficiency within established probability zones before committing to a larger operational area. This reflects a core principle of Search Theory: that expanding search areas without sufficient evidential basis risks diluting effort and reducing overall probability of success (Mansfield et al., 2023).

Finally, option E (Search Suspension Criteria Review) was almost universally ranked last, demonstrating a strong operational mindset of perseverance. SAR teams focus on refining and improving search efforts rather than prematurely considering a transition to a recovery or investigative phase (Burgess, 2021). The placement of this option at the bottom of most rankings suggests that defining search suspension criteria is viewed as a strategic decision that should only occur once all other viable search avenues have been exhausted. This reinforces the commitment of SAR practitioners to continue search efforts for as long as operationally feasible.

These findings suggest that SAR training and operational strategies should continue to emphasise the importance of refining searches around high-probability clues rather than prematurely making large-scale changes to search parameters. By ensuring that teams prioritise immediate, evidence-based adjustments, search efficiency can be maximised while reducing unnecessary resource deployment (Jacobs, 2015).

A structured approach to extending searches should be reinforced, starting with behavioural analysis and area reassessment before committing to expanded boundaries or additional specialised resources (Koester, 2008). This systematic process ensures that SAR teams make evidence-driven decisions and allocate resources effectively, rather than relying on instinctive or reactive measures (Mansfield, Carlson, Merrifield, Rosenberg, Swanson, & Templin, 2024).

Encouraging an evidence-driven mindset remains important, as prioritising evidence review and search refinement leads to more precise operational strategies. By consistently assessing search data and integrating findings into decision-making, SAR teams can optimise their response while maintaining a high level of adaptability in dynamic environments (Koester, 2008).

Lastly, the resilience of SAR teams in prolonging search efforts is evident, with a strong preference for exhaustive exploration before considering suspension. Training programmes should reinforce the mindset of sustained search operations, ensuring that responders are equipped with the tools and strategies necessary to persist through challenging and uncertain search conditions. By aligning training and field strategies with these insights, SAR organisations can improve efficiency, maximise resource effectiveness, and enhance operational outcomes in search efforts (Hammond, 2004).

Map Questions

Four of the questions proposed were map questions. The exercise involved interpreting four different topographic map scenarios, each posing operational challenges for search planning. The aim of the analysis is to evaluate how well participants engaged with core SAR principles such as terrain interpretation, hazard identification, and planning concepts. The participants' annotated maps were analysed against exemplar answers, with the aim of evaluating their understanding of key SAR principles.

Map 1: Probability Area Based on Subject Category and Terrain Type

Question:

Ed the Trumper has gone missing and this subject is known to have a 75% likelihood of his subject category being found in native bush. The search area is 50% exotic forest and 40% native bush. Where would you draw a higher probability area?

Model Answer Summary: The highest probability zones are expected within the native bush areas due to the statistical likelihood from the subject profile (See *Figure 2: Model Answers for Map 1*). Focus should be on the 40% native bush sections, particularly those closest to access points, known routes, or logical travel corridors.

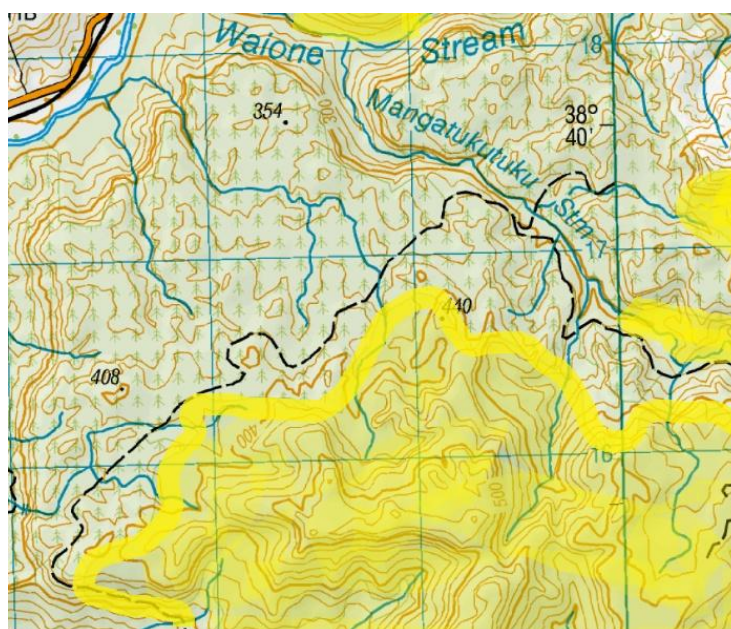


Figure 2: Model Answers for Map 1

Themes in Participants Responses:

- **Correct Prioritisation of Native Bush:** Most participants placed their highest probability zones within the native bush regions, correctly interpreting the statistical clue.
- **Hazard and Access Considerations:** Some students also factored in nearby hazards or ease of access.
- **Variable Clarity:** While many maps correctly prioritized the terrain type, clarity in boundaries and communication of reasoning varied.

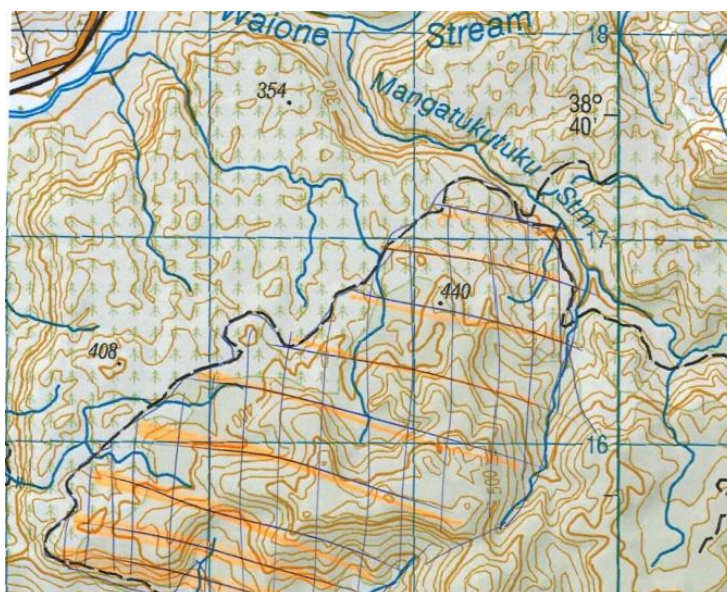


Figure 3: Participant Response for Map 1

This map revealed solid comprehension of how subject category statistics influence area prioritisation (See Figure 3: Participants Response for Map 1). Most participants accurately identified native bush as the focal point. However, some confusion between native bush and exotic forests was inconsistent, highlighting an opportunity for future training to incorporate revision of basic key/legend understanding and application.

Map 2: Adjusted Terrain Composition with Same Subject Profile

Question: Ed the Trumper has gone missing (again) and this subject is known to have a 75% likelihood of being found in native bush. The search area is 40% tussock and 30% native bush. Where would you draw a high probability area?

Model Answer Summary: Despite the smaller amount of native bush, it remains the most statistically significant area. The high probability zone should again be placed within the native bush sections, particularly those connected by logical movement paths or close to entry/exit points (See Figure 4: Model Answers for Map 2).

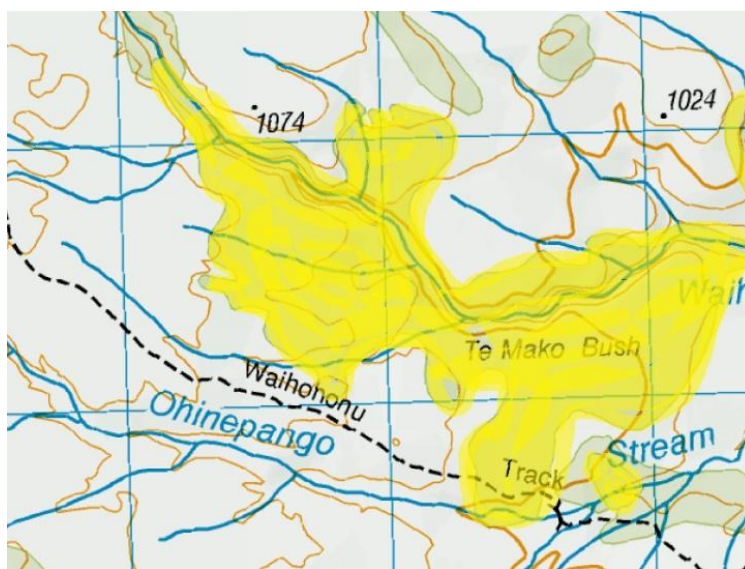


Figure 4: Model Answers for Map 2

Themes in Participants Responses:

- **Prioritisation Consistent with Native Bush Preference:** Like Map 1, most students correctly placed their primary search zones in the native bush (See *Figure 5: Participants Responses for Map 2*).
- **More Hesitation or Fragmentation:** A few responses split their focus between tussock and bush or marked wider areas, possibly due to the reduced bush percentage.
- **Route-Based Reasoning:** Several responses attempted to incorporate subject movement logic (e.g., proximity to tracks or spurs).



Figure 5: Participants Response for Map 2

This scenario tested whether participants could maintain statistical focus even when the preferred terrain type was less available. The slight drop in confidence and clarity (compared to Map 1) suggests that participants may benefit from exercises that explicitly train decisions under constraints or imperfect distributions. Reinforcing the concept of prioritisation over area dominance could be helpful.

Map 3: Linear Feature Identification



Figure 6: Model Answers for Map 3

Question: Using the highlighters provided, highlight the linear features that are present.

Model Answer Summary:

Linear features including waterways (streams, rivers), roads, tracks and trails, powerlines and fences, as well as topographical elements like ridgelines or gullies inferred from contours (See *Figure 6: Model Answers for Map 3*).

Themes in Participants Responses:

- **Waterways and Tracks Consistently Identified:** Nearly all participants highlighted visible tracks and streams, which are standard linear features in SAR navigation and search planning.
- **Some Missed Subtle Features:** The map omitted less obvious features such as contour-defined spurs or drainage lines.
- **Cartographic Literacy Use Varied:** There was inconsistency in how well participants understood the map legend to confirm features. It was assumed participants had sufficient map-reading knowledge. However, inconsistencies emerged in how less common features were interpreted, suggesting varying levels of confidence and familiarity with non-standard map elements.

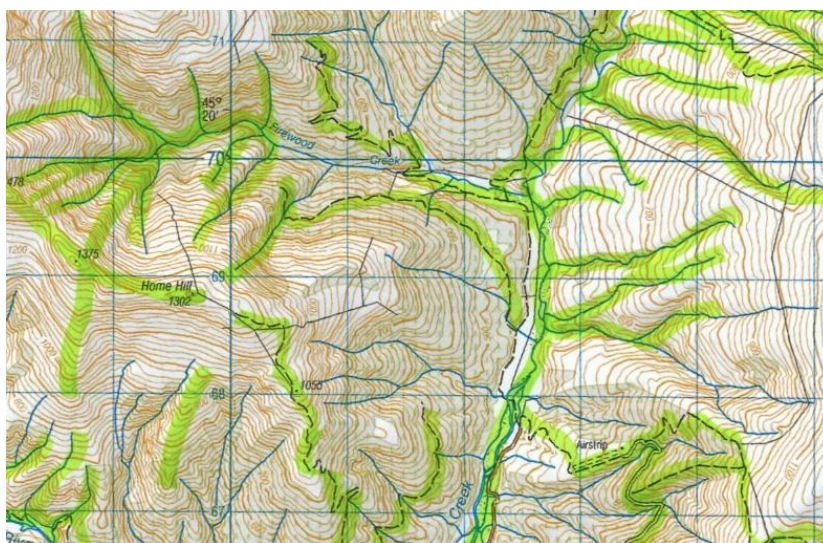


Figure 7: Participant Responses for Map 3

This task focused on observational and cartographic literacy (See *Figure 7: Participants Responses for Map 3*). While most participants demonstrated strong basic map-reading skills, deeper attention to terrain-shaping features was sometimes lacking. Reinforcement through layered exercises, first identifying, then ranking linear features by navigational value, could improve higher-order interpretation.

Map 4: Linear Feature Identification in a Different Terrain Context

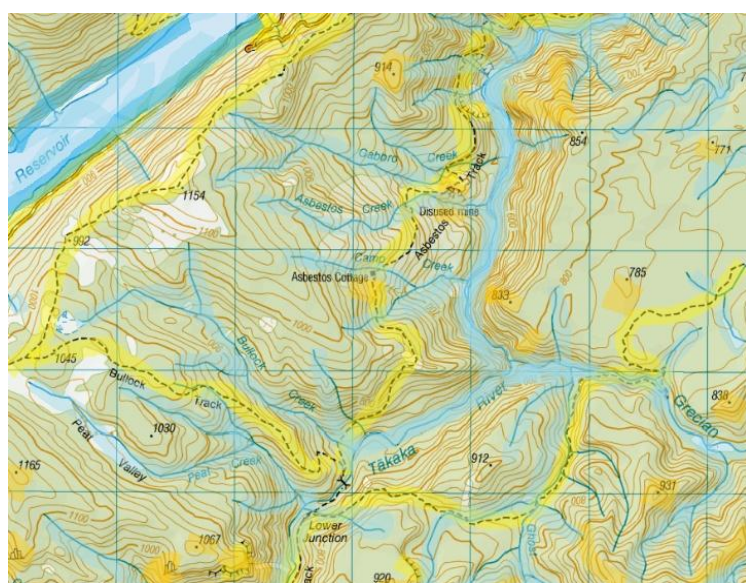


Figure 8: Model Answers for Map 4

Question: Using the highlighters provided, highlight the linear features that are present.

Model Answer Summary: As in Map 3, features included waterways (streams, rivers and reservoir), roads, tracks and trails, powerlines and fences, attractants, as well as topographical elements like ridgelines or gullies inferred from contours (See *Figure 8: Model Answers for Map 4*).

Themes in Participant Responses:

- Increased Detail in Some Responses: Compared to Map 3, several participants included more nuanced features like fence lines or inferred terrain elements.
- Inconsistent Highlighting Techniques: Some annotations were cluttered or unclear, making it hard to assess intent.
- Improved Integration: A few responses integrated linear feature identification with planning thoughts (e.g., movement corridors).

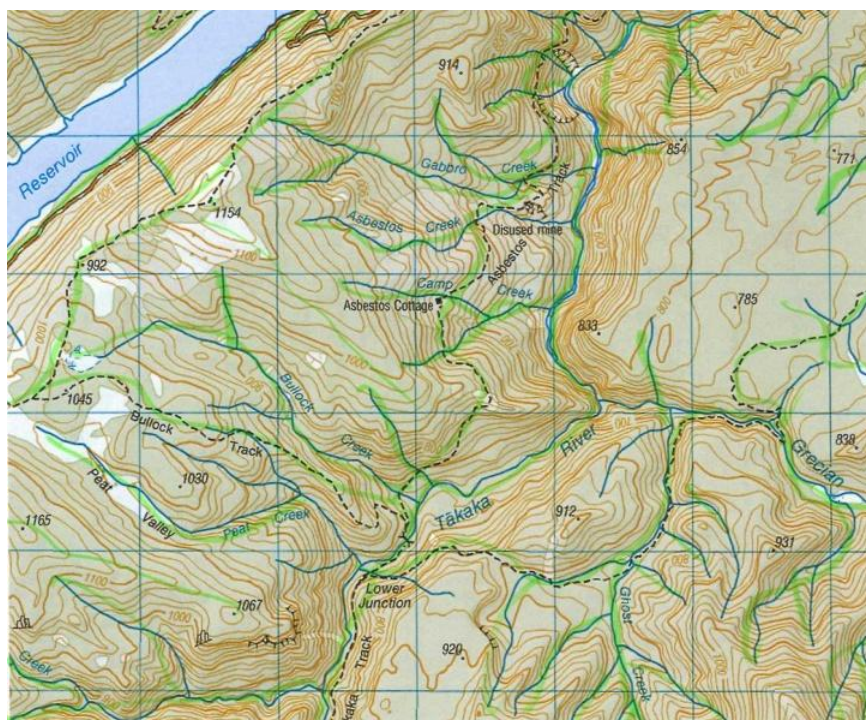


Figure 9: Participants Response for Map 4

By repeating the task in a new context, Map 4 allowed comparison of participants consistency and map adaptability (See *Figure 9: Participants Response for Map 4*). While many improved on their first attempt, annotation clarity remained a challenge. Explicit teaching on symbol standardisation and expected output format may support better communication of spatial reasoning.

Cross-Map Themes and Observations

Participants demonstrated growing comfort with applying subject profile statistics to terrain selection, particularly when the preferred terrain type was dominant in the map area. However, some confusion arose when the preferred terrain made up a minority of the available area, indicating a need for greater confidence in prioritisation logic despite uneven distributions.

In terms of linear feature literacy, most participants successfully identified basic features such as tracks and rivers, but fewer consistently recognised or highlighted more subtle topographical elements like spurs or gullies inferred from contour lines. Map annotations reflected varied levels of confidence and clarity; while many responses showed evidence of sound SAR thinking, inconsistencies in annotation style and visual communication may limit the interpretability of these maps in real-time operational contexts.

Encouragingly, several participants began to demonstrate emerging operational thinking by incorporating elements such as access routes and logical movement paths, suggesting a growing awareness of the practical application of terrain analysis in search planning.

The analysis demonstrates encouraging development in map interpretation and SAR reasoning among participants. Participants are clearly engaging with terrain and statistical data, though depth and confidence vary. Linear feature identification is strong at the basic level but could be strengthened through structured contour analysis.

Continued emphasis on scenario-based exercises and training that blends visual interpretation with operational context will further develop the competencies required in field-based search planning (Hammond, 2024).

Discussion

Beyond the core topics, the responses reveal several underlying themes that highlight opportunities for improvement in SAR operations and research communication. One key theme is variability in terminology. While most groups agree on fundamental definitions, slight differences in wording suggest the need for greater standardisation in training and learning materials.

Aligning terminology across teams and organisations will help ensure consistency in communication and reduce potential misunderstandings during search operations (New Zealand Government, 2019).

Challenges relating to terminology consistency are not unique to the New Zealand context. Internationally, multi-agency SAR and disaster response environments have similarly identified difficulties in maintaining shared operational language, particularly where terminology evolves across organisations and jurisdictions. Efforts such as lexicon standardisation projects and INSARAG-aligned guidance highlight the importance of common definitions to support interoperability and reduce miscommunication in high-tempo environments (INSARAG, 2020). The findings of this study therefore align with broader international trends, reinforcing the need for deliberate terminology harmonisation within SAR systems.

Another important theme is the real-world ambiguity that SAR personnel frequently encounter. Some scenarios do not fit neatly into predefined categories, requiring responders to exercise flexible, situation-based judgment. Training programs should emphasise critical thinking and adaptability to equip personnel with the skills needed to make sound decisions in unpredictable environments.

Finally, the operational implications of clear and consistent definitions cannot be overlooked. Standardised terminology improves communication and coordination during search operations, reducing the risk of misinterpretation in critical situations. Establishing a shared lexicon across SAR teams will enhance overall efficiency and effectiveness, ultimately improving outcomes in search and rescue missions.

Operational Implications and Recommendations

To address the variability identified in terminology, conceptual reasoning, and terrain-based decision-making, a set of practical, system-level interventions is required to strengthen consistency and operational effectiveness within SAR practice.

A nationally consistent SAR lexicon should be developed to support shared understanding across agencies and operational contexts. Variability in the interpretation of core terms such as Initial Planning Point (IPP), Last Known Point (LKP), and Point Last Seen (PLS), as well as distinctions between “Lost” and “Missing,” highlights the need for standardisation to reduce ambiguity in both planning and field environments. The importance of shared terminology is well established in multi-agency and high-tempo operational settings, where inconsistent language can undermine coordination and situational awareness (Jezek, 2016; INSARAG, 2020). A national lexicon should therefore include not only standardised definitions, but also guidance on how terms are applied across planning, intelligence, and operational contexts. Integration into national training doctrine, including courses such as Manage the Initial Response (MTIR) and Extended Search Planning (ESP), would support consistent application, while ongoing governance and version control led by NZSAR would ensure the lexicon remains current and operationally relevant.

In parallel, training programmes should move beyond conceptual understanding and place greater emphasis on applied, scenario-based learning that reflects the realities of SAR decision-making (Rodriguez, 2022). The variability observed in terrain interpretation and subject classification suggests a need for training that reinforces decision-making under uncertainty. Time-constrained exercises can simulate the cognitive pressures experienced in operational environments, encouraging intuitive and experience-driven reasoning (Goldhammer, 2015). Similarly, terrain-constrained probability tasks, particularly where preferred terrain types are not dominant, can strengthen practitioners’ ability to prioritise effectively under imperfect conditions. Enhanced cartographic literacy is also required, particularly in the interpretation of contour-derived features such as spurs and gullies, which are critical to terrain-based search planning (Speake & Axon, 2012). In addition, scenario-based classification exercises involving ambiguous or mixed-profile subjects can improve the application of Lost Person Behaviour (LPB) principles, particularly in situations where behavioural cues are unclear or conflicting (Koester, 2008).

The findings also highlight variability not only in terrain interpretation, but in the communication of spatial reasoning. Inconsistent map annotation reduces the clarity of operational products and may limit shared situational awareness during planning and tasking. Standardised annotation conventions, including the use of symbols, colour, and boundary definition, should therefore be incorporated into both training and operational processes such as Incident Action Plan (IAP) development. Improving the consistency and readability of map-based outputs will enhance communication across teams and support more effective coordination in dynamic environments (Schaefer et al., 2017).

Finally, the results indicate the presence of an implicit decision-making hierarchy among SAR practitioners that warrants explicit recognition within training and doctrine. Participants consistently prioritised behavioural reassessment and the refinement of high-probability areas before deploying specialist resources or expanding search boundaries. This aligns with established principles of search theory, which emphasise the iterative refinement of probability of area (POA) and the importance of evidence-based decision-making in optimising search effectiveness (Koester, 2008; Mansfield et al., 2023). Formalising this hierarchy within training frameworks would support more consistent decision-making and reduce the likelihood of premature or inefficient expansion of search efforts.

Limitations

While the findings presented in this report provide valuable insights into the thematic understanding of key SAR concepts, several limitations should be acknowledged.

One of the primary limitations of this study is the demographic composition of the participants. The individuals who took part in the LandSAR Hui (Conference), where the quiz was administered, were predominantly experienced leaders in the SAR field. With extensive expertise in SAR operations, their responses are likely shaped by advanced knowledge and practical experience. As a result, the findings may not accurately represent the perspectives of less experienced personnel or those new to SAR. This disparity in experience could lead to a more sophisticated interpretation of terminology and concepts, potentially differing from how these terms are understood by novice SAR responders in real-world situations (Randel, Pugh, & Reed, 1996).

Another key limitation relates to the context in which the quiz was conducted. The quiz was designed to assess participants' instinctive responses under time constraints, mirroring real-world SAR conditions where rapid decision-making is important. However, this format may not fully capture how individuals process and apply these concepts in a more reflective or deliberate setting (Vijayaratham, 2012). Given more time to consider their answers, participants might provide responses that reflect deeper reasoning or more nuanced interpretations (Sherman, Harvey, Royse, Heim, Smith, Romano, King, Lyons, & Holt, 2019).

The generalisability of the findings is also limited by the specific sample of participants involved in this analysis. The quiz was administered at a national conference held in Tāmaki Makaurau Auckland, meaning the responses reflect the knowledge and experiences of SAR personnel operating within the North Island context. While these individuals are highly skilled, the findings may not be directly applicable to SAR teams in other regions or those with differing levels of experience. The unique challenges and environmental conditions of SAR operations in this region could shape the interpretation and application of key concepts in ways that differ from practices in other locations (Giles, 2008).

Additionally, variability in terminology and interpretation of SAR concepts among participants may be influenced by personal or organisational preferences rather than fundamental differences in understanding (Jezek, 2016). While these variations provide valuable insights, they do not necessarily indicate a broader inconsistency in SAR terminology across different teams. Further research involving a more diverse sample of SAR practitioners could help determine whether these variations are widespread or unique to specific groups.

Furthermore, it is important to acknowledge that some quiz questions were designed to probe respondents' implicit biases or assumptions regarding how theoretical outputs, such as TBP models, could be translated into operational tools. While this provided valuable insight into participants' real-world reasoning, it also introduced variability based on personal experience and comfort with applying academic theory in high-stakes, time-sensitive environments (Rodriguez, 2022). These questions may not have been interpreted uniformly, and responses could reflect differences in how individuals conceptualise the operational value of research outputs.

In light of these limitations, it is important to interpret the findings with caution and consider the specific context in which the study was conducted when applying the results to broader SAR training or operational improvements.

Future Research

To strengthen the effectiveness of SAR operations and align training with both theoretical insights and practical realities, several key recommendations have emerged from this analysis. First, the development and adoption of a national SAR lexicon is essential (Papier, Chalmers, Byrnes, & Goldsmith, 2004). A shared and standardised set of definitions, particularly around terms such as Initial Planning Point (IPP), Last Known Point (LKP), Point Last Seen (PLS), and the distinction between "Lost" and "Missing", will improve clarity and consistency across operational contexts, reducing the likelihood of miscommunication in time-critical scenarios.

Building on this, scenario-based training should be expanded to incorporate both conceptual and map-based exercises that mirror the complexity of real-world situations. Specifically, training should include constrained terrain scenarios, where preferred subject environments are less dominant, to build confidence in statistical prioritisation despite imperfect distributions. Enhanced cartographic literacy is also needed (Speake & Axon, 2012), with a focus on identifying and prioritising terrain features inferred from contour lines, such as spurs, gullies, and ridgelines. This should be complemented by standardised visual annotation techniques to ensure clarity and operational alignment during planning and briefings. Additionally, subject classification training should emphasise ambiguous profiles, such as mixed-activity individuals (e.g., a daywalker carrying a rifle), to reinforce flexible, evidence-based application of Lost Person Behaviour (LPB) theory (Koester, 2008). A continued emphasis on evidence-driven planning should remain central to all training frameworks, reinforcing the preference for localised tasking around high-probability clues before implementing broader search changes (Snaprud, 2022). Training modules

should also encourage critical thinking and adaptability to prepare teams for uncertain and evolving conditions (Rodriguez, 2022).

Scenario-based training and field exercises are essential for developing SAR personnel's ability to navigate ambiguous situations. By incorporating real-world case studies, SAR personnel can strengthen their critical thinking skills and improve their ability to classify incidents effectively (Anderson, Pitel, Weerasinghe, & Papazoglou, 2016). Exposure to varied scenarios will reinforce decision-making frameworks, enabling teams to apply theoretical knowledge in practical contexts. Field exercises provide hands-on experience that allows SAR teams to simulate operations with diverse subject profiles, such as lost hikers, hunters, and mixed-use recreationalists. These exercises help refine decision-making processes and reinforce the application of standardised terminology in dynamic environments, preparing SAR personnel for the complexities of real-world search operations (Rodriguez, 2022).

To support the uptake of research findings, communication strategies should be tailored to account for varying levels of SAR experience (Baxter, & Braverman, 2004). Findings should be presented in accessible formats that bridge the gap between academic research and field application, improving knowledge transfer and application. Further, regular evaluation of how SAR personnel interpret and apply key concepts in operational contexts should be built into national training frameworks, creating a continuous feedback loop for learning and improvement (Hodges & Larra, 2021).

Lastly, strong stakeholder engagement is essential to aligning theoretical insights with practical realities (Goodman, & Sanders Thompson, 2017). Involving SAR practitioners in research development will enhance the relevance and applicability of findings. A collaborative research approach will ensure that academic insights contribute meaningfully to operational advancements, supporting innovation and continuous improvement in the SAR field.

Conclusion

This analysis reveals that SAR personnel demonstrate a strong foundational understanding of core concepts and a high level of operational reasoning, particularly in prioritising evidence and behavioural cues in search planning. However, variations in terminology interpretation, confidence in terrain analysis under constraints, and inconsistency in map-based visual communication highlight important areas for development. The inclusion of the map-based questions provided a critical layer of insight, revealing how theoretical knowledge is applied spatially and visually under operational conditions. While participants generally performed well when dominant terrain matched the subject profile, confidence wavered when terrain distribution was more complex. This suggests that training must move beyond ideal scenarios and into the nuanced decision-making required in the field.

Encouragingly, many participants demonstrated emerging operational thinking and a willingness to integrate subject movement logic and terrain assessment. Reinforcing these skills through immersive, scenario-driven training and clear operational language will help develop even greater consistency and agility among SAR teams.

However, the findings also highlight that research outputs, even those designed with SAR in mind, such as statistical models or theoretical frameworks, require thoughtful adaptation to be usable in the ambiguous, time-constrained contexts of field operations. To bridge this gap, it is essential that future research and training initiatives focus not only on producing data or models but also on translating these into intuitive, actionable tools for practitioners under pressure. By implementing these recommendations and improving the interface between theory and practice, SAR organisations can enhance the effectiveness, responsiveness, and clarity of their operations in Aotearoa New Zealand.

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Abbreviations

ESP	Extended Search Planning
IPP	Initial Planning Point
INSARAG	International Search and Rescue Advisory Group
LandSAR	Land Search and Rescue

LKP	Last Known Point
MTIR	Managing the Initial Response
PLS	Place Last Seen
SAR	Search and Rescue
TBP	Terrain-based Probability

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