25

Risk Assessment

A semi-quantitative risk assessment has been undertaken for the EAW expansion project. This chapter summarises the outcomes of the risk assessment workshop and risk assessment report (**refer Appendix Q**).

This chapter:

- Describes the risk assessment process that was undertaken for the EAW Project.
- Presents outcomes and findings of the EAW risk assessments that describe the risk events for the overall project (Note that detailed descriptions of specific risk events described in the relevant technical chapters in the EIS).
- Demonstrates whether the proposed expansion of EAW will pose an acceptable risk to assets including public health and safety, economy, society, environment, and property and infrastructure.
- Demonstrates that the EAW risk assessment process meets the regulatory requirements.

25.1 Introduction

The proposed expansion of EAW broadly comprises four separate developments within the EAW precinct. The scope of this DEIS includes the four main developments, along with required works associated with these developments. The four main proposed developments within the scope of this DEIS are:

- Barge ramp and hardstand area
- Marine supply base
- Additional rail loop
- Tug and small vessels berths

In addition to the four main developments, dredging is a fundamental component of the project. The assessment of risks associated with dredging considered cutter suction dredging, which is the most likely dredging methodology. Other dredging options may be considered, depending on the dredging contractor appointed. Potential impacts will be assessed with the finalisation of the draft DMP.

The scope of each of the four developments is outlined elsewhere in this DEIS (refer Chapter 2).

The Risk Identification and Strategy Using Quantitative Evaluation (RISQUE) risk assessment methodology was adopted for risk assessment, as it allows for the practical documentation and comparison of known and potential impacts across the project, cost-effective mitigation measures to be developed, and for the nature of the risks to be understood in terms of when, where, and to which assets the known impacts and risks will exist.

25.2 Approach

25.2.1 Overview of the Approach

The risk management approach for the EAW risk assessment is based on the RISQUE method which is a widely accepted approach to risk management, often involving the use of a multi-disciplinary “expert panel” for assessing the probabilities and consequences associated with potential risk events.

This approach was selected because it is essentially simple and is able to assess (on a relatively even basis) risks associated with social, environmental, engineering and economic issues and events. It

was decided that an alternative, simulation approach sometimes used by the RISQUE method, was not appropriate for the Project.

Highly complex systems involving feedback mechanisms and multi-faceted inter-relationships have been incorporated into the risk assessment through the use of a team of subject matter specialists.

In general terms, the RISQUE method is a cyclical process based on the ISO/Australia and New Zealand Standard for Risk Management (ISO 31000:2009) framework, as described in **Error! Reference source not found.**.

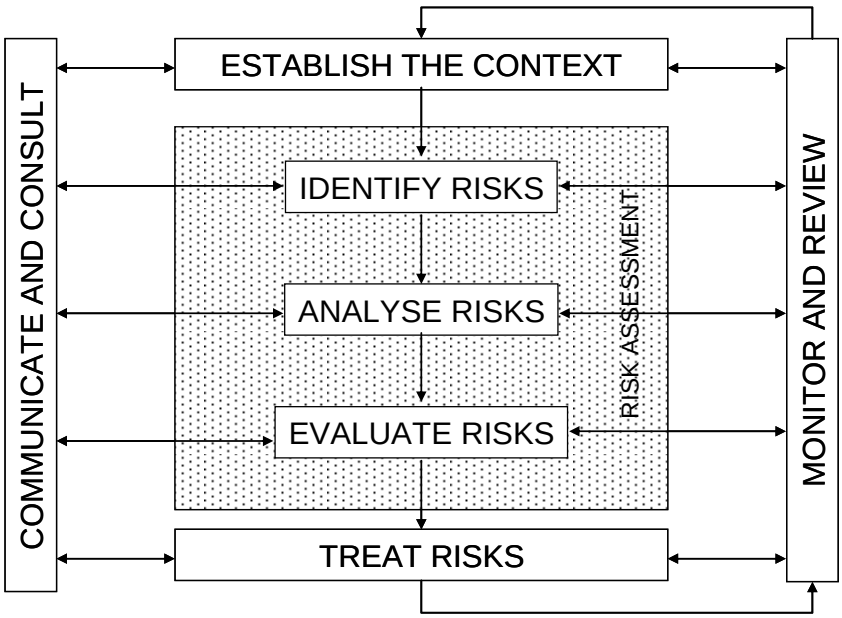

Figure 25-1 Overview of ISO 31000 Risk Management Process

Error! Reference source not found. shows that the ISO 31000 risk management process is iterative and that the main elements of the process are:

- Communicate and consult – Communicate and consult with stakeholders at each stage of the process.
- Establish the context – Context for the project has been described in the project description. This step provides background to the analysis and structure of the risk assessment.
- Identify risks – Identify when, where, why and how risk events could occur. Information was obtained from DLP personnel and from subject matter specialists. The process was essentially workshop-based with support from other discussions, meetings, and reviews that took place outside of workshops, and was facilitated by URS.
- Analyse risks – Identify existing controls, evaluate likelihoods and consequences to determine levels of risk. The level of analysis was relatively simple (involving calculation of risk quotients and adding risks and likelihoods as appropriate) and was performed by the URS risk analyst.
- Evaluate risks – Compare estimated levels of risk with evaluation criteria, consider benefits versus adverse outcomes. The role of the risk analyst in the risk evaluation process was to generate appropriate outputs from the risk analysis that would be useful for stakeholders (including DLP, community and regulators) to evaluate the risk posed by the Project and to form their views.

- Treat risks – As required, to develop and implement specific strategies for increasing benefits and reducing potential costs and to ensure that all material risk events are addressed in the actions contained with the EMP of this EIS.
- Monitor and review – Monitor the effectiveness of all steps of the risk management process. The client, with support from the risk analyst, will assess changing circumstances.

25.2.2 What is Risk?

Risk is a condition resulting from the prospect of an event occurring and the magnitude of its consequences. Therefore, risk is an intrinsic combination of:

- The likelihood of an event and its associated consequences occurring (this incorporates consideration of the frequency of the event and the probability of the consequences occurring each time the event occurs); and
- The magnitude of potential consequences of the event.

In quantitative terms, “risk” is defined by a risk “quotient”, which is:

Risk Quotient = Likelihood x Consequence

The risk quotient is therefore a numerical value that describes the level of risk posed by an event.

Both likelihood and consequence can be measured in several ways using different techniques, depending on the aims of the risk assessment and the nature of the risk issue. The selected methodologies for assessing likelihoods and consequences in the risk assessments are described in following sections.

Dealing with Uncertainty

As risk is a concept used to describe events that may or may not occur, and for which the scale of potential impacts cannot be accurately predicted, there is always inherent uncertainty associated with the estimation of risk.

Considering the two-dimensional nature of risk (likelihood x consequence), there are two key types of uncertainty in any estimation of risk:

- Uncertainty in the estimated likelihood of an event occurring
- Uncertainty in the magnitude of the event consequences.

The underlying cause of the uncertainty itself may be a result of a combination of issues such as lack of historical information for similar situations, uncertainty in scientific knowledge, natural variability, or uncertainty due to assumptions inherent in technical models or calculations used for forecasts and predictions. In assessing and measuring uncertainty, one must take into account each of the assumptions made and the extent of its validity.

25.3 Risk Identification

A workshop (with subsequent follow-up and validation) process was followed to perform the task of risk identification. Subject matter specialists in attendance provided expertise in marine systems modelling, asset management, marine operations, construction engineering, marine ecology, terrestrial ecology, social impact assessment, air emissions, underwater noise emissions, cultural heritage, economics, water quality, terrestrial hydrology, visual impacts, and infrastructure.

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The following tasks were performed at the workshop:

- Develop a preliminary list of risk events.
- Identify cause-effect relationships (event trees).
- Identify likelihoods of risk events and the severity of their consequences.
- Analyse the risk.
- Assess the outcomes.

A preliminary list of risk events was developed prior to the risk workshop and was built upon during the initial stage of the workshop.

25.3.1 Event Trees

The preliminary list of risks was developed into event trees by establishing cause and effect relationships. Separate event trees were developed for the Construction, Operation, and De-commissioning (however, no substantive events were identified for the de-commissioning stage). Table 25-1 shows the event tree for dredging operations during the Construction period. An event tree is a diagram that clearly shows the linkages between initiating events and their subsequent impacts and consequences for each risk event.

Table 25-1 Event Tree for Dredging Operations during Construction

Activity		Initiating event	Probability of event occuring over the construction period (around 6 months)	Impact	Probability of indicated consequence assuming the initiating event occurs	Consequence
Dredging operations		Seabed removal	1	Removal of flora and fauna	1	Environmental damage
		Use of overseas vessels	0.01	Introduction of marine pests	0.001	Environment and infrastructure da
		Plume sediment production	1	Smothering benthic biota	0.1	Environmental damage
		Plume nutrient mobilisation	1	Development of algal blooms	0.0001	Environmental damage
		Contaminants within plume	1	Toxic to flora, fauna	0.001	Environmental damage
		Reduced light within plume	1	Reduced photosynthesis	0.1	Coral damage, dieback
		Dredge operation noise	1	Disturbance to protected species	0.0001	Interference with feeding
		Barge transit to dredge spoil ground	1	Interference with marine traffic	0.00001	Infrastructure damage, public safe
		Refuelling spill	0.01	Fuel slick	1	Visual, environmental impact
		Spoil disposal	1	Smothering	1	Environmental damage
		Presence of exclusion zone	1	Recreation, access	0.001	Relocation of activities
		Presence of heritage asset	0.0001	Damage to heritage	1	Loss of heritage
		Presence of UXO	0.01	Explosion	0.00025	H&S

Event trees are linear by nature. That is, in order to derive the two components of risk (likelihood and consequence) they indicate a linear cause and effect process that links the likelihoods of an event and its subsequent impacts occurring with the magnitude of the consequences, to provide an estimate of risk for each event.

For example, the second row of Table 25-1 shows that the workshop concluded that it is possible (around a 1 in 100 chance over the Construction period) that an overseas dredge will be used. If an overseas dredge is used, then it is unlikely (approximately a 1 in 1,000 chance) that a new marine pest would be introduced, resulting in environmental damage (and flow-on consequences).

The total frequency for that specific risk event is the product of the above two probabilities (0.01 x 0.001 = 0.00001 or 1 in 100,000). The total risk is the combination of the total frequency and the consequence (consequence levels not shown in Table 25-1).

25.3.2 Estimating Likelihoods

For more common events (i.e. those with a likelihood above a 1 in 10 (10%) chance of occurrence over the life of the project, the event likelihood is usually estimated to the nearest few percent (e.g. 5% (0.05), 20% (0.2), 70% (0.7) etc.) based on the subject matter expert's experience or knowledge of similar types of events, and documented information in the industry and literature.

On the other hand, for more novel, untested activities and events with likelihoods below a 1% chance over the life of the project, an individual expert's experience becomes increasingly less direct as the likelihoods become lower. In these cases, project likelihoods are estimated more conceptually and expressed in order of magnitude terms (for example, a 1 in 100 or a 1 in 1,000 chance).

At the workshop, a likelihood guide was supplied to assist participants in estimating likelihoods and to ensure consistency of approach to making this type of conceptual level estimate for events with lower likelihoods. As the name suggests, a likelihood guide serves as a guide only, however the application of a single guide across all of the different disciplines and event types ensures greater consistency of likelihood estimates across the risk assessment.

25.3.3 Estimating Consequences

Consequences tables are used in semi-quantitative risk assessments to help the expert team identify and quantify (on an even basis) appropriate levels of impact on a range of asset types, resulting from the occurrence of a potential risk event.

The consequences table was developed to achieve a practical level of consistency when estimating consequence levels across different disciplines or environmental assets. The consequences table incorporates qualitative descriptions for different consequence types and levels, and normalises them into a consistent set of quantitative measures.

Table 25-2 shows the qualitative consequence level (Negligible, Minor, Moderate, Major, and Extreme), a generic qualitative description for each level and the quantitative value assigned to each consequence level. Intermediate values are also indicated.

Table 25-2 Range of Consequence Levels and Generic Descriptions

Negligible	Minor	Moderate	Major	Extreme
Minimal, if any impact for some communities. Potentially some impact for a small number (<10) of individuals.	Low level impact for some communities, or high impact for a small number (<10) of individuals.	High level of impact for some communities, or moderate impact for communities area-wide.	High level of impact for communities area-wide.	High level of impact State-wide.
0.1 0.3	1 3	10 30	100 300	1000 Plus

The quantitative values show that each subsequent consequence level represents an order of magnitude (factor of ten) increase in the scale of the consequence, which was a critical factor in

ensuring that the levels could be applied consistently across all disciplines. The generic qualitative descriptions describe not only the level of impact but also a description of how widely the impact could be felt (i.e. number of individuals or communities affected), as this is also a key factor in being able to estimate the magnitude of the consequence. For example, the Extreme consequence level refers to impacts that could be felt State-wide.

The key categories of impact in the consequence table include:

- Property and Infrastructure
- Environment
- Social
- Economic
- Public Health and Safety.

In some situations, it was considered that the event, if it were to occur, would have multiple consequences (for example, excessive noise would have consequences for the local community as well as the environment). In these situations, the consequence values were recorded for each of the categories. These were then summed for each risk issue. For example, a value of 1 for Environment consequences and a value of 10 for Social consequences give a total value of 11 for the total consequence of the risk issue.

25.3.4 Risk Register

The two key outputs from the workshop risk identification process are:

- Events risk register.
- Inputs risk register.

Events Risk Register

The events risk register is a list of events that could result in impacts and potential impacts from implementation of the EAW Project. Workshop participants were shown the preliminary list of risk events that was developed prior to the workshop and were asked to add to the list (without real discussion) to ensure that all of the key impacts and risk events were captured.

A screening process then followed, where the workshop participants efficiently prioritised the issues with respect to criteria such as: likelihood of occurring, scale of impacts, known community interest, relevance to this specific project, and plausibility of pathways. Priority Level 1 issues were identified as high priority, and Priority Level 3 issues were relatively low priority. Some issues were excluded at that point, without assigning a priority level.

Of 92 risk events that were considered for inclusion in the risk assessment, the assessment ultimately considered 36 Priority 1 events in more detail.

The workshop briefly reviewed the Priority 2 and 3 issues immediately after completion of assessment of the Priority 1 risk profile and concluded that detailed evaluation of the remaining risk issues was not required.

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Inputs Risk Register

The inputs risk register shows the event pathways, likelihoods and consequences that were provided by the subject matter specialists at the workshop. These values were then input directly into the EIA risk model.

After the workshop the participants were provided with copies of the combined risk register (event risk register and inputs risk register) for review and validation. The outcomes of all corrections additions were entered into the risk registers and input to the final risk model.

Description of Risk Events

Berth Activity

1. Fire

Fire, as a result of refuelling, during both construction and operations stages would have a property impact due to damage to infrastructure. Possible personnel injury and / or fatality with economic and public health and safety risk. Fuel spillage into harbour could also cause environmental damage.

2. Breakwater Placement

The breakwater placement can smother existing habitats.

3. Pile Driving

Disturbance to protected species, mainly dolphins, turtles and dugongs. Noise may affect their feeding habits.

4. Increased Harbour Traffic

Increased harbour traffic could result in increased collisions during operations, which could result in oil spills and public health and safety concerns. Reduced accessibility of work areas could result in social impacts.

CSD Activity

5. Dredging Access Channel and Berths

Dredging access would impact on tide velocity, wave speed changes and sediment deposition.

6. Sea Bed Removal

The environmental impact associated with the removal of flora / fauna habitats.

7. Introduction of Marine Pests

The long term environmental implications to the ecosystem function due to introduction of marine pests. Economic factors due to closing the wharf during remediation and possible follow on affects to other industries within the area due to contamination.

8. Plume – Smothering by Sediment

Impacts to corals and mangroves as a result of increased turbidity or sediment accumulation.

9. Release of nutrients into water column

Possible algal growth due to the release of nutrients from dredging activities.

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10. Release of contaminants from sediment

The release of contaminants would most likely affect flora and fauna and social impacts due to public concerns with regards to contaminants potentially being toxic to humans.

11. Plume reduced light

Increased turbidity could result in reducing the light available within the plume area resulting in corals inability to photosynthesis, causing damage and potential die-back. Marine fauna would avoid the area due to low light and poor visibility.

12. Underwater Noise

Disturbance to protected species, mainly dolphins, turtles and dugongs, is likely but minimal as fauna would move from noise affected area. The noise may affect breeding habits.

13. Barge transit movement

This event could cause increased water traffic in the area impacting on access and recreational vessels. If incident occurs (collision between the barge and recreational vessel), there would be social and public health and safety concerns.

14. Refuelling and Supply

Fuel spills could occur during refuelling of the dredge which could have social and environmental consequences via direct impacts to the harbour.

15. Spoil Ground Sedimentation

The spoil ground biota would be smothered as a result of dredge material disposal.

16. Exclusion Zone

During dredging, an exclusion zone would be required during the activity that would limit recreational fishing within a proximity to EAW.

17. Presence of Heritage Sites

This risk refers to discovery of new, previously unknown heritage sites.

18. Presence of UXO

An exploding UXO could cause impact damage to equipment or injury to personnel operating the dredge.

19. Introduction of Marine Pests

The long term environmental implications to the ecosystem function due to introduction of marine pests. Economic factors due to closing the wharf during remediation and possible follow on affects to other industries within the area due to contamination.

20. Fuel Spillage

Risk and Impacts as per 14

21. Release of Toxic Material

The material could affect flora and fauna. Social impacts due to public concerns the material potentially could be toxic to humans. Risks would continue throughout maintenance dredging operations.

22.Damage to Sacred Site (Catalina Island)

Risks associated with dredging operations to Catalina Island having a potential loss of heritage and social impact. Erosion, depositional change of wave and current impacts on the island are also considered.

Marine Supply Base Activity

23.Contaminated stormwater release

Risks associated with contaminated run-off from the facility could occur, particularly during the wet season which could include fuel, heavy metals, pesticides and hazardous material.

24.Vehicle accident rock hauling

Risks associated with vehicle accidents associated with increased traffic during construction.

25.Fuel pipeline, tank failure

Risks associated with spills could occur that could have social and environmental consequences via direct impacts to the harbour.

26.Pile Driving

Disturbance to protected species, mainly dolphins, turtles and dugongs. Noise may affect their feeding habits.

27.Introduction of Marine Pests, Weeds

The long term environmental implications to the ecosystem function due to introduction of marine pests. Economic factors due to closing the wharf during remediation and possible follow on affects to other industries within the area due to contamination. Introduction of weeds to the project area.

28.Fuel, Sewerage Spillage

Risks associated with contaminated run-off from the facility could occur which could have social and environmental consequences via direct impacts to the harbour.

Rail Loop

29.Inadequate Compaction, Geotechnical Failure

Risks associated with geotechnical failure could cause impacts such as derailment of train, environmental damage in the event of hazardous product loss into the harbour or waterways, and potential social and public health and safety concerns.

30.Reclamation for Hardstand

Risks associated with the loss of recognised habitat, feeding and resting area for flora and fauna.

31.Train Derailment

Risks associated with train derailment include potential social and public health and safety concerns, or environmental damage or possible hazardous product loss entering the environment.

32. Uncontained Loads

This event could cause material spillage (wind blown or accumulative) to the environment from train carriages.

33. UXO – Explosion

This event could occur during operations and/or construction with risks associated with potential for injury and social or public health and safety risks.

34. Cultural Heritage Site Present

Risks associate with the existence of a known cultural heritage site which contains middens and artefacts.

35. Vehicle Accident

This event is regarding collisions of vehicles that include trains, haul trucks, road trains and public vehicles.

25.4 Impact Analysis

Risk analysis involved modelling the probabilities and consequences for each substantive risk event for the EAW Project. Risk quotients (see below) were calculated for the Construction and Operations periods. The risk profiles generated by the risk model show all risk events ranked (prioritised) in order of decreasing risk.

The risk for each risk event is stated as a “risk quotient” and is the likelihood of the event occurring (total frequency over the specific period) multiplied by the consequence level if the event were to occur. The contribution by time period refers to the proportion of the risk quotient that occurs during the stated project time period (Construction or Operations). The contribution by Asset refers to the proportion of the risk that is posed to the defined community assets: Public health and safety, Economics, Social, Environmental and Property / Infrastructure.

Establishment of a risk target helps stakeholders to understand what level of risk might be considered acceptable in the context of the scale of the EAW Project. For the EAW Project the risk target was set at a risk level of 1. A risk target of 1 is equivalent to a 10% chance of a Moderate level impact occurring (i.e. consequence value of 10) or a 1% chance of a Major event occurring (i.e. a consequence value of 100). The selected risk target is therefore more conservative than the major project target.

The outcome of the EAW risk analysis (impacts and potential impacts assessment) is a series of graphs showing the highest risks for the project in order of risk quotient, the level of risk considered acceptable for each event, and the consequences and timing of the risks, (i.e. whether the risk was posed to the environment, public health and safety, etc, and whether the issue could occur during Construction, operation, or both).

25.5 Impact Evaluation

All projects will have positive and negative impacts on the wider environment (impacts on people and their activities, the natural environment, infrastructure, economics). Communities and regulators need to weigh the benefits of the project against the anticipated negative impacts.

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The positive impacts of the EAW Project are identified and discussed in Chapter 2 of this DEIS. This risk assessment considers only the negative impacts of the project. Impacts from a project can be separated into two classes:

- Known impacts
- Potential impacts

Known impacts are derived from events for which it is practically certain that they will occur (be initiated) at some stage during the life of the project. The chance that these events and their consequential impacts will occur is effectively 100% (or 1). The only real uncertainty lies in the magnitude of impacts when the event occurs. Known impacts on the wider environment from a project need to be identified and reduced to levels that are as low as reasonably practical.

Potential impacts are derived from events that may or may not occur due to project activities. These events are known as risk events. For risk events there is uncertainty as to whether the event will occur in addition to the uncertainty of impact magnitude. The level of risk posed by a project can often be reduced by implementing actions that reduce the likelihood of the risk event occurring and, or actions that reduce the level of impact if the event were to occur.

25.5.1 Known Impacts

Six events that will have known impacts were identified during the workshop. Figure 25-2 is a profile of the known impacts and shows that it is expected that the project will cause three Moderate level impacts and three Minor level impacts.

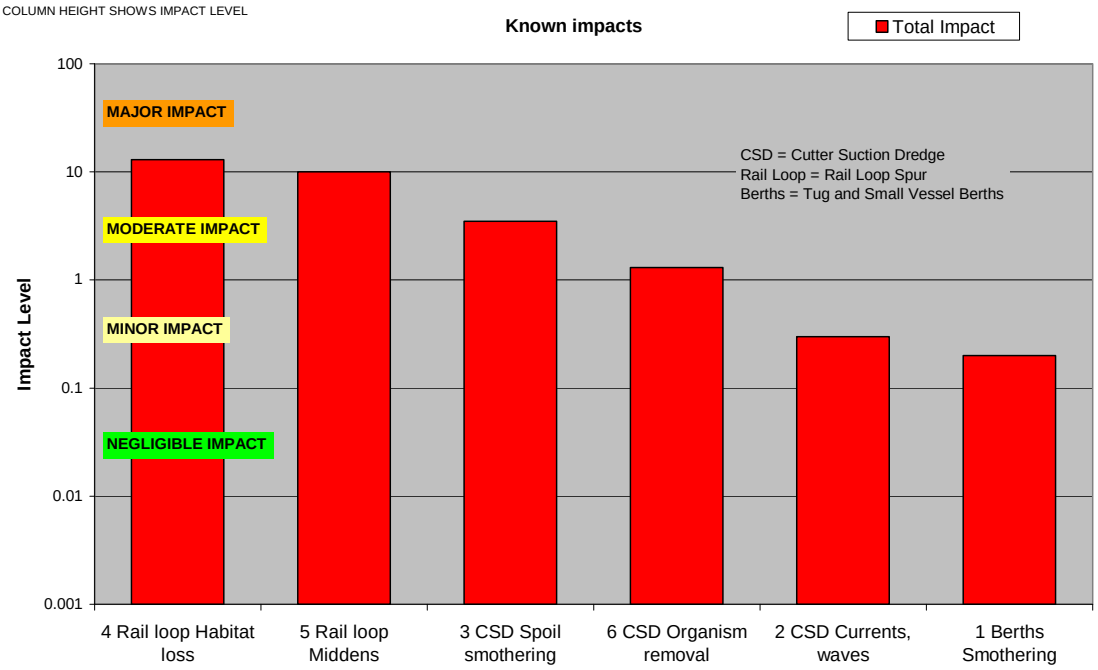

Figure 25-2 Profile of Known Impacts

Based on the current project description, two of the anticipated Moderate impacts will be caused by deposition of the rail loop and its associated lay down area. The remaining Moderate impact will be caused by dredging activities.

Rail Loop, Habitat Loss

A well established bird feeding and resting area (particularly used by migratory species) occurs within the rail loop. In addition, there will be some loss of mangrove and foreshore habitat. The magnitude of the impact has been assessed as Moderate, based on the view that a relatively small proportion of such habitat would be affected and the relative ease with which the birds would relocate.

Rail Loop, Middens

Rail loop construction will take place by deposition of construction and fill material for the bund and lay down area. Deposition may or may not be preceded by removal of the existing mud and soil layers. Cultural heritage articles, mainly in the form of middens and artefacts, are known to be present within the rail loop footprint and this assessment assumes that they will be destroyed.

The magnitude of the impact has been assessed as Moderate, which is equivalent to substantial damage / destruction / removal of a single heritage site.

Dredging Spoil, Smothering

Marine modelling indicates that the plume that will be generated by the channel and berth dredging operation will cause some smothering of the sea floor by sediment, and that the area affected will be quite localised with respect to the dredged area. A considerably larger area will be covered by the dredging plume, but the concentration of suspended sediments in that plume will be low and barely distinguishable from natural variation in suspended sediment in the water column.

Following the indicative guidelines of the consequences table, the workshop concluded that within the localised area, smothering by sediments will have a Minor impact on habitat and benthic organisms.

Dredging, Organism Removal

Dredging will involve removal of seabed areas and therefore physical removal of marine flora and fauna. The area affected will be restricted to the dredged area. Following the indicative guidelines of the consequences table, the workshop concluded that within the dredged area, smothering by sediments will have a Moderate impact on habitat and benthic organisms.

Dredging, Currents, Waves

Marine modelling shows that some altered water current directions and flow rates, plus wave action will be caused by dredging the access channel and berths. It is expected that the changed tidal flow regime will cause deposition (or additional deposition) and some of the deposition areas will need additional dredging, predominantly during dredge maintenance activities. The assessed Minor impact is based on a financial cost within the approximate range from $0.1 to $1 million.

Berths, Smothering

Placement of the rock fill breakwater will cause smothering of habitat and benthic organisms within the breakwater footprint. The impact has been assessed a Minor on the basis of having only a small area affected by the works, but the effect will be permanent.

Table 25-3 shows the estimated impact levels for the six known events.

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Table 25-3 Known Impacts

Risk Rank	Event Name	Total Impact	Construction Impact	Operation Impact	Property/Infra Risk	Enviro Risk	Social Risk	Econ Risk	Public H&S Risk
1	4 Rail loop Habitat loss	13	13			3	10		
2	5 Rail loop Middens	10	10				10		
3	3 CSD Spoil smothering	3.5	3.1	0.4		0.4	3.1		
4	6 CSD Organism removal	1.3	1.3			0.3	1		
5	2 CSD Currents, waves	0.3		0.3	0.3				
6	1 Berths Smothering	0.2	0.2			0.1	0.1		

Timing of Known Impacts

Figure 25-3 indicates that five of the six known impacts are expected to occur during the construction stage. Construction of the rail loop is expected to have the greatest impact, as three of the four Moderate impacts (loss of habitat, destruction of aboriginal heritage sites, and organism removal) will occur during construction of the rail loop.

Localised, on-going sediment deposition is expected to occur throughout the operations stage.

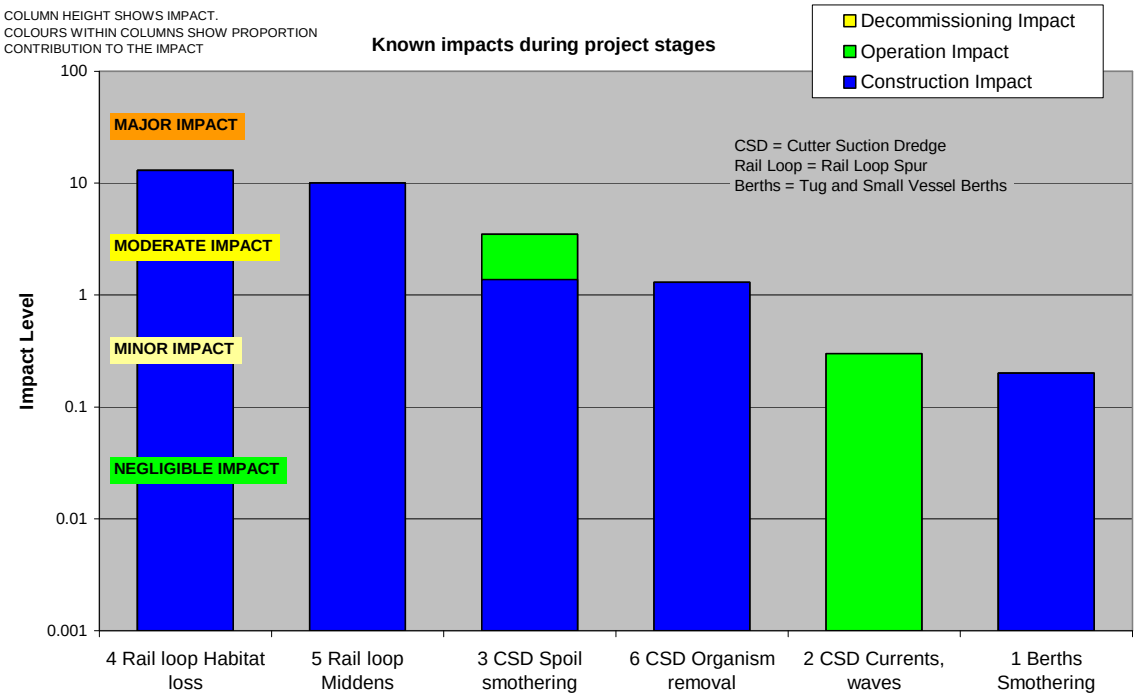

Figure 25-3 Timing of known impacts

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Assets Impacted Upon

Figure 25-4 shows which asset categories are expected to be affected by the known impacts of the project. The profile shows that although the expected impact on natural environment assets due to smothering, habitat loss and organism removal will be relatively small, the perceived value of those assets by people is relatively high, as reflected in their associated social impact levels. The profile also shows that anticipated damage to middens will most likely have a Moderate social impact.

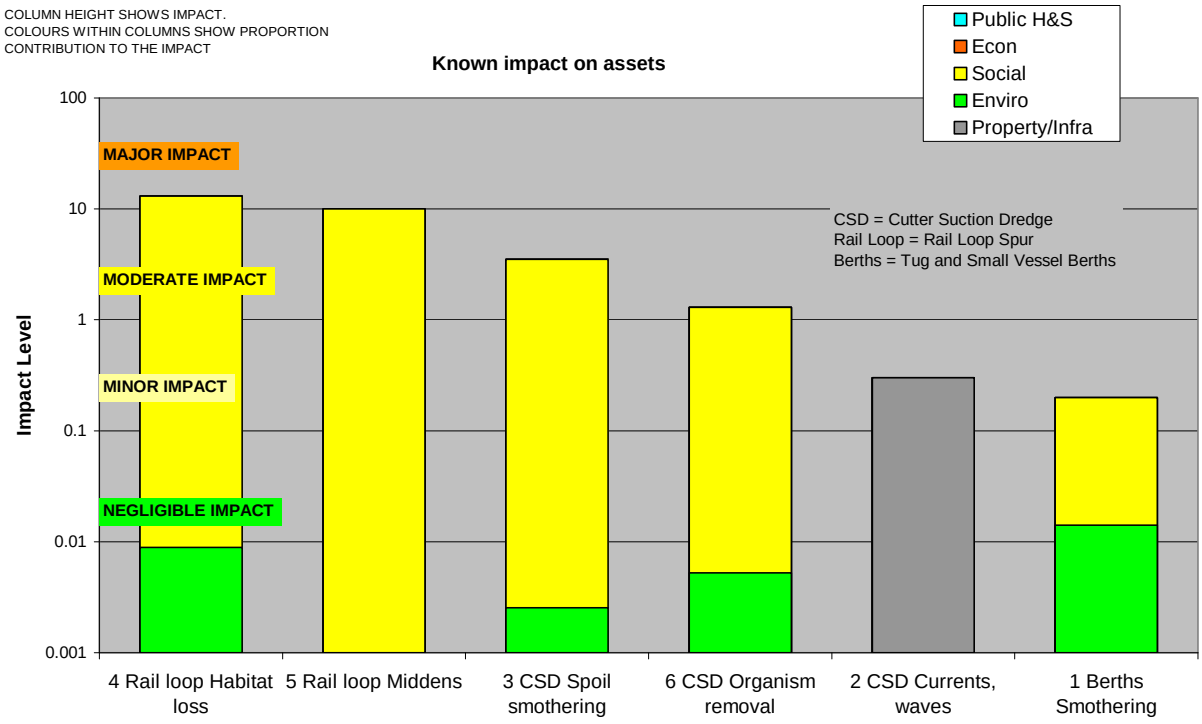

Figure 25-4 Known Impact on Assets

Figure 25-4 also shows that there will most likely be Minor financial costs to dredge sand bars that will form in response to the modified wave and current regime. The final profile for known events (Figure 25-5) shows which activities will most likely create the greatest known impact.

The profile shows that construction of the rail loop will have the greatest impact (Moderate level). Cutter suction dredging during construction and operations will have a lower (but still Moderate) impact on the wider environment. Berth construction will have a combined Negligible impact on the wider environment. No known impacts were identified for the barge ramp and hardstand or the MSB.

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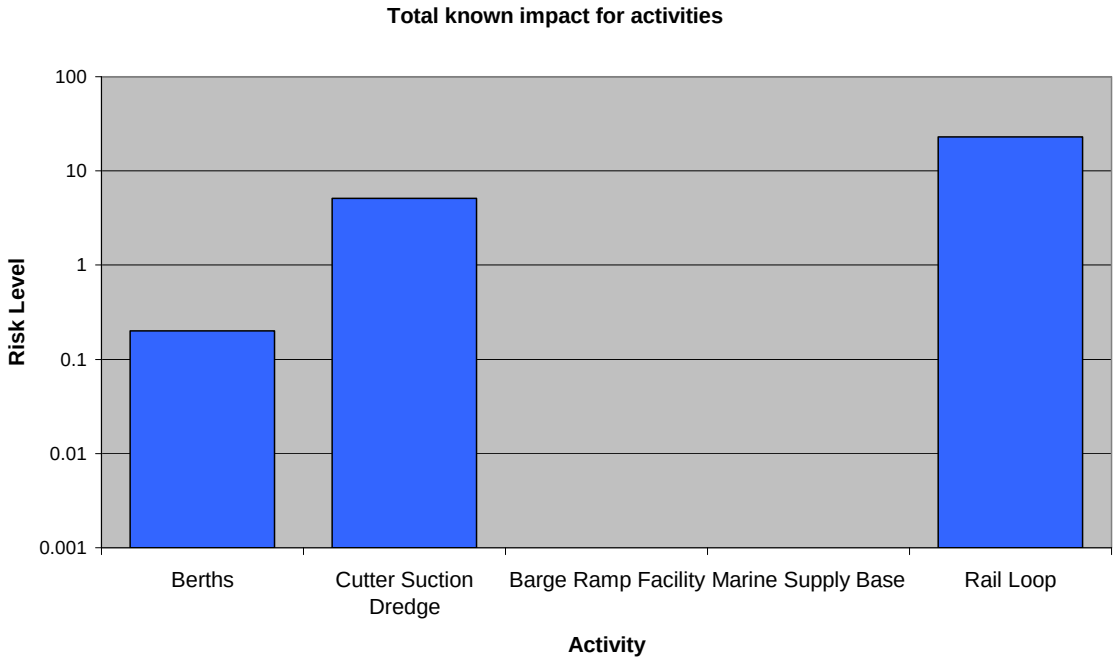

Figure 25-5 Impact by Activity

25.5.2 Potential Impacts (Risks)

A selected range of risk profiles have been generated by the risk model. These profiles are provided and discussed in the following sections.

Overall Risk Potential Impacts (Risk) of the Project

Figure 25-6 shows the risk events for the EAW Project, listed in order of decreasing risk level. The height of the column represents the risk level (likelihood x consequence) for that risk. Note that there is an order of magnitude (10 times) difference between the horizontal grid lines on the risk profile. This order of magnitude variation reflects the level of "accuracy" of the risk model outputs. As can be seen from the profile, the target risk level is set at 1 and shows what is considered to be an acceptable level of risk for risk events.

Figure 25-6 shows that all the individual risk events for the Project are below the target risk level.

However, the risk levels posed by seven events lie within one half an order of magnitude of the target risk level for a single event.

The two highest risk events (21 MSB Stormwater and 15 Barge Ramp Stormwater) lie just below the target risk level. Strategic actions to reduce these risks are articulated in the DEIS EMP (Chapter 26).

The next five highest risk events (22 MSB Vehicle accident, 16 Barge Ramp and Hardstand Vehicle accident, 23 MSB Fuel pipeline, tank, 11 CSD Plume smothering, and 7 CSD Reduced light) pose similar levels of risk. Management and monitoring of these risk events is included in the DEIS EMP.

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The remaining events pose relatively low risk, but monitoring of the next five risk events (24 MSB Piling noise, 10 CSD Oil spill, 2 Berths Piling noise, 13 CSD Heritage, and 4 CSD Plume, marine pests) is considered within the DEIS EMP.

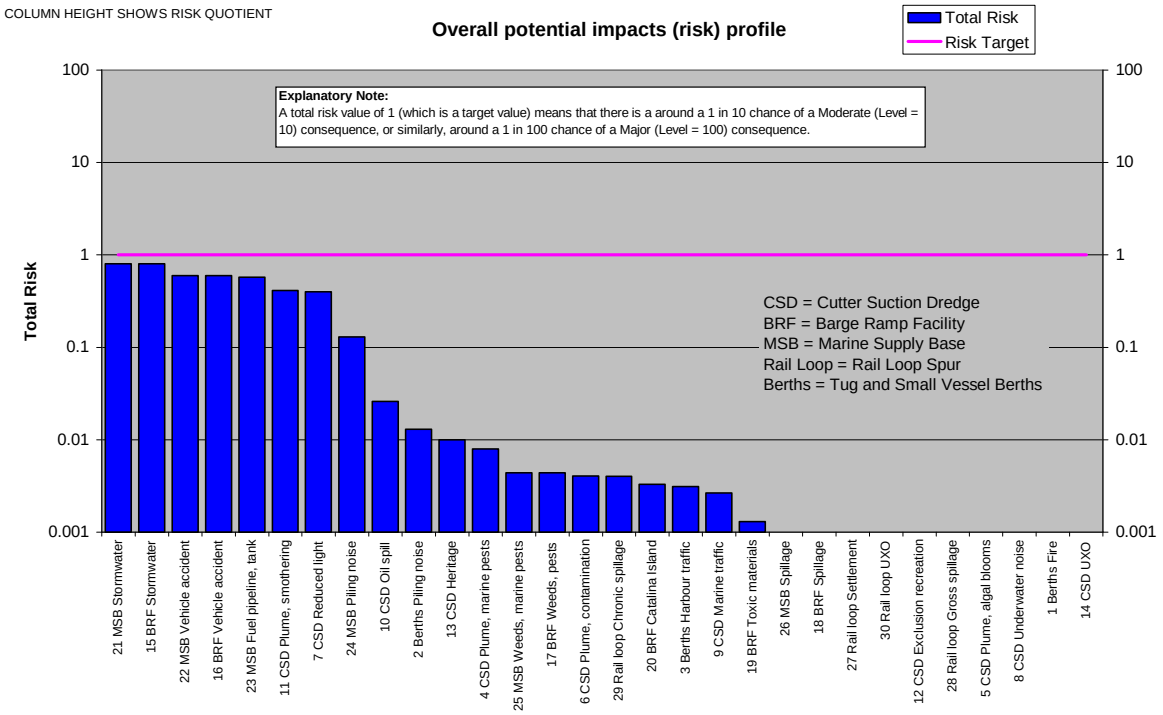

Figure 25-6 Overall Risk Profile

Table 25-4 provides details on the 30 risk events and for each event shows: the total risk quotient; the risk quotient contributed by the Construction and Operations, and the risk quotient contributed by each of the four consequence categories.

Caution is required when interpreting the numbers in the table below, as the risk assessment is only accurate to around one half an order of magnitude. Representing the risk quotient to several decimal places (as in Table 25-4) does not reflect the accuracy of the risk quotient but can be used to differentiate between risk quotients

In the next risk profile (Figure 25-7), the risk events are shown in the same order, but with the key contributors proportioned within the columns.

Table 25-4 Risk Outputs

Risk Rank	Event Name	Total Risk	Construction Risk	Operation Risk	Property/Infra Risk	Enviro Risk	Social Risk	Econ Risk	Public H&S Risk
1	21 MSB Stormwater	0.8	5E-40	0.8	2E-21	0.2	0.6	2E-21	2E-21
2	15 BRF Stormwater	0.8	5E-40	0.8	2E-21	0.2	0.6	2E-21	2E-21
3	22 MSB Vehicle accident	0.6	0.6	5E-40	3E-22	3E-22	0.3	3E-22	0.3
4	16 BRF Vehicle accident	0.6	0.6	5E-40	3E-22	3E-22	0.3	3E-22	0.3
5	23 MSB Fuel pipeline, tank	0.572	5E-40	0.572	0.039	0.13	0.39	1.3E-22	0.013
6	11 CSD Plume, smothering	0.4105	0.41	0.0005	0.0101	0.1001	0.3003	1.01E-21	1.01E-21
7	7 CSD Reduced light	0.4011	0.4	0.0011	1.01E-21	0.1001	0.301	1.01E-21	1.01E-21
8	24 MSB Piling noise	0.13	0.13	5E-40	1E-21	0.03	0.1	1E-21	1E-21
9	10 CSD Oil spill	0.026	0.013	0.013	2E-22	0.006	0.02	2E-22	2E-22
10	2 Berths Piling noise	0.013	0.013	5E-40	1E-22	0.003	0.01	1E-22	1E-22
11	13 CSD Heritage	0.01	0.01	5E-40	1E-23	1E-23	0.01	1E-23	1E-23
12	4 CSD Plume, marine pests	0.008	0.004	0.004	0.002	0.002	0.002	0.002	2E-25
13	25 MSB Weeds, marine pests	0.0044	0.0004	0.004	0.001	0.0011	0.0013	0.001	1.01E-23
14	17 BRF Weeds, pests	0.0044	0.0004	0.004	0.001	0.0011	0.0013	0.001	1.01E-23
15	6 CSD Plume, contamination	0.00404	0.004	0.00004	1.01E-23	0.00101	0.00303	1.01E-23	1.01E-23
16	29 Rail loop Chronic spillage	0.004	5E-40	0.004	1E-22	0.001	0.003	1E-22	1E-22
17	20 BRF Catalina Island	0.0033	0.0033	5E-40	0.0003	1E-24	0.003	1E-24	1E-24
18	3 Berths Harbour traffic	0.0031	5E-40	0.0031	0.001	0.0001	0.001	1E-24	0.001
19	9 CSD Marine traffic	0.00266	0.00133	0.00133	0.00006	2E-25	0.0006	2E-25	0.002
20	19 BRF Toxic materials	0.0013	5E-40	0.0013	1E-23	0.0003	0.001	1E-23	1E-23
21	26 MSB Spillage	0.00065	5E-40	0.00065	5E-24	0.00015	0.0005	5E-24	5E-24
22	18 BRF Spillage	0.00065	5E-40	0.00065	5E-24	0.00015	0.0005	5E-24	5E-24
23	27 Rail loop Settlement	0.00036	5E-40	0.00036	0.00003	0.00003	0.0001	0.0001	0.0001
24	30 Rail loop UXO	0.000231	0.000231	5E-40	0.00003	0.000001	0.0001	1E-25	0.0001
25	12 CSD Exclusion recreation	0.0002	0.0001	0.0001	2E-23	2E-23	0.0002	2E-23	2E-23
26	28 Rail loop Gross spillage	0.00018	5E-40	0.00018	0.000015	0.000015	0.00005	0.00005	0.00005
27	5 CSD Plume, algal blooms	0.000143	0.00013	0.000013	1.1E-24	0.000033	0.00011	1.1E-24	1.1E-24
28	8 CSD Underwater noise	0.000141	0.00013	0.000011	1.1E-24	0.000031	0.00011	1.1E-24	1.1E-24
29	1 Berths Fire	0.0001006	0.0000503	0.0000503	0.00002	0.0000006	0.00002	2E-26	0.00006
30	14 CSD UXO	0.0001	0.0001	5E-40	1E-25	1E-25	1E-25	1E-25	0.0001

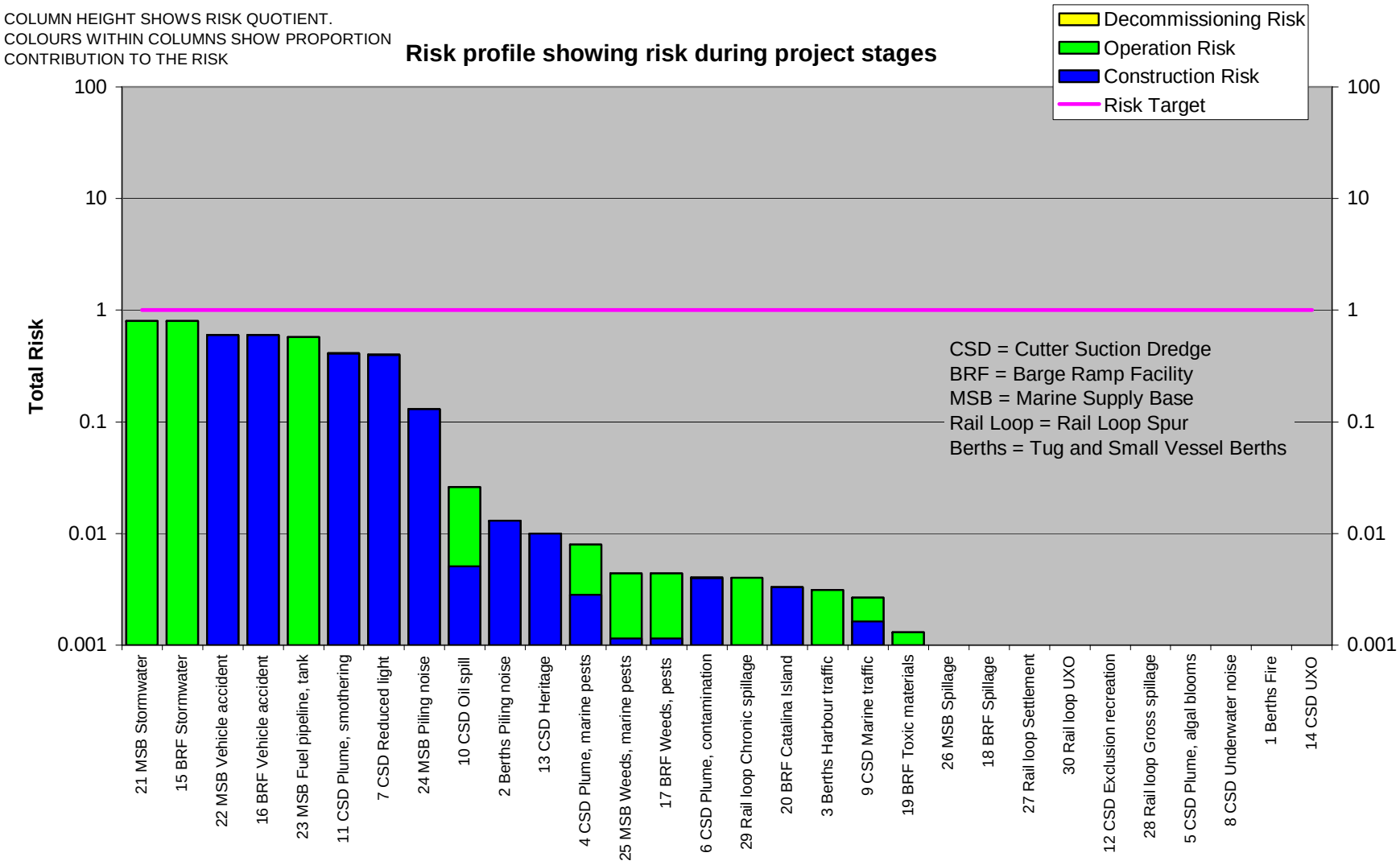

Figure 25-7 Risk by Project Stage

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Like Figure 25-6, the height of the columns in Figure 25-7 represent the risk quotient (likelihood x consequence) for that risk event. However, the colours within each column show the proportion that project timing (Construction and / or Operation) contribute to each risk event.

The profile shows that the risk posed by three of the highest eight risk events applies for the construction period only and that the remaining five events pose risk only during operation.

Some risk events apply for both the construction and operation periods. For example, for the ninth highest risk event (10 CSD Oil spill), roughly 50% of the risk is attributable to the construction phase, and roughly 50% of the risk is attributable to the operation phase.

The following risk profile that shows risk in relation to community assets (Figure 25-8) is read exactly like Figure 25-7, except the colours within the columns show the proportion of risk posed to the identified assets.

Figure 25-8 shows that most of the risk would be posed to society (mainly potential impact on amenity) and that the risk posed to the natural environment, the economy, infrastructure and public safety is comparatively low.

For the two highest risk events (21 MSB stormwater and 15 barge ramp and hardstand stormwater), roughly 80% of the risk would be posed to society (amenity), and around 20% of the risk would be to the natural environment. By contrast, for example, the 12th highest risk event poses almost equal, but low, risk to infrastructure, the natural environment, society (amenity), and the economy.

The profile also indicates that the 3rd and 4th highest risk events pose approximately equal risk to public safety and society (amenity).

Figure 25-9 shows the activities that create the greatest potential impact (risk).

The profile shows that construction and operation of the MSB and barge ramp and hardstand will pose the highest risk to the wider environment. Dredging activities will pose less, but similar, risk. In contrast, tug berth and rail loop construction and operation will pose low risk to the wider environment.

The risk profiles of Figure 25-10 show the same combined levels of risk for each activity, but also provide more information by indicating the key contributors to the total risk for the activity.

Figure 25-11 shows the proportion of risk posed to the assets by each of the project activities.

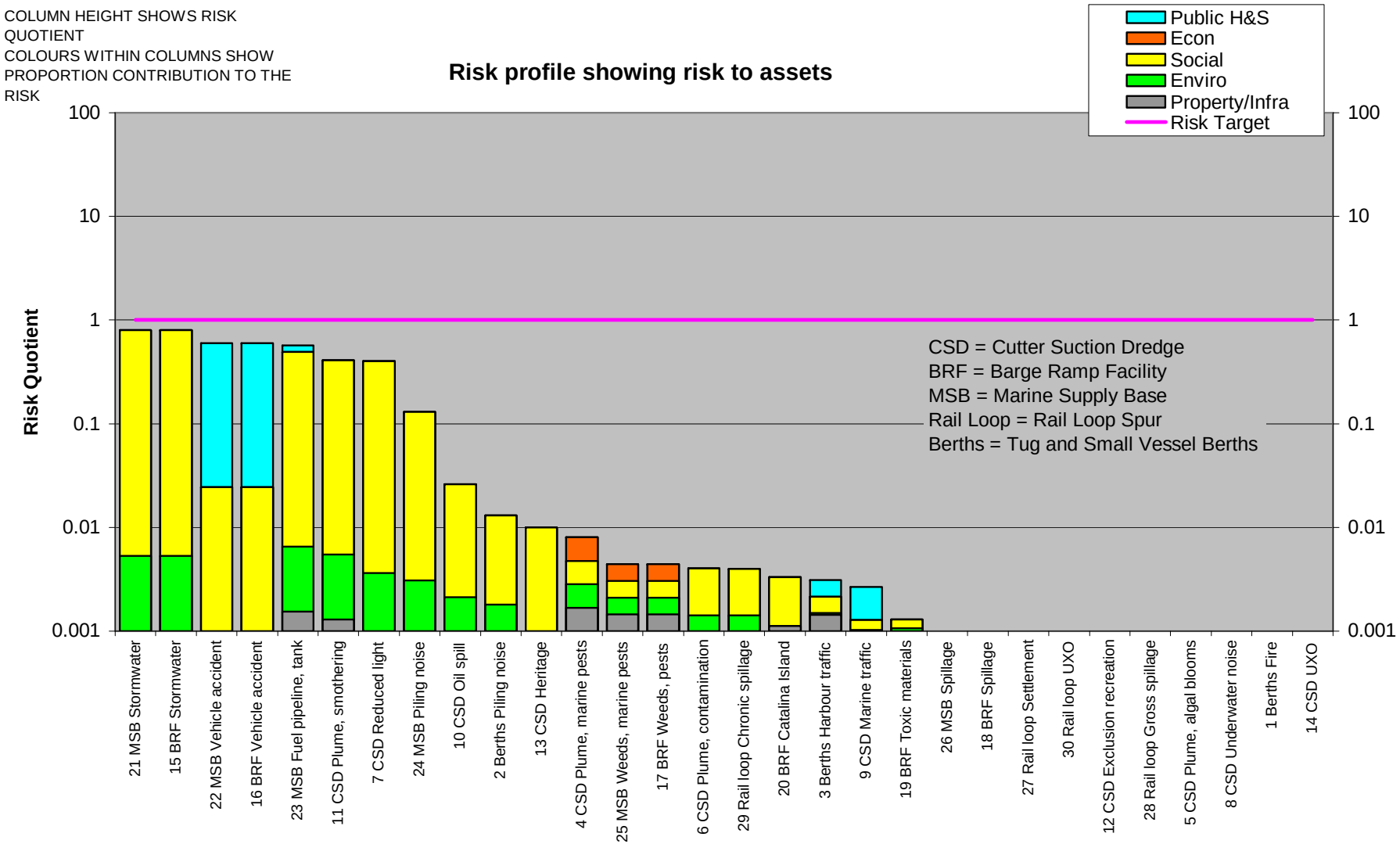

Figure 25-8 Overall Risk Profile Showing Contribution by Assets

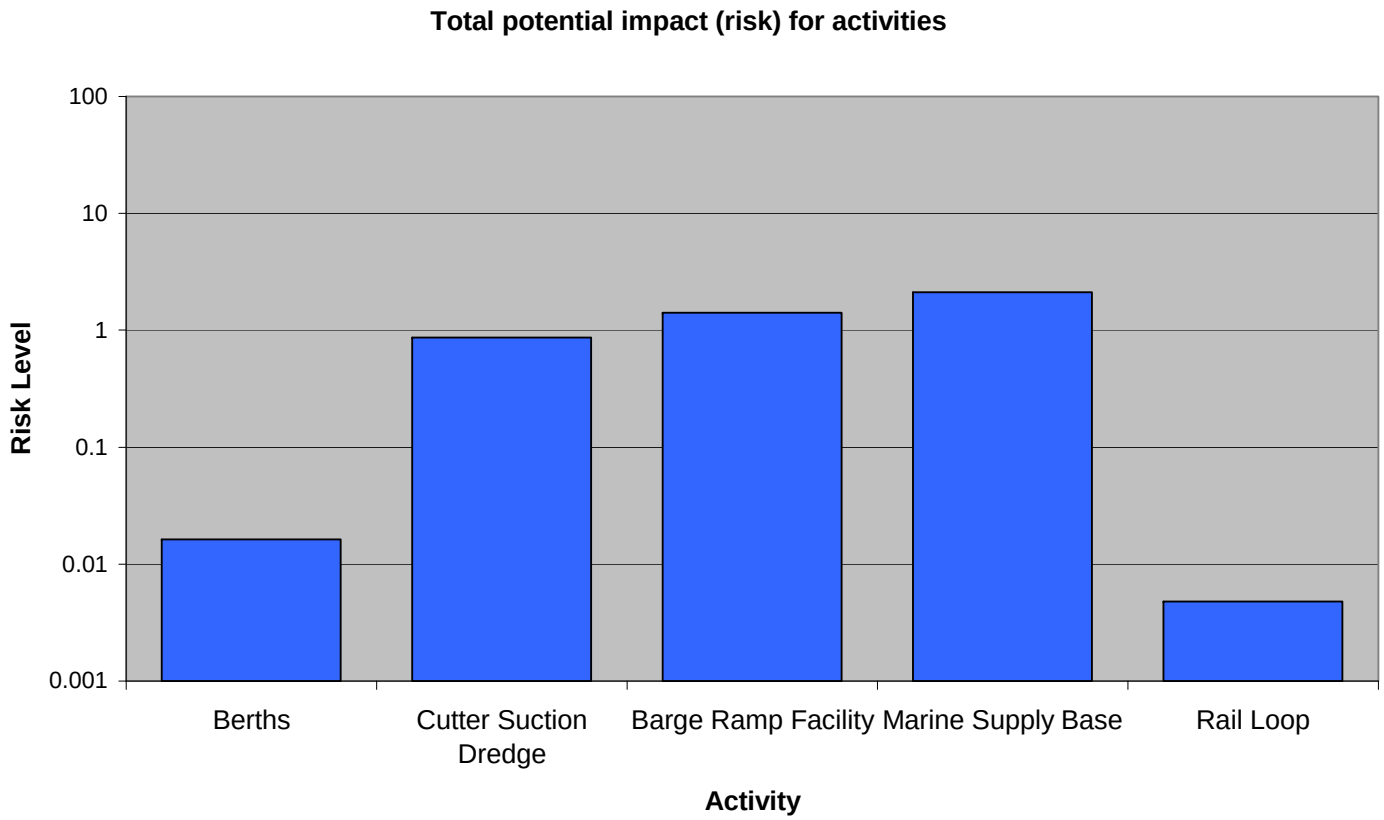

Figure 25-9 Potential Impact (Risk) by Activity

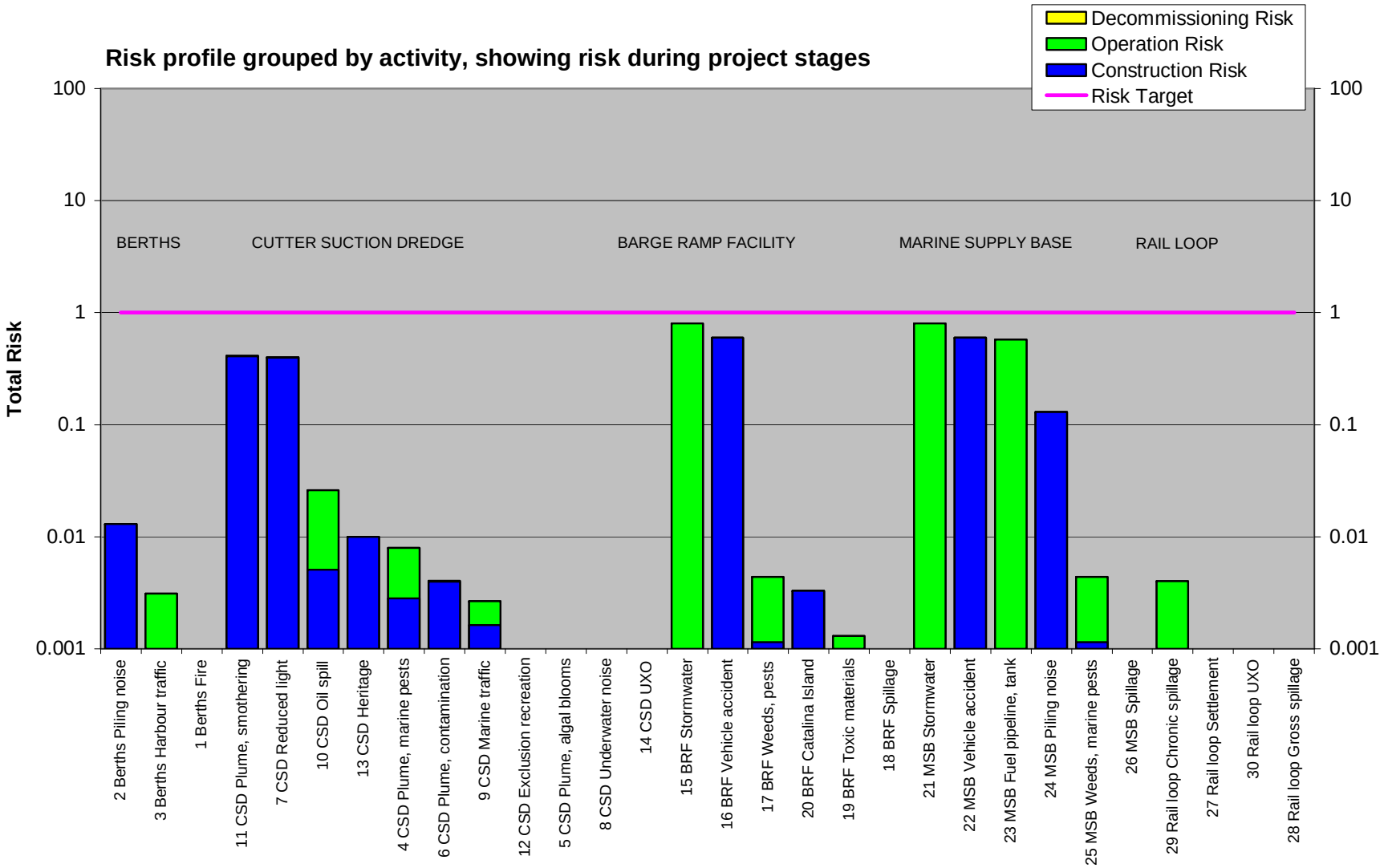

Figure 25-10 Project Activities Showing Contribution by Project Stage

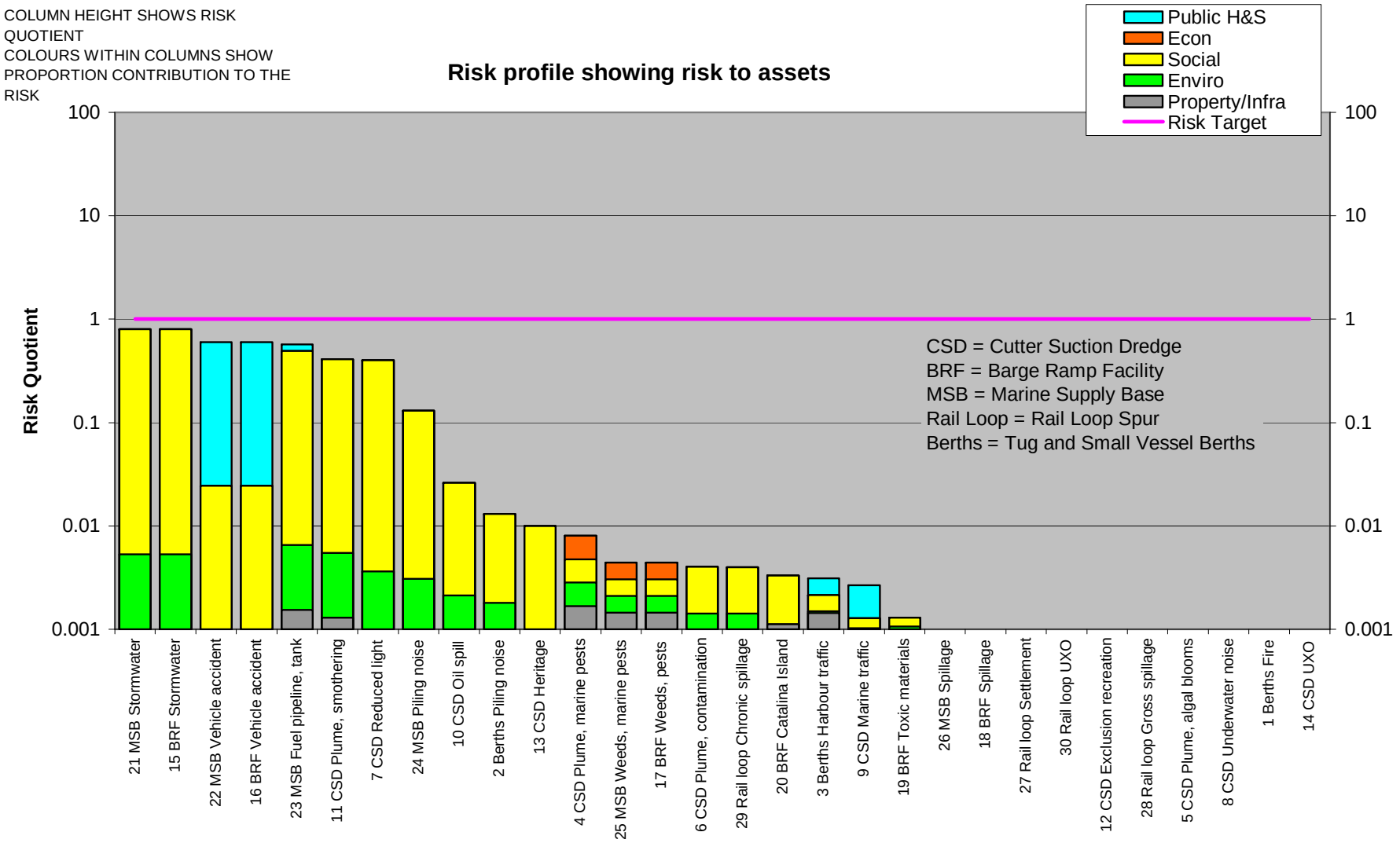

Figure 25-11 Project Activities Showing Contribution by Asset

25.6 Conclusions

A preliminary list of 92 events that could potentially lead to negative impacts (financial, environmental and social) on the wider environment was developed. Upon further consideration, six known events and 30 risk events were assessed in some detail.

The following main conclusions have been derived from the EAW DEIS risk assessment:

- Known impacts:
  - Rail loop construction and cutter suction dredging will cause known impacts on the wider environment.
  - Six events are expected to lead to known negative impacts from the Project. The events will cause three Moderate level impacts and three Minor level impacts.
  - Two of the expected Moderate impacts will be on habitat and middens and will be caused by construction of the rail loop. The remaining Moderate impact will be caused by dredging activities.
  - Most of the known impacts will occur due to construction activities.
  - The expected impact on natural environment assets due to smothering, habitat loss and organism removal will be relatively small, but the perceived value of those assets by people is relatively high, which will lead to elevated social impact (mainly amenity) levels.
- Potential impacts (risks)
  - All the individual risk events for the Project are below the target risk level.
  - However, the risk levels posed by seven events lie within one half an order of magnitude of the target risk level for a single event.
  - The risk posed by three of the highest eight risk events applies for the construction period only and the remaining five events pose risk only during operation.
  - Most of the risk would be posed to society (mainly potential impact on amenity) and the risk posed to the natural environment, the economy, infrastructure and public safety is comparatively low.

Construction and operation of the MSB and barge ramp and hardstand, and to a lesser extent dredging activities, will pose the highest risk to the wider environment