

Chapter 3

Stormwater Management Planning

3.1 Introduction

To achieve best practice in the environmental management of stormwater, it is important that catchment management activities are guided by strategies or plans.

This section provides guidelines for the development of stormwater management plans. While it is intended mainly for application at local government levels, the process of establishing priorities and actions could also be applied to whole catchments.

Stormwater management plans (SWMPs) are a way of helping councils and other catchment managers to recognise the impacts of activities within their boundaries and to develop best practice management strategies and programs.

These guidelines are not a prescription for managing urban stormwater but describe a planning process that can be tailored to individual needs and to take account of specific social, economic and environmental factors.

Councils and other agencies have many responsibilities which are often seen as more important or of higher priority than stormwater management. Each council must make its own judgments about balancing priorities, dealing with conflicting objectives and allocating resources. SWMPs should provide a framework for making these judgments, recognising the consequences of decisions and being accountable for performance.

A **SWMP** must identify actions to improve the environmental management of urban stormwater and protect the environmental values and beneficial uses of receiving waters.

Technical knowledge is only one obstacle to improved stormwater management. More often, the main constraint is a lack of agreement that improved environmental performance is important or a lack of consensus on stormwater management priorities. A key

to achieving more effective action lies in establishing consistent priorities across agencies. The SWMP process is designed to:

- generate commitment to a best practice approach;
- identify priorities based on risk assessment;
- develop management strategies and actions; and
- establish a basis for ongoing cooperation and coordination between agencies.

Commitment is achieved mostly through involvement of a wide cross-section of council staff and key agency representatives in the planning process and through assignment of accountabilities.

Agreed priorities are identified by involving council, EPA, Melbourne Water/CMA and other key stakeholders (water authorities, for example, or VicRoads) in a systematic assessment of environmental risks associated with urban stormwater.

It is important for those with a role in improving the environmental management of stormwater to share in the process of developing the plan. This means representatives from across functional areas of council and agencies such as EPA, Melbourne Water or Catchment Management Authorities should be involved.

3.2 The risk management approach

The risk management approach is based on assessing the risk or likelihood of losing significant values of receiving environments due to the impacts of urban stormwater.

Stormwater flows and stormwater pollution are a threat to the environmental, amenity and other values of waterways. The risk of those values being lost depends on two factors:

- the scale or severity of the stormwater threat; and
- the sensitivity of the receiving environment to that threat.

The aim of risk assessment is to identify areas where the risk of damage is greatest. As a first step we need to assign scores or rankings to the various environments or receiving waters to indicate the risk of damage due to stormwater flows or pollution. If we assign numerical values to indicate the size of the threat and the value of receiving waters, we get a measure of the risk to that environment by multiplying the two as illustrated in Figure 3.1. We then have an objective indication of risk which can be used to assign priorities.

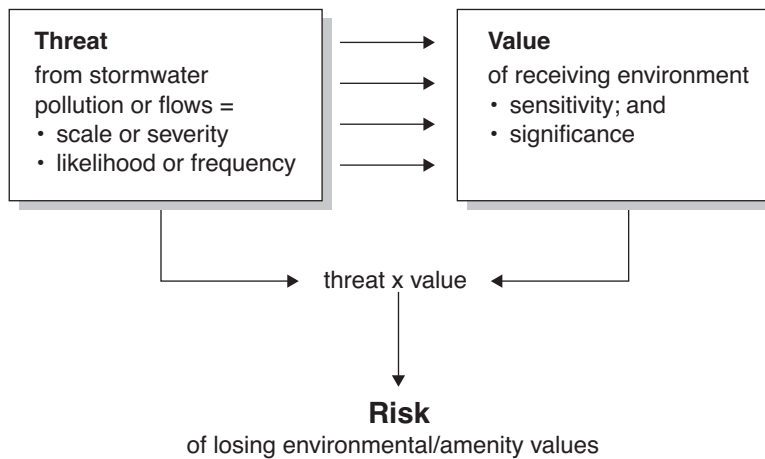


Figure 3.1 Risk assessment approach.

For example, the *environmental* values of Port Phillip Bay beaches may not be particularly sensitive to litter deposited by stormwater drains. However, recreational amenity is greatly affected. Recreation values of the beaches are regarded as very significant given the level of use and are quite sensitive to litter. A pollution threat such as litter at Bay beaches is likely to rank highly in any risk assessment.

3.3

Development of a stormwater management plan

The most appropriate risk management strategies for achieving improved stormwater management will depend on local circumstances. Most often, risk management will involve a combination of best practice approaches including the following:

- **planning:** planning controls should recognise the potential effects of land development and land-use on water quality;
- **operations and land management:** the way works and services such as waste collection are provided by municipalities and the private sector should be reviewed, to ensure that stormwater quality is protected;
- **education and awareness:** community and business awareness programs may be instrumental in changing attitudes and the way in which individuals treat their environment; and
- **infrastructure:** structural treatment measures such as litter traps can be used to capture and retain pollutants.

No one approach can be considered as 'best practice'. The achievement of best practice will depend on the successful integration of actions to protect stormwater quality across functional areas within council and on coordination with other agencies (Figure 3.2).

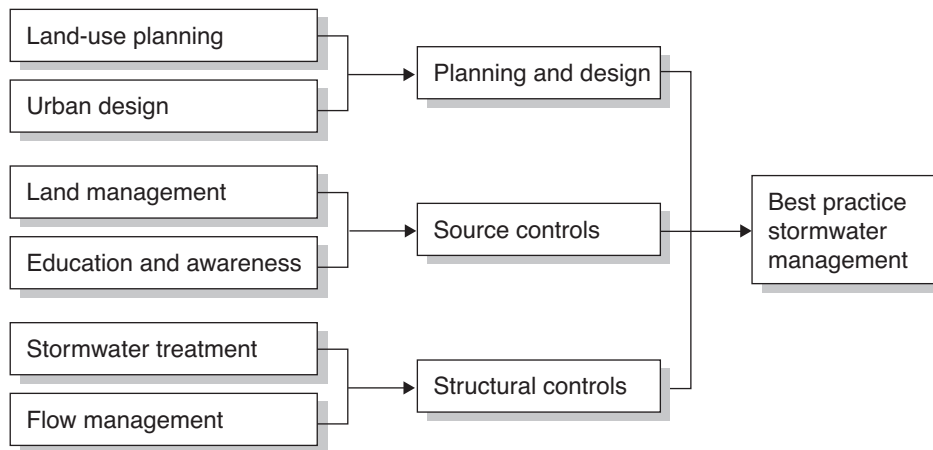


Figure 3.2 Best practice environmental management of urban stormwater requires the integration of a range of measures within a defined program.

When considering the application of a range of proposed approaches to the management of stormwater threats, a number of questions should be asked.

- Is the cost of measures to avoid or reduce risks high without sufficient benefit? If so, their *cost-effectiveness* is relatively low.
- Do council or others have sufficient resources, expertise or powers to implement the measure? If not, their *capability* is low.
- Is it practical to implement the measure? There may be no space for installing a structure to treat stormwater, for example. If so, the *opportunity* is lacking.

Potential management strategies should be evaluated on the basis of cost, effectiveness, capability and opportunity.

For all practical purposes, a risk free environment cannot be achieved in existing urban areas. Establishing a shared responsibility for stormwater management involving industry, community, commerce, agencies and councils will help to ensure that risks are addressed by those with the best capacity to do so.

3.4 The process

The process recommended for developing a SWMP is illustrated in Figure 3.3 below.

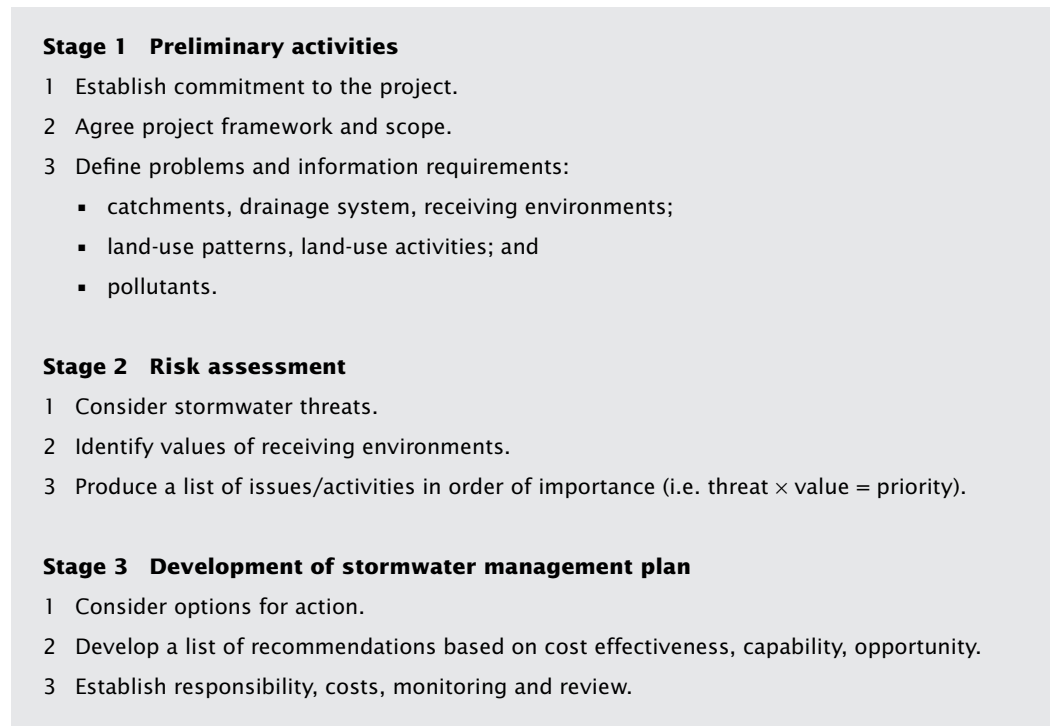


Figure 3.3 The process for formulating a stormwater management plan.

3.4.1 Stage 1: Preliminary activities

Part A: Framework

In this first stage, the commitment of key stakeholders is confirmed, administrative matters are agreed to and a project schedule confirmed.

<i>Purpose:</i>	To initiate and organise the planning project and obtain commitment of key stakeholders.
<i>Inputs:</i>	Context setting.
<i>Outputs:</i>	Commitment, accountability, schedule.
<i>Process:</i>	Meeting with key stakeholder representatives.

It is important to obtain the commitment of key stakeholders, especially senior council managers including the Chief Executive. The development of the plan will be led by the municipality—a senior council officer should be appointed as project manager.

Checklist

Key stakeholders committed	<input type="checkbox"/>
Project schedule confirmed	<input type="checkbox"/>
Project manager appointed	<input type="checkbox"/>
Participants in planning process identified	<input type="checkbox"/>

Part B: Inception

This stage involves bringing together participants in the planning process to establish the objectives of the project. It is important for participants to gain an understanding of the process, of organisational arrangements and of the need for their involvement and contribution.

<i>Purpose:</i>	To develop participants understanding, highlight key issues and identify information sources.
<i>Inputs:</i>	Context, outline of the planning process and its objectives.
<i>Outputs:</i>	Understanding, involvement, issues, information needs, timelines, map of land-uses, map of stormwater system including receiving waters.
<i>Process:</i>	Workshop, interviews, field inspections, review of documents.

This is a critical stage in the planning process involving the gathering of information to support the rest of the planning process and ensuring the active involvement of the key participants from council and other agencies.

It is recommended that representatives from council and other agencies be brought together in a workshop. This provides an opportunity to involve participants in a discussion of stormwater management issues in the municipality, including pollution and flow management threats and opportunities for improved performance. Use the workshop as a means to:

- develop understanding of the objectives of the project and the planning process;
- reinforce the role of participants in contributing to the development and implementation of the plan;
- identify key people to interview in more detail;
- identify sites for field inspections; and
- identify people to collect and provide key information required for development of the plan.

During the inception stage it is important to begin to gain an understanding of the extent to which existing and potential future activities may be a threat to receiving environments

Category	Impacts	Typical sources	Typical components
Pathogenic organisms (P)	Closure of beaches Human infection Illness and disease	Sullage, sewer overflows, animals	Faecal coliforms, bacteria, viruses
Oxygen depleting substances (D)	Low dissolved oxygen Smells, stress to aquatic life	Sullage, sewer overflows, animal waste, grass and leaf litter	Organic matter
Toxicants including metals and salts (T)	Bio-accumulation Death of aquatic life	Cars, car parks, roads, processing industries, spills, atmospheric deposition	Pesticides, herbicides, petroleum products, lead, zinc
Sediment (S), including suspended solids and turbidity	Muddy water, siltation, smothering of aquatic life	Stream erosion, construction sites, unmade roads, sand transport	Silt, sand, gravel, clays
Litter (A)	Mainly visual, interferes with aquatic life	Commercial areas, fast food outlets, plant debris	Paper, plastic, leaves, dead vegetation
Nutrients (E)	Promotes plant and algal growth, blue-green algal blooms (Eutrophication)	Sullage, sewer overflows, animals, STP discharges	Phosphorus and nitrogen
Flow	Increased volume or velocity of flows can scour or erode receiving waters. Increased freshwater volumes can affect estuarine or marine environments.	Increased stormwater runoff	Volume, frequency, velocity

Source: Pat Condina and Associates.

Table 3.1 Stormwater threats, sources and impacts on receiving waters.

and how well existing management processes within council and other agencies deal with stormwater issues. Examples of typical issues and their origin are given in Table 3.1.

It is important to use the inception stage to establish how a review of management processes will be undertaken. The review should cover planning, regulation, education, enforcement and operations as well as any existing structural approaches to managing stormwater impacts as outlined below. The relationship between council and other agency activities should also be examined. This information will contribute to the formulation of management strategies later in the planning process.

<i>Planning:</i>	Planning scheme, planning policies, permit conditions and the Municipal Strategic Statement (MSS).
<i>Operations:</i>	Specifications for service delivery (e.g. waste collections), asset maintenance activities, depot operation.
<i>Regulation:</i>	Integration between policy, planning controls, local laws and enforcement activities.
<i>Education:</i>	Programs aimed at those involved in activities with potential to affect the stormwater system.
<i>Infrastructure:</i>	Incorporation of structural measures into buildings, roads and drainage systems to reduce environmental impacts.

Document the nature of urban land-use

It is useful at this stage to compile an overall picture of land-use activities. This is best represented by the planning scheme zones covering the area. However, local knowledge of differences between land-use types must be applied. For example, to distinguish between old and new industrial areas which may differ in the types of industries and the quality or standard of associated infrastructure. The basis of differentiation is the potential of different activities or land uses to generate pollutants.

In addition to site specific activities there are a number of transient activities, such as building construction, which must be accounted for. Other examples are building maintenance activities, home car servicing and so on. Transient activities can be significant polluters and are difficult to control.

Document the stormwater system

It is also important to document the stormwater system. This is best presented as a map with physical features showing the catchments (main catchments and sub-catchments), the drainage system (main drains), and the receiving environments which might include open water ways, wetlands, lakes and coastal waters.

A context map which shows adjacent municipalities in the entire catchment is also useful.

Checklist Workshop 1

- Participants are committed
- Participants understand planning process and schedule
- Participants understand nature of stormwater impacts
- Information requirements been identified
- Responsibility for gathering information been allocated
- Key people to be interviewed have been identified
- The date of the next workshop has been agreed

Checklist Stage 1 Outputs

- A map of the stormwater system been prepared
- A map of land-use activities been prepared
- Current management processes have been reviewed and gaps identified, e.g. planning scheme, operations, local laws, integration between functional areas
- Field inspections have been undertaken
- Interviews have been undertaken

3.4.2 Stage 2: Risk assessment

Part A: Threats and values

This stage involves identifying and confirming:

- the nature and source of stormwater threats to receiving environments; and
- the values of receiving environments.

It is important to be thorough in the assessment of threats and values to avoid significant later reworking of the results.

<i>Purpose:</i>	To identify and rank the values of receiving environments and the threats posed by stormwater pollution or flows.
<i>Inputs:</i>	Reports, local knowledge, familiarisation with land-use activities and receiving environments, interviews.
<i>Outputs:</i>	Agreed ratings or rankings of stormwater threats and receiving environment values.
<i>Process:</i>	Review of existing information from stage 1, workshop to present and confirm assessments of threats and values.

Threats

A list of major site specific and transient activities with potential to damage receiving environments should be prepared which includes:

- the type of stormwater threat (see Table 3.1); and
- a significance rating of the threat.

In arriving at a significance rating, consideration should be given to the quantity of pollutant load generated and the frequency of occurrence. There will seldom be data available on the impact of these activities on receiving environments. However, an informed assessment can be based on professional judgment and experience as well as local knowledge, history of spills, complaints, age of infrastructure and so on. Discussions should take place with key people in council, EPA operations, Catchment Management Authority or Melbourne Water and others.

Table 3.2 below is an example of a listing of stormwater threats.

Activities	Location	Litter	Nutrients	Sediments	Pathogens	Toxicants	Deoxygenating materials	Flow	Significance rating
Industrial areas	Clarinda Rd/ Centre Rd								2
	Moorabbin East (Keys Rd/South Rd/Warrigal Rd)								1
	Centre Rd (Clayton)								1
	Osborne Rd (Clayton South)								1
	Westall Rd (Springvale)								1
	Heatherton Rd/Totals Rd								3
		High threat	Medium threat	Low threat					
(From City of Kingston Stormwater Management Plan, SGS 1999).									

Table 3.2 Example of a listing of stormwater threats.

Numerical ratings on a 1–3 or 1–5 scale are an alternative to the more qualitative ranking used in Table 3.2.

Values

The key goal of the stormwater management plan is to protect and enhance the ‘values’ of receiving environments. These values can be categorised under a number of headings including:

- **environment:** physical and ecological attributes of waterways;
- **amenity:** recreational and landscape attributes;
- **economic:** economic benefits derived from water environments;
- **hydraulic:** contribution to protection of property and public safety from the risk of flooding; and
- **cultural:** association with known sites of cultural and heritage significance.

The values of receiving environments need to be assessed for each of these categories. This can be done qualitatively using the sort of criteria suggested in Table 3.3.

Workshop

The results of the assessment of threats and values should be presented to stakeholders. This can involve presentation of maps, working through the ranking process used and discussion of the results. Participants should be given the opportunity to question the results and add any information that may have been missed during the assessment

Value	Category	Examples of attributes
Environment	Significance	Biodiversity, significant species (e.g. rare or threatened), treaties, protection agreements, listings, sites of significance
	Intactness or integrity	Size of intact area (e.g. continuity of habitat), remnant vegetation, level of invasion by exotic species
Amenity	Significance	Extent of open space associated with the receiving environment, extent of facilities such as trails, car parks, picnic areas, areas for canoe or boat launching, extent and continuity of public access, visual attractiveness
	Use	Visitor numbers, level of active water-based recreation or passive non-contact recreation, number of associated recreation events held at the site
Economic	Direct	Water-use, fishing or aquaculture, tourism, transport (e.g. ferry services)
	Indirect	Property values
Hydraulic		Extent to which the environment contributes to the protection of property and public safety from flooding
Cultural		Sites of cultural and heritage significance

Table 3.3 Assessing the values of receiving environments.

process. The aim should be to achieve consensus on the rankings of threat and value. Failure to achieve consensus at this stage may lead to arguments about priorities for action later in the planning process and require a reassessment of values and threats. It may be necessary to follow up individually with some participants to work through the detail of the assessment for particular threats or receiving environment attributes. That is, try to quickly identify what can be agreed upon at the workshop, but be prepared to spend some time on following up a few outstanding issues later.

Checklist Workshop 2

- Stormwater threats identified and presented to workshop
- Values of receiving environments identified and presented to workshop
- Good representation of stakeholders at the workshop
- Reasonable consensus achieved
- Arrangements made to follow up and resolve any significant disagreements

Part B: Risk assessment

This stage involves reviewing stormwater related threats to determine the potential risks to the values of receiving environments. It should take into account:

- the transmission efficiency of drains carrying the pollution or flow threats;
- the significance of receiving water values; and
- the sensitivity of those values to the threats identified.

<i>Purpose:</i>	To assess and rank the stormwater risks to receiving environments.
<i>Inputs:</i>	Rankings or ratings of receiving water values and stormwater threats, knowledge of drainage system pathways to receiving environments.
<i>Outputs:</i>	Risk ranking of threatening activities.
<i>Process:</i>	Threat × value = risk (Figure 3.4).

A numerical rating system or a simple designation of high, medium, low as shown can be used to rank the potential risks. Figure 3.4 below is an example of a useful approach to risk ranking. The results of this ranking can be added to the significance rating column in Table 3.2.

Checklist	
Stormwater threats and receiving water values systematically translated into risk rankings	<input type="checkbox"/>
Rankings which seem inappropriate highlighted and explored further	<input type="checkbox"/>
Prepared to present and explain the basis of the risk rankings to stakeholder workshop	<input type="checkbox"/>

3.4.3 Stage 3: Development of stormwater management plan

Part A: Management strategies

This stage involves confirming risk rankings at a workshop of stakeholders and then identifying and evaluating a range of best practice management options for managing the priority risks. These can include measures related to land-use planning, urban design, land management, operations, enforcement, education and awareness, and infrastructure (stormwater treatment).

<i>Purpose:</i>	To identify and evaluate best practice approaches to managing priority stormwater risks.
<i>Inputs:</i>	Priority risk rankings.
<i>Outputs:</i>	Priority management strategies, tasks, actions and responsibilities.
<i>Process:</i>	Workshop to present and confirm risk rankings, and to identify and evaluate management options.

Management options should be evaluated against criteria of cost, effectiveness in protecting or enhancing values (reducing risk), opportunities for implementation and capability of the municipal council or other agencies to implement. Table 3.4 provides some examples of how these criteria might be applied.

For any activity (such as land development) likely to threaten a particular receiving environment, a brief assessment of management measures related to land-use planning,

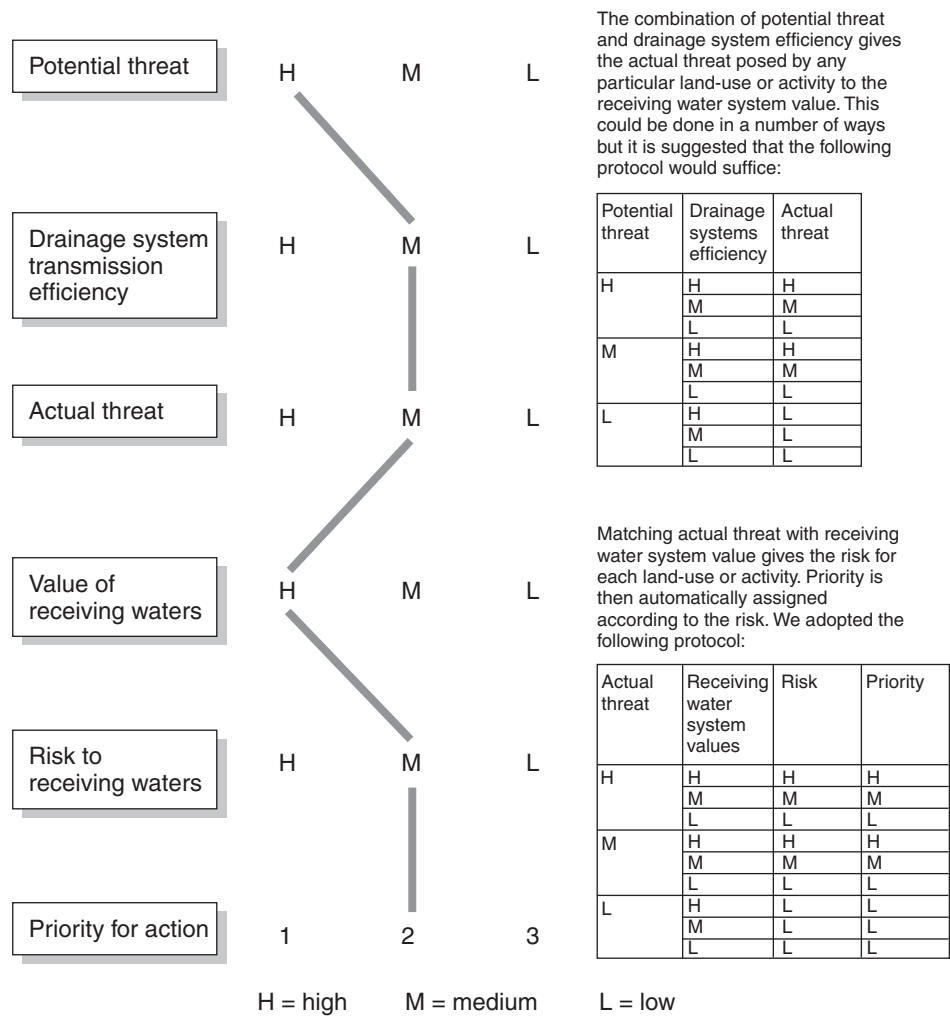


Figure 3.4 Rating system for identifying priorities for action.

Key	
Management Approach	Symbol
Planning	Pl
Operations	Ops
Enforcement	Enf
Infrastructure	Inf
Education	Ed

urban design, land management, operations, enforcement, education and awareness and stormwater treatment and infrastructure can be undertaken quite quickly. The simple ordination shown in Figure 3.5 is a useful tool for comparing and discussing the effectiveness and feasibility of management options for each priority stormwater risk.

Be sure to take notes during the workshop to ensure you understand the reasons behind the results of the evaluation.

Category	Suggested evaluation criteria	Explanation
Effectiveness	Cost	Use approximate cost categories to compare costs. For example: major cost > \$500,000 moderate/high \$100 – \$500k moderate \$50 – \$100k low < \$50k
	Effectiveness	Assess how well the measure is likely to reduce risk.
Feasibility	Capability	Is it technically feasible to manage? Do we have enough information to be effective? Are the skills readily available? Does the technical ability or understanding exist?
	Opportunity	Are statutory powers available? What's our track record like? Do others need to be involved and will they agree to it? Is space available where structural measures are proposed? Can the measure be included as part of another project which is to be implemented e.g. drainage system upgrade.

Table 3.4 Example of presentation of opportunities for implementation of management measures.

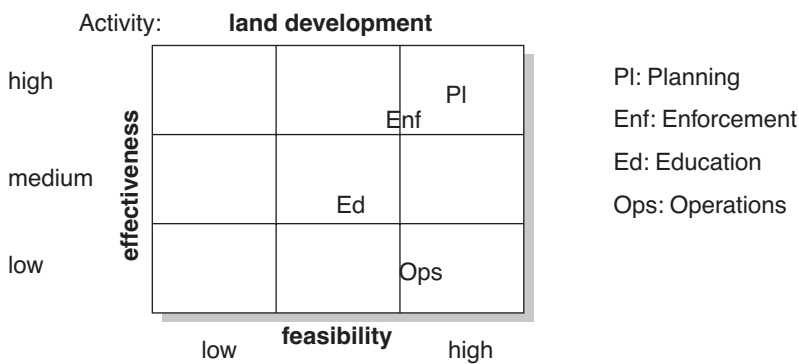


Figure 3.5 One way to present the effectiveness and feasibilities of options for comparisons.

Developing detailed actions

Where particular management measures or options rate highly for feasibility and capability, detailed actions should be formulated. Where relevant these should include:

- suggested changes to planning schemes, Municipal Strategic Statement (MSS), policies and permit conditions;
- suggested changes to specifications for service delivery;
- the type, location and indicative cost of structural treatment measures;

- target groups for education programs or enforcement;
- specific locations for targeted programs (a particular industrial or commercial area or receiving environment);
- the need to further investigate the extent or nature of stormwater threats;
- the need for coordination with others;
- responsibility for leading implementation ie council department, CMA/MWC, EPA or other; and
- suggested performance measures.

Grouping actions into strategies

For each category of management approach, a number of specific actions are available. See Figure 3.6 below. Priority risk activities for which a similar range of management actions are appropriate can be grouped into broad strategies. For example, an industrial and commercial areas strategy might be an appropriate way of grouping management measures to deal with a range of risk activities related to industrial and commercial land uses in the municipality. A goal or objective should be assigned to each broad strategy. For example:

Industrial and commercial areas strategy

Goal:

‘To encourage the operations of businesses in the target industrial and commercial activity areas to adopt best practice in relation to the containment of pollutants to stormwater with education as a first priority and enforcement as a last resort and at the same time to implement effective clean-up procedures and pollutant capture devices where they are necessary.’

There is also likely to be a need for a ‘Corporate Strategy’ to address the inclusion of general policies and objectives into the council corporate plan and planning scheme including the MSS. This strategy should also deal with the integration of actions across functional areas within council and with arrangements for coordination with other agencies such as EPA and MWC.

Checklist

- | | |
|---|--------------------------|
| Management approaches for priority risks evaluated | <input type="checkbox"/> |
| Detailed actions developed for priority risks where feasibility and capability are high | <input type="checkbox"/> |
| Actions grouped into management strategies | <input type="checkbox"/> |
| Responsibilities agreed | <input type="checkbox"/> |
| Strategy developed for integration of actions within council and coordination with others | <input type="checkbox"/> |
| Final plan circulated for comment | <input type="checkbox"/> |

Management options		Strategy Area						
		Sewer overflow /leaks	Industrial area	Commercial areas	Southlan	Service stations	Major roads	Building and construction
	Action							
Planning	Planning permit conditions							
	Land use planning							
	Subdivisional/development planning							
	Site management plans							
Operations	Management of septic systems							
	Housekeeping and materials							
	Waste management							
	Spill prevention and clean-up							
	Contractor/contracting specifications							
	Monitoring							
	Sewer system overflow monitoring							
	Street cleaning							
	Building site debris cleaning							
	Vegetation collection/mulching services							
	Garbage collection							
	Kerbside recycling							
	Collection/disposal of domestic toxicants							
	Car park design							
	Reserve and waterway							
Detection/audit/enforcement								
Enforcement	Planning permit/bylaw enforcement							
	Control of illegal dumping							
	Control of illegal connections							
Infrastructure	On-site sediment detention (truck washes, silt fences, etc.)							
	Soakage disposal pits							
	Alternative pavement forms							
	Grate/inlet screens/traps							
	Oil/grit separators							
	Litter basket/trap							
	Rainwater storage/reuse							
	Infiltration trenches							
	Grass swales/diversions							
	Vegetated filter/buffer strips							
	Sand filters							
	Leachate treatment/treatment							
	Sewerage system improvements							
	Trash rack							
	Floating debris traps							
	In-line litter/gross pollutant traps							
	Sediment settling basins							
	Infiltration basins							
	Constructed wetlands							
	Stabilised drainage lines							
Combined SW quantity/quality treatment basins								
Education	Community education							
	Staff/contractor education/training							
	Information dissemination							
	Industry best practice guidelines							

(Adopted from City of Kingston Stormwater Management Plan SGS 1999)

Figure 3.6 Management option for different areas within council.

Part B: Implementation planning

This stage requires a meeting of senior managers from council, EPA and CMA/MWC to discuss and confirm:

- commitment to implementing strategies in the plan;
- responsibilities for actions;
- accountability for delivery;
- initial targets and reporting arrangements.

<i>Purpose:</i>	To confirm priority actions and implementation arrangements.
<i>Inputs:</i>	Priority management strategies, tasks, actions and responsibilities.
<i>Outputs:</i>	Agreement on actions to be implemented and responsibilities.
<i>Process:</i>	Meeting with senior management of council and key stakeholders.

Successful implementation of the plans will require:

- clear expression of commitment to improved stormwater management;
- incorporation of stormwater management objectives into the statutory planning framework and other relevant plans strategies and policies;
- coordination of planning, education, operations, enforcement and infrastructure activities within council and with other agencies;
- strengthened relationship with EPA and Melbourne Water/CMA to deliver coordinated programs and ensure consistent priorities; and
- continuous improvement in operational practices particularly to ensure environmental performance objectives are written into specifications for service delivery.

The success of stormwater management plans will be evaluated by the extent to which objectives, policies and programs for the environmental management of stormwater are incorporated into:

- municipal strategic statements and planning schemes;
- operational programs;
- capital works programs;
- annual business plans; and
- developer contribution plans

of council as well as EPA, Melbourne Water and other key stakeholders. See Figure 3.7.

Checklist	
Senior managers in council EPA and CMA/MWC have endorsed the plan.	<input type="checkbox"/>
Responsibilities have been defined	<input type="checkbox"/>
Initial actions have been agreed for implementation	<input type="checkbox"/>
Ongoing coordination arrangements are agreed and understood and protocols are in place	<input type="checkbox"/>
Other plans, programs, policies have been modified to incorporate SWMP actions and objectives	<input type="checkbox"/>

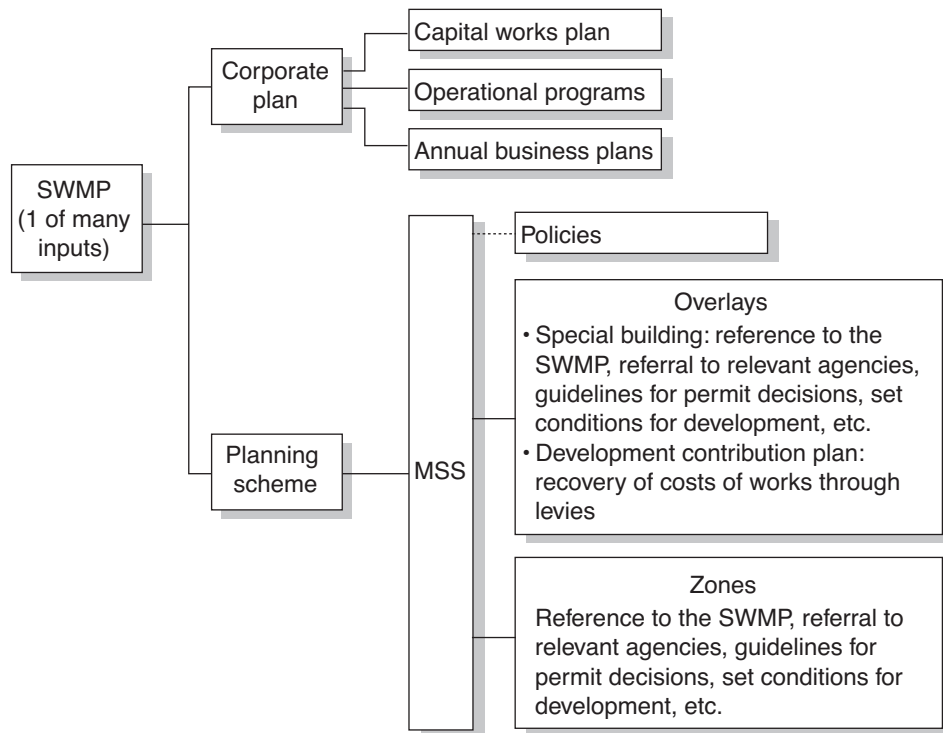


Figure 3.7 Relationship between SWMP and other plans, strategies and policies.