Factors Likely to Accentuate Serious Harm
The FLASH Rating
A Risk Communication Tool

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Abstract: This paper discusses a tool that can be used to make the most of instructors' past experience and group discussions to evaluate the hazards and risk of serious harm posed by a specific activity. The tool can then be used to communicate the risk of those hazards to other staff. The need for such a tool became apparent when reviews found that there were differing perceptions among staff of the risk in the Mangatepopo Gorge and this was identified as one factor in a tragedy where seven people died. The resulting risk communication tool can be used both in training instructors and during programmes to identify factors that might lead to serious harm in order to establish when higher levels of supervision are required and to decide if an activity should be cancelled due to having too much risk on the day. Use of this tool has been found to be valuable in discussing factors that lead to serious harm in any activity, recording this learning for future users of the activity, and for evaluation of suitability of the activity prior to conducting it in a programme on any day. It has application across a wide range of organisations and activity settings.

Keywords: Risk management, risk perception, risk communication, serious harm, accident, incident

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The Mangatepopo Tragedy and Risk Perception

In April 2008, six students and a teacher drowned in a flash flood while carrying out a gorge trip on the Mangatepopo Stream. This happened despite a hazard analysis of the gorge environment prior to this event that had identified the serious risks posed by such a flash flood and how heavy rain, that might be falling unseen in the upper catchment of the stream, could lead to such an outcome with little local indications of a problem. Policies and procedures had been put in place to prevent this identified hazard resulting in an incident

Figure 1: Instructor and students in the Mangatepopo Gorge at normal water flows

This paper is not a comprehensive review of the causes of the incident. Instead it focuses on only one of the identified causes of the incident, suggesting an alternative/ additional method of hazard analysis. This method has potential application across the outdoor sector and beyond.

The Mangatepopo Gorge trip has been carried out with school groups at OPC since the 1970's. Over the years the most common trip had been a 'Downstream Gorge Trip" where the group are lowered into the gorge and then swim, wade and walk past various river obstacles in a vertical walled gorge environment where escape options are very limited. Halfway down the gorge it is possible to leave the riverbed on an elevated ledge (named Halfway Ledge) that is above all flood risk. The Halfway Ledge provides a safe and relatively spacious haven where a group could stay reasonably comfortably for an extended period. A permanent ladder and cache of rescue gear had also been installed on the Halfway Ledge so that a group could exit from this ledge to a walking track on the ridge above without undue difficulty. From the end of the Halfway Ledge it is possible to re-enter the stream and negotiate along the stream to a hydro dropshaft which gives access to a sealed road. (NB: A hydro drop shaft is a dam

structure where water enters a tunnel on one side through a protective grill for electricity generation purposes)

A second variation to this trip had been carried out in earlier times, but became more popular in recent years after a landslide temporarily removed the abseil/lower point for the downstream trip. This was known as the 'Upstream Gorge Trip'. The upstream trip involved starting at the hydro dropshaft, walking and wading upstream as far as deemed suitable for the group but most regularly to below the Halfway Ledge, and then turning around and retracing the route.

The gorge is approximately 700m long and a fit and capable person could navigate the sections between safe spots in 30 minutes (Abseil point to Halfway Ledge – 15 minutes; and Halfway Ledge to hydro dropshaft – 15 minutes). A group moving steadily could cover the entire length of the gorge in under an hour.

The Mangatepopo tragedy occurred on an upstream trip. The risk from a flood event proved just as great as the downstream trip as the group approached the Halfway Ledge.

Interviews by the Department of Labour of staff following the Mangatepopo Tragedy indicated that there was not a consistent understanding among staff of the potential risk posed to students in this activity. DOL investigators stated that, "The impression given is that the upstream gorge walk had less risk associated with it than the downstream walk. It is possible that, as a result, some complacency was able to develop in the implementation of systems around entry to the gorge." (DOL, 2008). These differing perceptions may have arisen due to factors such as the trip being less technical (no abseil/lower required), because groups experienced the ground they would need to retrace to exit the gorge, because the trip seemed less committing in that it was possible to turn around at any time, and because the trip was used as a training trip for instructors building up experience to undertake the downstream trip. Through these factors it seems that the perception of the risk for this trip among some staff was less than eventuated on the day.

This raised the question of how best to convey a 'risk rating' for an activity to all staff, what level of supervision is required for activities of various 'risk ratings', and what would trigger the cancellation of any activity. As for many in the outdoor industry, OPC had Risk Analysis and Management System (RAMS) forms highlighting all of the identified hazards that existed in any activity. In listing all hazards in the one form without any hierarchy, I believe these can fail to give an overall impression of the seriousness of that activity in total. This is particularly relevant for activities where the activity contains risk that is high in potential severity but low in frequency of occurrence of that risk (NB: National Institute of Water and Atmospheric Science models for the gorge indicate a flood event of this magnitude is likely to occur once every two years (NIWA, 2008)). In such cases complacency can arise because of the low occurrence of actual incidents.

This incident has shown that OPC lacked a system or tool that clearly points out the potential of an activity to result in serious harm, the factors that might lead to those serious harm events and a consistent approach for clear decision making for managing the risk in those activities. I have not come across such a tool during my work in this sector which leads me to believe that other organizations may be in a similar position.

Having recognized the short comings of the RAMS system OPC senior management and instructing staff became involved in a process to establish a more comprehensive system for calculating and communicating risk. This process is described below.

<u>The Development of a Tool to Focus on Potential Serious Harm</u>

Research into serious harm events in industrial settings indicate that the factors that are predictive of those events include sources of high energy, new activities and certain construction situations (Petersen, 1988)

When these factors were translated to the outdoors the following factors were identified, many of them verified through a study of incidents at outdoor education centres and peer reviewed for validity (Davidson, 2004a):

High Energy Sources:

- Speed
- Height
- Moving water
- Extreme temperatures
- Extreme weather
- Fire (including use of cookers)

Other Factors:

- Water activities were particularly problematic whether the water is moving or not
- Avalanche is a particular outdoor hazard that leads to serious injury/death
- New instructors to an activity may present a higher risk
- Remoteness reduces the ability to respond or react in case of an emergency.

At OPC we trialed a matrix of these factors that could lead to serious harm, specific to an activity and site, to generate discussion and share knowledge among staff for that activity. We rated each of the factors according to the scale below, resulting in a grading for each site specific activity.

Most of the factors have a rating of:

- 0 = no risk;
- 1 = low risk of the factor causing serious harm;
- 2 = medium risk of the factor causing serious harm;
- 3 = high risk of the factor causing serious harm

Because of the special nature of water in serious harm events in the outdoors (accentuates hypothermia and drowning leaves little time to resolve a crisis), it is scored on a scale of two to four rather than one to three. The 'Other' category under 'Extra Factors' can be repeated as often as necessary with each additional factor identified adding to the total score.

FLASH RATING SYSTEM	Activity Factors				Environmental Factors			Extra Factors		**Total**
	Water (2 - 4)	Avalanche (1 - 3)	Speed (1 – 3)	Height (1 – 3)	Extreme Temp (1 – 3)	Extreme Weather (1 – 3)	Remote (1 – 3)	Fire or burners (1 – 2)	Other? (1 – 3)	
Local bush walk around OPC	0	0	1	1	1	2	0	0	1	**6**

Table 1: FLASH risk rating for local bush walk around OPC

Groups of instructors were asked to consider a particular activity, carried out at a particular site, and give each of the serious harm factors a rating as discussed above. The rating scale is deliberately 'coarse' to force the group discussing a particular factor to put it into a low, medium or high category. If a category is in debate they are encouraged to adopt the highest rating. This process tends to generate significant discussion and particular local knowledge of hazards is brought out and should be recorded for reference by future readers.

The rating for any category is the 'absolute risk' (Priest & Baillie, 1987) of serious harm that is understood to be posed by that category – that is, the risk posed without any management or controls being put in place. So, if the controls or management practices for whatever reason failed to be deployed, this is the risk of serious harm that would or could be present.

The result of the discussion is an overall risk rating for the activity, along with recorded notes on particular hazards that may not be known to people new to that particular activity. The discussion and recording of key serious hazards was found exceptionally valuable by all those who took part. The overall risk rating for any site specific activity we termed its FLASH rating (factors likely to accentuate serious harm). The FLASH process focuses on discussion around hazards that may lead to serious harm as opposed to RAMS forms where these serious harm hazards can be 'lost' among less serious hazards.

Grouping activities according to cumulative risk of serious harm

Using the FLASH rating with a number of common OPC activities gives the following table.

FLASH RATING SYSTEM	Activity Factors				Environmental Factors			Extra Factors		**Total**
	Water (2 - 4)	Avalanche (1 - 3)	Speed (1 – 3)	Height (1 – 3)	Extreme Temp (1 – 3)	Extreme Weather (1 – 3)	Remote (1 – 3)	Fire or burners (1 – 2)	Other? (1 – 3)	
Mangatepopo Upstream Gorge (summer)	4	0	1	2	2	3	2	0	2	**16**
Mangatepopo Downstream Gorge (summer)	4	0	1	3	2	3	2	0	2	**17**
Okupata Caving	3	0	0	1	1	3	2	0	0	**10**
Sailing (sheltered water)	2	0	2	0	1	2	1	0	0	**8**
High Ropes	0	0	0	3	1	3	0	0	0	**7**
Low Ropes	0	0	0	1	0	0	0	0	0	**1**

Table 2: Comparison of FLASH risk ratings for a range of OPC activities

An overview of these FLASH analyses (note that the commentary is not included here) show the following:

- That the analysis produces a spread in ratings from 1 to 17 using the activities and sites chosen
- That a higher rating points to an activity that has a higher combination of objective risks that could lead to a serious harm
- That the analysis predicts that both the Downstream Mangatepopo Gorge and Upstream Mangatepopo Gorge have high FLASH ratings that indicate an activity where the risk of serious harm is high
- That even if an activity receives a lower rating, this rating may be the result of fewer factors, any one of which might have a high risk of causing serious harm (eg. High Ropes – height and weather). **Therefore total FLASH rating is not enough by itself on which to base decisions that an activity needs a higher level of risk management.**

After analyzing a large sample of activities occurring at various sites, a group of very experienced senior staff at OPC looked at whether grouping activities within ranges of FLASH scores produced valid categories from 'Low Risk' to 'High Risk' activities. They used their long term knowledge of the activities and the hazards present to determine if the groupings appeared valid.

Initial indications are that the following groupings of activities by FLASH rating can be made:

- 0 - 8 points (**low risk**, but be aware of any single factor(s) scoring high)
- 9 - 16 points (**medium risk** – may be difficult to manage if environmental or group conditions are less favourable.)
- 17 - 20 points (**high risk** – likely to be several factors that must be managed in order to prevent serious harm and higher levels of supervision are required.)
- 21+ points (**Unacceptable Risk** - for an educational group)

The colour coding was immediately found to be helpful in thinking about the implementation and monitoring of the activity.

Because the FLASH analysis is being used as a risk communication tool to point particularly to hazards leading to serious injury, and even a low score could conceal one or more factors that has a maximum ranking, it was decided that the score for the activity should be followed by a letter code indicating any factor that has been given the highest score in for that factor.

It was also decided that if an activity at a specific site scored a 'Green' ranking, but contained one or more factors at maximum points, then it would be upgraded to 'Yellow'

The examples above yield the following FLASH ratings:

Low ropes	1
Local bush walk around OPC	6
High ropes	7 Ht Wx
Sailing (sheltered water)	8
Caving Okupata	10 Wx
Mangatepopo Upstream	16 W Wx
Mangatepopo Downstream	17 W Ht Wx

Note that the High Ropes activity scores a FLASH rating of seven, but is upgraded to a 'Yellow' category of activity because it has scored maximum points in Height (operating at 12m can lead to death) and Extreme Weather (lightning storms on a metal cableway at height could lead to death)..

Commentary should follow a FLASH analysis to point out the thinking behind the ratings and any local knowledge experience that might be relevant to a first time reader or someone wanting to refresh their knowledge.

A) Calculating the Provisional FLASH Rating for an activity.

The analysis above gives a risk rating for each activity/site based on the combination of factors that have the potential to cause serious harm. These factors can be thought of as objective hazards which can be managed to reduce the absolute risk. Such management techniques should be recorded using a normal risk management tool such as a RAMS form or Safety Action Plan. These management processes will take into account current accepted practices, ratios for supervision, qualifications, etc.

The FLASH analysis shows that some activities contain a combination of serious hazards such that the level of supervision may need to be increased for a particular activity at a particular site. OPC senior management believes that to maintain a substantial margin of safety with our standard group size of ten students:

- 'Green' activities can safely be supervised by one instructor
- 'Yellow' activities may need two instructors in some circumstances
- 'Orange' activities will require two instructors

Note: An 'instructor' who is put in a supervisory role at OPC is one who has been trained, inducted into local conditions and assessed as competent by a senior member of staff against established criteria that are benchmarked against unit standards and/or national qualifications.

B) Achieving a Generic FLASH Rating for any activity at a specific site.

The OPC Senior Management Team decided that there are a number of judgments to make in relation to each activity to make a final decision as to whether an activity will require a higher number of instructional staff, or whether it should be cancelled on a particular day.

The first stage in this decision-making process is to answer the following two questions for Green or Yellow activities. Any Green or Yellow activity will be moved into the Orange category (two instructors) if a positive answer is given to either of these:

1) If the instructor is incapacitated will the group be exposed to unacceptable risk?
2) If an incident occurs to a member, or subset, of the group, will the rest of the group be exposed to unacceptable risk while the instructor is involved in resolving the incident?

Once these questions have been addressed then the final colour coding has been determined for the FLASH rating for the activity at a specific site in a general context. This is not the end of the process. Each analysis must be individualized for the group, conditions and instructor experience on the day.

These questions presuppose that the group has an acceptable level of common sense, has been trained in the communication device(s) that the group carry, they have a safe area to wait while assistance comes and will not be subjected to further hazards. If these criteria are not met then, if the instructor is incapacitated or resolving an incident, the activity becomes one that is unsupervised with risks that are unacceptable (Davidson, 2004b) and a further instructor should be present to ensure safety.

C) Determining an Individualized FLASH rating for a specific group going into the field.

Prior to going into the field, or when programming staff on activities, if an activity has achieved a Yellow coding at the generic level, then a number of questions should be answered for the specific group, instructor and environmental conditions present. The Yellow rating indicates that under normal conditions then one instructor may provide a level of supervision that will provide a substantial margin of safety. If any factor is outside the normal range, then a higher level of supervision might be warranted. Following this logic, if an activity is Yellow, then an answer of 'Yes' to any of the following questions could well move it into the Orange category where two instructors are required:

1) Does the specific group, or any individual, have physical/emotional issues that increase the risk?
2) Do the environmental conditions on the day increase the risk?
3) Does the instructor have little experience at running the activity?

If the answers to all of the above questions is 'No' then the activity moves into the Green category and only one instructor is required.

The answers to these will give a final FLASH colour code for the activity on that day, with that instructor and that group.

The Yellow category can be considered a temporary classification for an activity that must be considered more closely on any day and moved to either Green or Orange along with the subsequent supervision levels.

D) Determining if an activity should be cancelled on the day - GO / NO GO

Once the questions have been addressed, then the number of instructors required to supervise with a substantial margin of safety has been decided. However there may still be factors that dictate that an activity should move into the Red (no go) category immediately prior to running the activity. The following questions should have a final check on the day at a simple 'go' or 'no go' level of decision making.

Are the current, or predicted, conditions suitable for the activity today?

- Group strength
- Water
- Avalanche
- Terrain, surface conditions, etc.
- Weather or temperature (using most recent information)
- Instructor(s) experience
- Other hazards

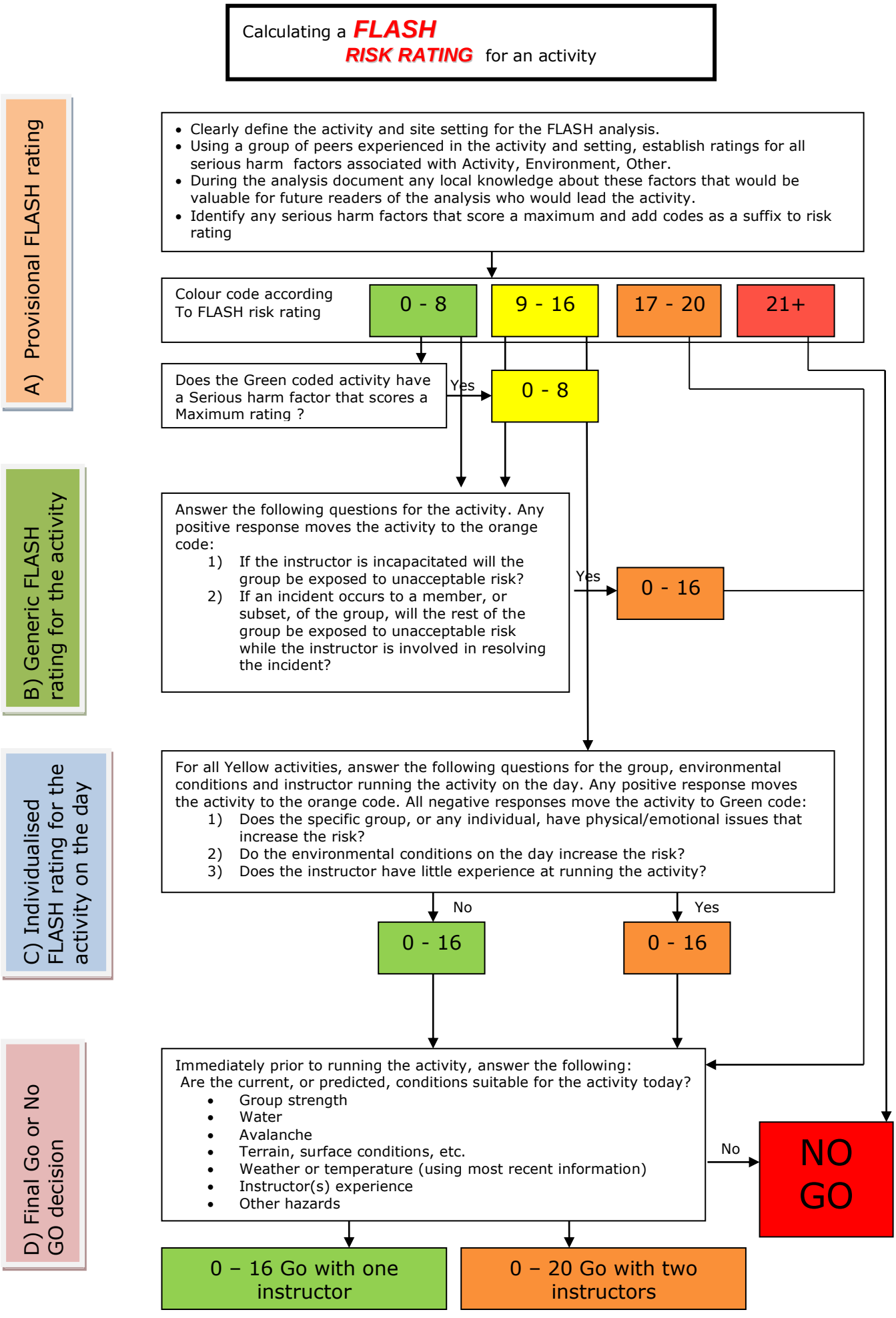

Figure 2: Flowchart outlining the stages of FLASH risk rating for an activity

Reflection on the Mangatepopo Tragedy

This paper began with a discussion of the Mangatepopo Tragedy and how a tool was required at OPC that could effectively communicate the risk of serious harm in an activity such as the upstream gorge trip and help with good decision making. The test is to consider what difference, if any, using the FLASH tool might have made.

The Mangatepopo Upstream Gorge trip receives a FLASH rating of  16 W Wx. The score of 16 makes the activity orange and therefore requires two instructors to provide a suitable level of supervision. In addition the factors of 'water' and 'weather' are highlighted and become critical in decision making. Weather and water levels would be monitored very carefully for this activity.

The final questions that would be asked prior to the activity being sanctioned on any day would be:

1) Does the specific group, or any individual, have physical/emotional issues that increase the risk?
   The group in question contained a boy with cerebral palsy and some members who had indicated a lack of water confidence. The answer would be No and the activity would achieve a 'No Go' rating based on this question.
2) Do the environmental conditions on the day (water and weather) increase the risk?
   The weather forecast on the day was for rain. This could raise the water level and cause unnecessary risk. Even without the extreme weather warnings this activity would have received a 'No Go' rating based on this question.
3) Does the instructor have little experience at running the activity?
   The instructor on the day had only recently achieved her sign-off for this activity. Unless an experienced second instructor could have been found to be the lead instructor for this trip, the activity would have received a 'No Go' rating based on this question.

Based on the FLASH rating alone, it is likely that the instructor would have self-assessed that the activity was not suitable to suggest for that group on that day. However, even if the activity was suggested, management and peer review of the proposed activity using the FLASH approach should have seen it receive a 'No Go' decision based on two key questions. If the weather and group strength were favourable, an experienced second instructor would need to be found to lead the trip.

As discussed at the outset of this paper, this tool only addresses one of the identified factors that may have contributed to the Mangatepopo Incident. OPC senior management believe that the FLASH tool is one improvement that might help them and others improve systems to aid in preventing others.

Conclusion:

At OPC we have found that the FLASH analysis stages described above are a useful way to communicate the factors in any activity, at a particular site, that can lead to serious harm. Furthermore it can help establish an appropriate level of supervision to achieve a substantial margin of safety. Finally a checklist of conditions on the day can help provide a final decision on whether an activity should proceed or not on that day

The four stages of the FLASH process described above are:

A. Identify the factors for the activity/site that could lead to serious harm. This will lead to a Provisional FLASH rating and colour code for the activity.
B. Determine the Generic FLASH rating and colour code for the activity by answering the two questions related to safety of the group in cases of instructor incapacitation or separation of the group if the instructor is managing an incident.
C. Answer the questions for the activity on that day which can affect the colour code for the activity and thus the level of supervision required for that day.
D. Answer the GO/NO GO questions for the activity for the day, any one of which can lead to the activity being cancelled on that day.

When introduced to OPC the process proved very useful, used alongside existing hazard identification systems such as RAMS or SAPS, for training staff or making decisions prior to participating in activities. It caused us to re-evaluate many of our own practices, and helped to encourage a questioning attitude with strong self-evaluation, prior to instructors registering intentions for activities for the day. It also provided a good peer review tool for those in supervisory roles giving advice to other instructional staff.

I encourage other organisations to experiment with this system to see if it will add value and increase margins of safety in your programmes.

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