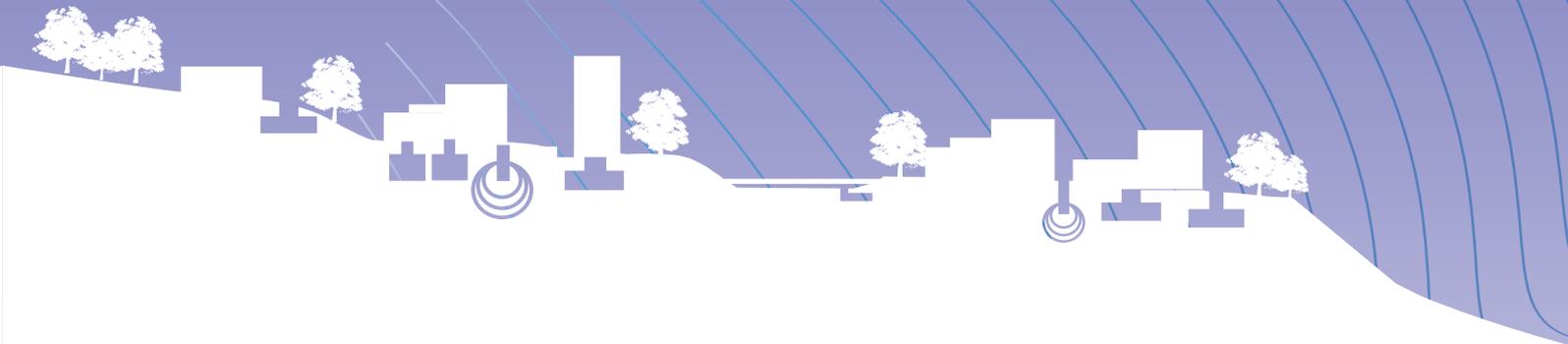


SUBMISSION CHECKLIST FOR STORMWATER MANAGEMENT IN MALAYSIA



Department of Irrigation and Drainage Malaysia

SUBMISSION CHECKLIST FOR STORMWATER MANAGEMENT IN MALAYSIA



Department of Irrigation and Drainage Malaysia, 2008

DISCLAIMER

This checklist is developed in good faith to assist developers, contractors and consultants on the proper use of MSMA and to ensure better compliance to the measure in the manual. Every efforts have been made to present the facts as accurately as possible at the time of publishing. Developers, contractors and consultants are encouraged to further validate the information, which is subject to changes and interpretation from time to time. The government therefore shall not be held responsible for liability for any loss, damage and failure for any goods or structures, which claim to be referred to this Guideline.

FOREWORD



The introduction of the "Urban Stormwater Management Manual for Malaysia" (MSMA) in 2001 represents a paradigm shift in the management of stormwater in the country. Stormwater will now be managed in 3 aspects:

- i) quantity control of stormwater runoff;
- ii) quality control of stormwater runoff; and
- iii) erosion and sediment control during earthwork stage.

With MSMA there is a complete change in the concept of quantity management from the previous practice based on rapid disposal to a new control at source concept utilising detention and retention storage. Equally important, stormwater runoff is now recognized as one of the largest contributors to river and waterway pollution, and there is a need to improve and regulate runoff quality through Best Management Practices (BMPs). At the same time, the current method of carrying out earthworks needs to be managed properly to mitigate extensive sedimentation to rivers.

As MSMA is now mandatory for new development, there is a need for consultants to quickly develop expertise in MSMA and familiarize themselves with the requirements for stormwater quality and ESCP. This need is more pressing for some consultants due partly to their lack of adequate exposure to MSMA during the earlier stages of its implementation. To achieve better quantity and quality control of stormwater runoff, it is imperative that BMPs, runoff quality, and erosion and sediment control be put into practice by developers, contractors and consultants.

This set of checklist has been produced to assist developers, contractors and consultants on the proper use of MSMA and to ensure better compliance to the measures in the Manual. I hope that this effort will enhance not only our understanding on the importance and realization of MSMA but also make the successful implementation of MSMA easier.

(Dato' Ir. Hj. Ahmad Husaini bin Sulaiman)
Director General
Department of Irrigation and Drainage Malaysia

CONTENT	Page
DISCLAIMER	i
FOREWORD	ii
TABLE OF CONTENT	iii
1. INTRODUCTION	1
2. STANDARD SUBMISSION PROCEDURE	1
3. APPLICABILITY	2
4. STORMWATER MANAGEMENT TECHNICAL STANDARDS	2
4.1 Runoff Quantity Control	2
4.2 Runoff Quality Control	3
4.2.1 During Construction	3
4.2.2 Post Construction	4
4.3 Aesthetical	4
4.4 Operation and Maintenance	4
5. SUBMITTAL REQUIREMENT	4
ANNEX A SUBMISSION OF PLANS FOR PLANNING PERMISSION	
ANNEX B SUBMISSION OF PLANS FOR DRAINAGE AND STORMWATER MANAGEMENT – REVIEW CHECKLIST	
ANNEX C SUBMISSION OF PLANS FOR EROSION AND SEDIMENT CONTROL – REVIEW CHECKLIST	
ANNEX D EROSION AND SEDIMENT CONTROL – INSPECTION AND MAINTENANCE OF BMPs- REVIEW CHECKLIST	

1 INTRODUCTION

This policy was established pursuant to the new Urban Stormwater Management Manual for Malaysia. The manual provides clear and consistent technical guidelines for stormwater management in the country while the Stormwater Management Policy aims to streamline the regulatory process.

This policy will establish uniform technical standards while consolidating the regulatory requirements of several authorities. The policy addresses both water quality (pollutants) and water quantity (flood control) by establishing the level of required controls which can be achieved through the use of site planning, nonstructural measures, and Best Management Practices (BMPs). BMPs reduce or prevent pollutants from reaching water bodies and control the quantity of runoff from a site. The Standards are designed to meet the stormwater management requirements under various regulatory programs, and:

- Prevent untreated discharges to receiving waters;
- Preserve hydrologic conditions that closely resemble pre-development conditions;
- Reduce or prevent flooding by managing the peak discharge and volumes of runoff;
- Minimize erosion and sedimentation;
- Reduce suspended solids and other pollutants to improve water quality;
- Provide increased protection of sensitive natural resources.

The Stormwater Management Standards are intended to be applied during routine project review by approving authorities. Use of the standards should prevent or minimize adverse environmental impacts due to unmanaged stormwater while limiting undue costs and recognizing site constraints.

2 STANDARD SUBMISSION PROCEDURE

A standard submission procedure for stormwater was developed in line with the One Stop Center (OSC) for submission and approval of land development initiated by the Ministry of Housing and Local Government. This standard submission procedure is part of the strategy of DID being the relevant administrative agency for stormwater management in getting all parties involved such as planner, consultant, project owner/developer, contractor and the local authorities to improve their understanding and practices and achieve the required development control objectives.

The procedure covers the authority requirements for each application on stormwater management for land sub-division, building plan approval and approval for erosion and sediment control plan. This procedure covers standard application forms, drawings and reports which have to be filled and complied by the parties who need to submit the requirements and the authority officer who has to check and approve the submission.

3 APPLICABILITY

This standard shall be applied throughout Peninsula Malaysia. The Stormwater Management Technical Standards shall be apply to industrial, commercial, institutional, residential, and roadway projects, including site preparation, construction, redevelopment , and on going operation. The Stormwater Management Technical Standards does not apply to:

- To any emergency repairs works.

4 STORMWATER MANAGEMENT TECHNICAL STANDARDS

The DID requires that all projects development meet the following Stormwater Management Standards. When any of the Standards cannot be met, an applicant may demonstrate that an equivalent level of protection will be provided.

4.1 Runoff Quantity Control

In stormwater management system, the quantity of the runoff shall be controlled by the following criteria:

- Minor and major system shall be planned both generally confirm to natural drainage pattern and discharge to natural drainage system within catchment as possible.
- Runoff at development site within catchment or sub-catchment shall be maintained as discharge at the existing natural drainage outlet/s and the controls discharges shall be less or equal to the existing capacity of the existing natural drainage capacity at downstream.
- Stormwater management system must be designed so that post development peak discharge rate (2 yr, 10yr, 50 yr and 100yr ARI) less than the pre-development (2 yr ARI). More stringent criteria may be required in sensitive area where stormwater problems presently exist.
- There will be no new stormwater conveyance system outfall may discharge the runoff directly into the existing receiving water without any control.
- All new urban development shall be provided with a minor drainage system with capacity not more than the 10 yr ARI as describe in Table 4.1 of the Manual.
- The minor drainage system may comprise any combination of pipe, swale, open drain or engineered waterway, to be serving for the catchment less than 20 ha.
- The major drainage system shall be provided for the development area and the catchment of the development area equal to or larger than 40 ha. The stormwater design ARI shall be 100 years or as describe in Table 4.1 of the Manual.
- Conveyance system for the drainage area from 20 to 40 ha should be designed with storm ARI 50 years.
- The platform/lowest floor level in all new urban development and re-development shall be protected for flooding up to 100 years ARI with 0.5m freeboard.

- Diversion of runoff to or from other catchment or sub-catchment is prohibited (not permitted).
- An adequate drainage reserve shall be provided for stormwater conveyance located within private lot to provide access for maintenance.
- The construction of Onsite Storage Detention (OSD) facilities can be allowed to serve the small drainage area up to 0.1 ha only. For the area more than that, the community detention/retention facilities should be provided.
- Adequate storage shall be provided for the detention pond to store the post-development design flows of 1 in 100 years ARI from the catchment without overflow the secondary outlet (spillway).
- Primary outlets for the detention pond shall be designed to reduce post-development peak flows from the pond must not exceed the pre-development peaks flows of 2 year (minor primary outlet and major primary outlet).

4.2 Runoff Quality Control

Criteria for runoff quality control are as the following:

4.2.1 During Construction

- No land clearing shall be allowed for the construction site before the installation of sediment control facilities onsite.
- The erosion and sedimentation controls shall be provided on all land development and building project to prevent up to the maximum extent possible, the transport of the sediment from the project site resulting from clearing and grading or others land disturbing activities.
- The adequate sediment pond or sediment trap shall be provided prior to sediment rotate/release from the site.
- Sediment pond/trap/basin should retain a minimum 70% of coarse of sediment > 0.02 mm for storm up to or including 3 months ARI (equivalent to 40mm of rainfall depth to capture and detain at least 90% of 24 hours storm events runoff volume in a year) for construction period < 2 years and 6 months ARI (equivalent to 50mm of rainfall depth to capture and detain at least 95% of 24 hours storm events runoff volume in a year), for construction > 2 years to be completed.
- The Erosion Sedimentation Control Plan (ESCP) shall be submitted for **project area more than 1 ha**. The plans must be prepared based on construction activities staging which covers land grading & earthworks (pre-bulk grading plan) and construction stage (post-bulk grading plan). For project area less than 1 ha, the developer shall submitted Best Management Practices Plan to control soil erosion and siltation onsite.
- Erosion and sedimentation control must be implemented during construction and land disturbance activities (earthworks phase).

4.2.2 Post Construction

- No new stormwater conveyance outfall may discharge the untreated runoff directly to any receiving water of the area.
- Any stormwater (runoff) discharges to environmental sensitive area must utilize certain BMPs approved for that area.
- The design ARI for water quality control facilities shall be 3 month ARI.
- The use of infiltration practices without pre-treatment (to capture solids and sediment) is prohibited.

4.3 Aesthetical

- Stormwater management system shall be designed with appropriate aesthetic value to enhance the appearance of the area with proper landscaping.
- The proper landscaping is required for any proposed engineered waterway, watercourse management and proposed detention pond.

4.4 Operation and Maintenance

- All stormwater management system design need to take into account for easy and adequate access for maintenance and the continuation of maintenance requirement.
- All stormwater management system must have the O&M plan and schedule to ensure the system function as per design.

5 SUBMITTAL REQUIREMENTS

This section presents the requirements a project proponent must fulfill upon submission (see ANNEX A, B and C), apart from the general requirements already established by Local Authority.

ANNEX A
SUBMISSION OF PLANS FOR PLANNING PERMISSION
– REVIEW CHECKLIST

ANNEX A

SUBMISSION OF PLANS FOR LANDUSE CONVERSION
AND LAND SUBDIVISION – REVIEW CHECKLIST

STORMWATER MANAGEMENT PLAN SUBMISSION FOR PLANNING PERMISSION

To:

JABATAN PENGAIRAN DAN SALIRAN

.....

.....

.....

.....

I hereby certify that the details in the plan(s), viz

.....

On Lot (s)

Section

Jalan

Land Title No.

for

are in accordance with the Urban Stormwater Management Manual for Malaysia and I accept full responsibility accordingly.

I herewith enclosed the following:

- | | | |
|----|-----------------------------------------------|-----|
| 1. | Relevant Site Plans | { } |
| 2. | Engineering Drawings | { } |
| 3. | Stormwater Management Report and Calculations | { } |
| 4. | Submittal Checklist | { } |

Signature:

Professional Engineer (M) and Seal

Name:

Address:

Registration No:

STORMWATER MANAGEMENT PLANS SUBMISSION FOR PLANNING PERMISSION

Project Title: _____ Engineering Firm: _____

Property Address: _____ Address: _____

Land Title No: _____ Phone No: _____

Contact Person: _____

DID USE ONLY

Submittal Date: _____ Review Date & Initials: _____

Submission Acceptable/Approval/ Rejected Date: _____ Approved/Rejected by: _____

Legend:

- { / } Complete
- { x } Incomplete/Incorrect
- { na } Not Applicable

This checklist has been developed to provide specific instructions to engineers. The purpose of this checklist is to expedite and facilitate the review process. This checklist gives the minimum requirements needed for review. All items are expected to be addressed in the first submittal, unless indicated otherwise. All items shall be checked as included or marked NA. Failure to do so will result in rejection of the submittal without review. Consultant shall review the entire check list, prior to first submittal, and check the box in the left-hand column ("Consultant's Initial Submission") to indicate compliance. Consultant must sign the first page.

TO THE CONSULTANT

Your submission for Landuse Conversion and/or Land Subdivision approval has been reviewed. The review was made per the following checklist. Please return the checklist and Plans comment sheets with your resubmittal. If you do not address a checklist item, including comments on the plan sheets, explain your reasoning.

I, the undersigned, acknowledge by signature that these documents meet or exceed the design standards of the Department of Irrigation and Drainage Malaysia and that they were prepared under my supervision. I, the undersigned, further acknowledge that to the best of my knowledge and belief, the products resulting from these documents will function as intended.

Consultant's Signature_____
Professional Seal_____
Date_____
Title_____
Company Name

SUBMISSION REQUIREMENTS

Initial Submission	Items	
	1	GENERAL
{ }	1.1	Name of proposed project development and address.
{ }	1.2	Name of developer with address, and telephone number on first sheet.
{ }	1.3	Name, address and telephone number of engineering firm or individual who prepared the plans.
{ }	1.4	Seal, signature and license number of a Malaysian Professional Engineer on all sheets.
{ }	1.5	Name and signature of License Surveyor on plans prepared by the surveyor
	2	SITE PLANS MINIMUM REQUIREMENTS
{ }	2.1	Location plan with appropriate scale. A map showing the general location of the project and the state boundary where the project is located.
{ }	2.2	Key plan with 1:50,000 scale showing the general vicinity of the project within 10 km radius and the river/main drain catchment.
{ }	2.3	Site plan with 1:3,000 or 1:6,000 scale showing the lot to be developed and the surrounding lots showing existing developments if any, standard sheet no, name of Mukim, district, rivers and streams, roads and infrastructure for rivers and drains.
{ }	2.4	Topography Survey plan 1:500 or 1:1000 scale. The survey should be based on Ordinance Survey Datum and the datum (Bench Mark or Temporary Bench Mark) must be clearly shown. The contour line shall be at 0.5 m interval and site spot levels not more than 10m distance. (with extensions into adjoining properties to cover additional distance of 30 m for development < 10 hectares; 50m for development 10 - 50 hectares; 100 m for development > 50 hectares).
{ }	2.5	Proposed layout plan 1:500 or 1:1000 scale showing the proposed main drain reserves, existing outlet drain/river reserve (if applicable) .
{ }	2.6	A similar plan as per item 2.5 but superimposed with existing topography survey.
{ }	2.7	Plans of the river/main drains if the land is crossed by the river/main drain. The plan comprises Cross-section Survey at every 20m intervals (at scale of 1:100 vertical, 1:100 horizontal) and Longitudinal Survey (at scale of 1:100 vertical, 1:1,000 horizontal) The survey should extend up to at least 150m at upstream and downstream of the lot boundary.
{ }	2.8	Hydrographic survey of existing pond/lakes/sea if applicable (1:500 or 1:1000 scale) with spots level at 10m interval.
{ }	2.9	All plans submission shall be in hardcopy and digital format in RSO or CASSINI coordinate.

SUBMISSION REQUIREMENTS

3 **STORMWATER MANAGEMENT REPORT MINIMUM REQUIREMENTS**

A loose leaf binder containing the stormwater management report. The report shall include the minimum coverage of the following information:

3.1 **Project Location and Site Descriptions**

A ***Report Requirements;***

- { } 1 Description of the location of the proposed development. Include a description of the site and a reference to adjacent properties and landmarks.
- 2 Description of the site such as
 - { } – general topography (slopes and slope lengths within the site)
 - { } – vegetation
 - { } – extent and nature of existing development
 - { } – drainage patterns
 - { } – critical areas within and in the vicinity of the proposed development site that have potential for serious stormwater problems
- { } 3 Identification of features such as streams, lakes, residential and commercial areas, reserves, parks and roads that might be affected by the proposed development from the perspective of water management.

B ***Mapping Requirements***

- { } 1 Provide location plan showing:
 - legal land description; and
 - adjacent properties (streams, lakes, residential and commercial areas, reserves, parks and roadways).
- { } 2 Show the kinds of development on adjacent properties.
- { } 3 Provide a plan showing the river and basin boundary where the project is located.
- { } 4 Provide land survey plan showing
 - { } – existing topography showing contours of the site
 - { } – existing drainage pattern and flowpaths (together with flow direction) through out the site
 - { } -any other main features such as drains, culverts, bridges, building, roads, lakes, ponds, or any other services with their invert level and soffit levels in detail.
- { } 5 Show critical features/areas within or near the development such as:
 - { } - Public Water Supply / Raw Water Intake
 - { } - Reservoir
 - { } - Swimming Beach
 - { } - Recreational/Tourism area
 - { } - Flood prone area
 - { } - Fishing area/aquaculture
 - { } - Mangrove Forest

SUBMISSION REQUIREMENTS

3.2 Proposed Project Development

A *Report Requirements;*

- | | | |
|-----|---|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| { } | 1 | The total project area that will be developed in Ha. |
| { } | 2 | Provide a general description of the proposed development, which should include the breakdown details of project components, the development area in Ha of each component and percentage to total development area. |
| { } | 3 | The proposed project implementation periods and stages/phases of project development with timing and duration. |

B *Mapping Requirements*

- | | | |
|-----|---|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| { } | 1 | Show the boundary of each project component, the area in Ha and their project development stages/phases. |
| { } | 2 | Show the limits of clearing and grading for each phase of the development. Each boundary line should be identified as to the <u>timing and duration</u> of disturbances. |
| { } | 3 | Proposed layout plan with 1:500 or 1:1000 scale which clearly shows the proposed main drain reserve, outlet drain reserve and river reserve (if applicable). |
| { } | 4 | Proposed layout plan of 1:500 or 1:1000 scale superimposed with topography survey details. |
| { } | 5 | For sites involving existing Mangrove Forest along the river within the project area, the adequate set-back or area reserved for the Mangrove Land Forest shall be provided according to the following criteria: |
| { } | | - distance 100m for recreation development |
| { } | | - distance 500m for housing development |
| { } | | - distance 1000m for industrial development |
| { } | 6 | For the area which there are existing sea shore within the project area, the adequate set-back or area reserved shall be provided according to the following criteria: |
| { } | | - Distance 60m from the sand beach, measured from Mean High Water Spring (MHWS) during high tide at the sea towards the land. |
| { } | | - Distance 400m from the muddy sea shore with mangrove forest measured from seaward edge of mangrove forest towards the land. |
| { } | | - There won't be any development allowed within the mangrove forest area or the reserved area for it as published in the Akta Perhutanan Negara 1984. |

SUBMISSION REQUIREMENTS

3.3 **Details of Stormwater Management Master Plan**

A Report Requirements;

- | | | |
|-----|---|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| { } | 1 | Preliminary investigation and basic information about existing stormwater issues within the project area and at downstream of discharge points (receiving water) which shall include; |
| { } | | – previous flood record |
| { } | | – existing 100 year flood plains |
| { } | | – maximum water level |
| { } | | – flow regulating structure such as bridges, culverts, gates, etc. |
| { } | | – stormwater pollution issues |
| { } | 2 | Describe the pre-development drainage system, which shall include the followings; |
| { } | | – Delineation of the drainage area. |
| { } | | – Calculation of pre-development peak discharges for all drainage areas, including their time of concentration (tc) and design storm used. |
| { } | | – Calculation of the carrying capacity of existing runoff conveyance system such as drains/culverts/bridges/streams/rivers and others. |
| { } | | – Existing drain/stream/river reserves. |
| { } | 3 | Describe the proposed post-development drainage and concept of stormwater control plans, which shall include the following information; |
| { } | | – Delineation of the proposed drainage area, proposed drain types, sizes and proposed discharge points (outlets). |
| { } | | – Calculation of post-development peak discharges for all drainage areas, including their time of concentration (tc) and design storm used. |
| { } | | – Calculation of the carrying capacity of proposed runoff conveyance system such as drains/culverts/bridges/streams/rivers and others. |
| { } | | – Proposed drain/stream/river reserve. |
| { } | | – Proposed stormwater quantity control structures, their designated area (detention/retention ponds should at least comprise 3% of the project area) and their proposed locations. |
| { } | | – Proposed stormwater quality control structures, their designated area and the proposed locations. |
| { } | | – Preliminary calculation of proposed regulated flows resulting from the proposed control structures (at each of their outlets). |

Mapping Requirements

- | | | |
|-----|---|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| { } | 1 | Topographic plans must show all existing drainage patterns and flowpaths (together with flow direction) throughout the site, their catchment boundary and catchment area in Ha. |
| { } | 2 | Show the existing 100 year flood plain boundary, maximum water level, special structures which regulate flow such as bridge, culvert, gate, etc. and stormwater pollution issues in the same topo plan. |

Consultant's
Initial
Submission
{ }

SUBMISSION REQUIREMENTS

DID
Remarks

- | | | |
|-----|---|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| { } | 3 | Show the drainage sub-catchment and flow directions for each drainage area after development and show the changes resulting from the proposed earthwork grading. Include a contour plan of the finished grades at an appropriate scale (1:2000). |
| { } | 4 | Provide the preliminary stormwater management masterplan which clearly shows the location and sizes of proposed main drains and their outlets and other drainage and stormwater facilities such as swales, waterways, detention/retention pond, sediment forebay, wetlands, GPTs, wet/dry ponds, etc. and their proposed reserves. |
| { } | 5 | Show in a separate plan the calculated pre-development peak discharges, post-development peak discharges, proposed drainage carrying capacity, regulated flows after controls at all proposed control structures and at all proposed drainage outlet points, and the existing carrying capacity of the existing receiving water located immediately outside the project area. |

ADDITIONAL REQUIREMENTS

COMMENTS

ANNEX B
SUBMISSION OF PLANS FOR DRAINAGE AND
STORMWATER MANAGEMENT
– REVIEW CHECKLIST

ANNEX B

SUBMISSION OF PLANS FOR DRAINAGE AND
STORMWATER MANAGEMENT – REVIEW CHECKLIST

STORMWATER MANAGEMENT PLAN SUBMISSION FOR DRAINAGE AND STORMWATER MANAGEMENT

To:

JABATAN PENGAIRAN DAN SALIRAN
.....
.....
.....
.....

I hereby certify that the details in the plan(s), viz

.....

On Lot (s)

Section

Jalan

Land Title No.

for

are in accordance with the Urban Stormwater Management Manual for Malaysia and I accept full responsibility accordingly.

I herewith enclosed the following:

- | | | |
|----|------------------------------------------------------------|-----|
| 1. | Relevant Site Plans | { } |
| 2. | Detailed Engineering Drawings | { } |
| 3. | Drainage and Stormwater Management Report and Calculations | { } |
| 4. | Submittal Checklist | { } |

Signature:

Professional Engineer (M) and Seal

Name:

Address:

Registration No:

**STORMWATER MANAGEMENT PLAN SUBMISSION
FOR DRAINAGE AND STORMWATER MANAGEMENT
REVIEW CHECKLIST**

Project Title: _____ Engineering Firm: _____

Property Address: _____ Address: _____

Land Title No: _____ Phone No: _____

Contact Person: _____

DID USE ONLY

Submittal Date: _____ Review Date & Initials: _____

Submission Acceptable/Approval/ Rejected Date: _____ Approved/Rejected by: _____

Legend:

- { / } Complete
- { x } Incomplete/Incorrect
- { - } Not Applicable

This checklist has been developed to provide specific instructions to engineers. The purpose of this checklist is to expedite and facilitate the review process. This checklist gives the minimum requirements needed for review. All items are expected to be addressed in the first submittal, unless indicated otherwise. All items shall be checked as included or marked NA. Failure to do so will result in rejection of the submittal without review. Consultant shall review the entire check list, prior to first submittal, and check the box in the left-hand column ("Consultant's Initial Submission") to indicate compliance. Consultant must sign the first page.

TO THE CONSULTANT

Your submission for Drainage and Stormwater Management approval has been reviewed. The review was made per the following checklist. Please return the checklist and Plans comment sheets with your resubmittal. If you do not address a checklist item, including comments on the plan sheets, explain your reasoning.

I, the undersigned, acknowledge by signature that these documents meet or exceed the design standards of the Department of Irrigation and Drainage Malaysia and that they were prepared under my supervision. I, the undersigned, further acknowledge that to the best of my knowledge and belief, the products resulting from these documents will function as intended.

Engineer's Signature

Professional Seal

Date

Title

Company Name

Consultant's
Initial
Submission

Items

SUBMISSION REQUIREMENTS

DID
Remark

1 GENERAL

- { } 1.1 Name of proposed project development and address.
- { } 1.2 Name of developer with address, and telephone number on first sheet.
- { } 1.3 Name, address and telephone number of engineering firm or individual who prepared the plans.
- { } 1.4 Seal, signature and license number of a Malaysian Professional Engineer on all sheets.
- { } 1.5 Name and signature of License Surveyor on plans prepared by the surveyor
- { } 1.6 Approval letter for land conversion should be attached

2 SITE PLANS MINIMUM REQUIREMENTS

- { } 2.1 Location plan with appropriate scale. A map showing the general location of the project and the state boundary where the project is located.
- { } 2.2 Key plan with 1:50,000 scale showing the general vicinity of the project within 10 km radius and the river/main drain catchment.
- { } 2.3 Site plan with 1:3,000 or 1:6,000 scale showing the lot to be developed and the surrounding lots showing existing developments if any, standard syit no, name of Mukim, district, rivers and streams, roads and infrastructure for rivers and drains.
- { } 2.4 Topography Survey plan 1:500 or 1:1000 scale. The survey should be based on Ordinance Survey Datum and the datum (Bench Mark or Temporary Bench Mark) must be clearly shown. The contour line shall be at 0.5 m interval and site spot levels not more than 10m distance. (with extensions into adjoining properties to cover additional distance of 30 m for development < 10 hectares; 50m for development 10 - 50 hectares; 100 m for development > 50 hectares).
- { } 2.5 Proposed layout plan 1:500 or 1:1000 scale showing the proposed main drain reserves, existing outlet drain/river reserve (if applicable) .
- { } 2.6 A similar plan as per item 2.5 but superimposed with existing topography survey.
- { } 2.7 Plans of the river/main drains if the land is crossed by the river/main drain. The plan comprises Cross-section Survey at every 20m intervals (at scale of 1:100 vertical, 1:100 horizontal) and Longitudinal Survey (at scale of 1:100 vertical, 1:1,000 horizontal) The survey should extend up to at least 150m at upstream and downstream of the lot boundary.
- { } 2.8 Hydrographic survey of existing pond/lakes/sea if applicable (1:500 or 1:1000 scale) with spots level at 10m interval
- { } 2.9 All plans submission shall be in hardcopy and digital format in RSO or CASSINI coordinate.

Consultant's
Initial
Submission

Items

SUBMISSION REQUIREMENTS

DID
Remarks

3 **DRAINAGE AND STORMWATER MANAGEMENT REPORT MINIMUM REQUIREMENTS**

{ }

A loose leaf binder containing the drainage and stormwater management report. The report shall include the minimum coverage of the following information:

3.1 **Project Location and Site Descriptions**

A ***Report Requirements;***

{ }

3.1.1 Description of the location of the proposed development. Include a description of the site and a reference to adjacent properties and landmarks.

{ }

3.1.2 Description of the site such as

{ }

– general topography (slopes and slope lengths within the site)

{ }

– vegetation

{ }

– extent and nature of existing development

{ }

– drainage patterns

{ }

– critical areas within and in the vicinity of the proposed development site that have potential for serious stormwater problems

{ }

3.1.3 Identification of features such as streams, lakes, residential and commercial areas, reserves, parks and roads that might be affected by the proposed development from the perspective of water management.

B ***Mapping Requirements***

{ }

3.1.4 Provide location plan showing:

{ }

- legal land description; and

{ }

- adjacent properties (streams, lakes, residential and commercial areas, reserves, parks and roadways).

{ }

3.1.5 Show the kinds of development on adjacent properties.

{ }

3.1.6 Provide a plan showing the river and basin boundary where the project is located.

{ }

3.1.7 Provide land survey plan showing

{ }

– existing topography showing contours of the site

{ }

– existing drainage pattern and flowpaths (together with flow direction) through out the site

{ }

-any other main features such as drains, culverts, bridges, building, roads, lakes, ponds, or any others services with their invert level and soffit levels in detail.

{ }

3.1.8 Show critical features/areas within or near the development such as:

{ }

- Public Water Supply / Raw Water Intake

{ }

- Reservoir

{ }

- Swimming Beach

{ }

- Recreational/Tourism area

{ }

- Flood prone area

{ }

- Fishing area/aquaculture

{ }

- Mangrove Forest

Consultant's
Initial
Submission

Items

SUBMISSION REQUIREMENTS

DID
Remarks

3.2 Proposed Project Development

A *Report Requirements;*

- { } 3.2.1 The total project area that will be developed in Ha.
- { } 3.2.2 Provide a general description of the proposed development, which should include the breakdown details of project components, the development area in Ha of each component and percentage to total development area.
- { } 3.2.3 The proposed project implementation periods and stages/phases of project development with timing and duration.

B *Mapping Requirements*

- { } 3.2.4 Show the boundary of each project component, the area in Ha and their project development stages/phases.
- { } 3.2.5 Show the limits of clearing and grading for each phase of the development. Each boundary line should be identified as to the timing and duration of disturbances.
- { } 3.2.6 Proposed layout plan with 1:500 or 1:1000 scale which clearly shows the proposed main drain reserve, outlet drain reserve and river reserve (if applicable).
- { } 3.2.7 Proposed layout plan of 1:500 or 1:1000 scale superimposed with topography survey details.
- { } 3.2.8 For sites involving existing Mangrove Forest along the river within the project area, the adequate set-back or area reserved for the Mangrove Land Forest shall be provided according to the following criteria:
- { } - distance 100m for recreation development
- { } - distance 500m for housing development
- { } - distance 1000m for industrial development
- { } 3.2.9 For the area which there are existing sea shore within the project area, the adequate set-back or area reserved shall be provided according to the following criteria:
- { } - Distance 60m from the sand beach, measured from Mean High Water Spring (MHWS) during high tide at the sea towards the land.
- { } - Distance 400m from the muddy sea shore with mangrove forest measured from seaward edge of mangrove forest towards the land.
- { } - There won't be any development allowed within the mangrove forest area or the reserved area for it as published in the Akta Perhutanan Negara 1984.

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Initial
Submission

Items

SUBMISSION REQUIREMENTS

DID
Remarks

3.3 Site Identifications

A *Report Requirements;*

- { } 3.3.1 Identification of all existing drainage (pre-development) patterns and flowpaths (together with flow direction) throughout the site with their catchment boundary and catchment area in Ha.
- { } 3.3.2 Preliminary investigation and basic information about existing stormwater issues within project area and at downstream of discharge points (receiving water) which shall include;
 - { } – stormwater issues (flooding, sediment, pollution etc.)
 - { } – previous flood record
 - { } – existing 100 year flood plains
 - { } – maximum water level
 - { } – Tailwater elevation at discharge points (max flood level at river or/and tide Levels at river/sea).
 - { } – Flow regulating structures such as bridge, culvert, flood/tidal gate, etc.
 - { } – Soil Types at the site

3.4 Hydrological Data Analysis

- { } 3.4.1 Derivation of Design Storm for the Project Area.
 - { } – Calculation of Critical Time of Concentration for the project site.
 - { } – Design Rainfall Intensity-Duration-Frequency Curve for the site.
 - { } – Design Temporal Pattern.
- { } 3.4.2 Design Frequency used for the drainage and stormwater management control facilities;
 - { } – Minor drainage (1 or 2 or 5 or 10 year ARI (see Table 4.1 in MSMA) for catchment area less than 20ha).
 - { } – Between minor and major drainage (50 year ARI for catchment area between 20 ha to 40ha)
 - { } – Major drainage (100 year ARI for catchment area more than 40 ha) systems.
 - { } – Stormwater Quantity Detention Pond (100 year ARI)
 - { } – Stormwater Quality Control Structures (3 month ARI – 40mm rainfall depth)
- { } 3.4.3 Runoff Estimation Methodology used in the analysis;
 - { } – Rational Formula.
 - { } – Rational Hydrographs Method.
 - { } – Hydrographs Method (methodology and/or computer software used).
- { } 3.4.4 Evaluation of the pre-development drainage conditions, which shall include the following;
 - { } – Delineation of the drainage area including off-site areas, and drainage area(s) draining to node(s).
 - { } – Estimation of runoff data characteristics (runoff coefficient, length, slope, 'n' values etc.)
 - { } – Calculation of time of concentration (Tc) and determination of critical Tc.
 - { } – Calculation of pre-development peak discharges for all drainage areas using selected design storm.

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Initial
Submission
{ }

Items

SUBMISSION REQUIREMENTS

DID
Remarks

- { } – Calculation of carrying capacity of existing drainage/culvert/bridge/stream/river and others.
{ } Identification of existing drainage/stream/river reserve.

3.5 **Development of Stormwater Management Master Plan.**

- { } Provide the drainage and stormwater management masterplan which clearly shows the alignment of proposed main drains, drainage flow direction, their outlets and others drainage and stormwater facilities such as swales, waterways, culvert, detention/retention ponds, sediment forebay, wetlands, GPTs, wet/dry ponds, etc. with their proposed reserves.

3.5.1 **Drainage and Conveyance System**

General

- { } 3.5.1.1 Proposed drainage system alignment/layout plans, with delineation of the proposed drainage areas and drainage area(s) draining to node(s), and drainage flow direction to the outlet.
{ } 3.5.1.2 Selection of design storm Average Recurrence Interval (ARI) of the drainage system shall based on minor and major system;
{ } – 1 or 2 or 5 or 10 year (see Table 4.1 in MSMA) for minor drainage (drainage area less than 20 ha).
{ } – 50 year for drainage between minor and major drainage system (drainage area between 20 ha to 40 ha).
{ } – 100 year for major drainage system (drainage area more than 40 ha).
{ } 3.5.1.3 Determination of runoff data characteristics (appropriate runoff coefficient for proposed landuse, drain/pipe length, slope, and “n” coefficient etc.).
{ } 3.5.1.4 Calculation of time of concentration (Tc) and determination of critical Tc for all drainage systems.
{ } 3.5.1.5 Calculation of post-development peak discharges for all drainage areas using selected design storm.
{ } 3.5.1.6 Determination of drainage types (earth/concrete/composite or open/closed) based on space availability, site suitability, environmental conditions (aesthetic, conservation etc.) and maintenance advantages and disadvantages.
{ } 3.5.1.7 Tabulation of all calculations in standard design sheets in which shall contains at least drainage area code ID, drainage link number, drainage length, drainage area, coefficient of runoff, design storm, design post-development discharges, proposed drain sizes and properties, proposed drainage capacity etc.
{ } 3.5.1.8 Calculation shall also include verification of capacity of the existing drainage system. Proposal to upgrade the existing drainage system shall be submitted if necessary.

Open Channel Stormwater Drainage System

- { } 3.5.1.9 All open channel drainage shall be grass lined/natural channel as far as possible to meet the water sensitive urban design requirement.
{ } 3.5.1.10 Open channel shall be designed for all major drainage system (for the catchment area > 40 ha).

Consultant's
Initial
Submission
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Items

SUBMISSION REQUIREMENTS

DID
Remarks

{ }	3.5.1.11	Drainage slope shall selected to obtain flows within the range of permissible velocities allowable for each drain. Determination of permissible velocities for self cleansing to avoid siltation and vegetation problems;
{ }		– for earth drain ($V_{min}>0.6$ m/s, $V_{max}<2$ m/s)
{ }		– for lined drain ($V_{min}>0.8$ m/s, $V_{max}<4$ m/s)
{ }	3.5.1.12	Hydraulic design criteria for open channel design shall based on;
{ }		– open channel characteristics determined by at least by Manning formula with appropriate Manning roughness factors and permissible velocities for open channel design.
{ }		– Normal depth determined
{ }		– Water surface profiles are computed for all channels using standard backwater methods and shown on final drawings for design ARI and 100 year ARI.
{ }		– Used of appropriate computer software available in the market on hydrologic and hydraulic calculations is acceptable (elaborate the methodology used by the software).
{ }	3.5.1.13	Adequate freeboard of at least 300mm shall be provided from the design water level.
{ }	3.5.1.14	Adequate drainage reserve shall be provided to allow access for maintenance (see Figure 26.1 and Table 28.1 in MSMA)
{ }	3.5.1.15	For earth drains, the slope should be properly turf with grass.
{ }	3.5.1.16	Maximum side slope for the open drainage
{ }		– concrete/brickwork/blockwork lining (vertical)
{ }		– stone pitching (1V:1.5H)
{ }		– grassed/vegetated (1V:2H)
{ }	3.5.1.17	Minimum bottom width of open drain is 500mm.
{ }	3.5.1.18	Open drains in locations open to pedestrian access shall be covered if the depth of the drain exceeds 0.6m.
{ }	3.5.1.19	Sediment trap/drain manhole (min size of 450mm x 450mm) shall be provided along open drain with max interval spacing at every 100m and min depth from drain invert is 600mm.
{ }	3.5.1.20	Drop structures should be provided to reduce the drainage longitudinal gradient such that the design flow velocities do not exceed the permissible limits.
{ }	3.5.1.21	Low-flow provision channel must be provided for grass open channel to cater for dry-weather flows.
{ }	3.5.1.22	Adequate erosion and scour protection shall be provided at high velocity areas such as at sharp bends for earth drains, at drop structures, outlets, sudden changes in cross-section, inlet and outlet of culvert wingwalls, bridge piers etc.
{ }	3.5.1.23	Adequate weep holes shall be provided for all lined open drains to relieve hydrostatic pressure.
{ }	3.5.1.24	The reinforced concrete drain should be provided for the lined open drains that exceed 0.9m in depth.
{ }	3.5.1.25	The stone used for stone-pitching drain shall be hard, durable with sizes between 150mm to 250mm. The top of the stone-pitching shall be capped with cement mortar at least 450mm.
{ }	3.5.1.26	Lined drains shall be provided with adequate granular bedding (min 100mm to 150mm) under the drain bottom.
{ }	3.5.1.27	Provide adequate safety measures such as 1.2m high handrail fence or covered with solid/grated cover at populated areas/area locations open to pedestrian access.

Consultant's
Initial
Submission

Items

SUBMISSION REQUIREMENTS

DID
Remarks

Closed Stormwater Drainage System

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| { } | 3.5.1.28 | Closed stormwater drainage system shall be designed for minor drainage system only (for the catchment area < 20 ha). |
| { } | 3.5.1.29 | Design shall be carried out for the 1 or 2, or 5 or 10 year ARI. Provisions must be made for safe conveyance to cater for 100 year storm to the discharge point via relief swales. |
| { } | 3.5.1.30 | Design calculations shall be based on Rational Method for the hydrologic estimation. |
| { } | 3.5.1.31 | All stormwater pipe systems shall be designed using "Hydraulic Grade Line (HGL) method using appropriate pipe friction (eg Darcy-Weisbach, Manning, Colebrook-White) and drainage structure head loss coefficients. |
| { } | 3.5.1.32 | The HGL analysis shall be carried out to verify that the water level in the catch basins for design storm will not be above the pipe soffit. |
| { } | 3.5.1.33 | Layout of proposed drainage system must include locations of inlets, manholes, mains, laterals, ditches, culverts, etc. |
| { } | 3.5.1.34 | Plans shall be provided to show the profile of existing natural ground and final grade along center line of storm drains. |
| { } | 3.5.1.35 | Drainage slopes shall be selected to obtain flows within the range of permissible velocities allowable for closed conduit drains (min slope at 1 in 500). |
| { } | 3.5.1.36 | Permissible velocities shall cater for self cleansing to avoid siltation and vegetation problems for closed conduit drain ($V_{min} > 1$ m/s, $V_{max} < 6$ m/s). |
| { } | 3.5.1.37 | Reinforced concrete scour stop collar shall be provided for pipelines laid on steep slope (>7%),. |
| { } | 3.5.1.38 | Pipe diameter for closed conduit drainage shall not be less than 450mm. |
| { } | 3.5.1.39 | Adequate drainage reserve shall be provided to allow access for maintenance (see Table 25.3 MSMA). |
| { } | 3.5.1.40 | Provide adequate clearance (at least 300mm) from other services between the outer faces of each service (see Table 25.4 MSMA). |
| { } | 3.5.1.41 | Pipe class shall be selected to provide adequate strength to meet construction, overburden and traffic loads. |
| { } | 3.5.1.42 | Minimum cover over pipelines should normally be 0.6m as measured from top of pipe to finished surface level. |
| { } | 3.5.1.43 | Maximum depth of stormwater pipelines to invert level shall generally be 6m. |
| { } | 3.5.1.44 | Adequate pipe bedding should placed and compacted under the pipes barrel with minimum of 75mm granular material/coarse river sand. |
| { } | 3.5.1.45 | Stormwater pipelines shall be constructed from materials proven to be structurally sound and durable and have satisfactory jointing systems. |

Consultant's
Initial
Submission

Items

SUBMISSION REQUIREMENTS

DID
Remarks

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| { } | 3.5.1.46 | Adequate manhole shall be provided for maintenance purposes which comply with design requirement as follows; |
| { } | | – provide manhole at changes in direction, grade, pipe size, junction, or at regular intervals for operation and maintenance access. |
| { } | | – round manhole shall be used for pipe diameter from 300mm to 675mm. |
| { } | | – chambered manhole shall be provided for pipe diameter more than 750mm. |
| { } | | – standard step irons shall be provided for maintenance access. |
| { } | | – maximum depth of manhole shall not exceed 6m. |
| { } | | – maximum manhole spacing should not exceed 40m. |

Culvert

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| { } | 3.5.1.47 | Show all culverts with structure I.D.'s label, sizes, types, slope and summary details in tabulation form, in the drawings. |
| { } | 3.5.1.48 | Methodology/software used shall be presented. |
| { } | 3.5.1.49 | Minimum pipe culvert sizes shall be 600mm. |
| { } | 3.5.1.50 | The culvert should be designed with a minimum freeboard of 300mm above the design water level to allow the debris flow. |
| { } | 3.5.1.51 | The culvert gradient shall be designed for self-cleansing and to avoid siltation with design velocity of not less than 1 m/s. |
| { } | 3.5.1.52 | Adequate erosion and scour protections shall be provided at inlet and outlet of the culvert. |

3.5.2 **Wet/Dry Pond (Stormwater Quantity and Quality Control)**

General

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| { } | 3.5.2.1 | Potential hazard for ponds should be identified to determine the risk of the pond failure to downstream populated area. |
| { } | 3.5.2.2 | Adequate soil investigation shall be conducted to provide parameters as inputs for the design of the pond |
| { } | 3.5.2.3 | The maximum pond depth should not exceed 3.0m under 1 in 100 year ARI design flow for which the primary outlets have been designed. |
| { } | 3.5.2.4 | Minimum recommended embankment top widths shall not be less than 4m. |
| { } | 3.5.2.5 | For ease of maintenance, the side slope of a grassed earthen embankment and basin storage area should not be steeper than 4(H):1(V). However, to increase public safety and facilitate ease of mowing, side slopes of 6(H):1(V) (or flatter) are recommended. |
| { } | 3.5.2.6 | For reservoir area, the slope can be steeper (max 3(H):1(V)) after reaching a water depth of 1m. |
| { } | 3.5.2.7 | The floor of the basin shall be designed with a minimum grade of 1% to provide positive drainage and minimise the likelihood of ponding. |
| { } | 3.5.2.8 | Adequate drainage of the basin floor between storms is essential if the facility is to be used for recreation. |
| { } | 3.5.2.9 | For dry pond, subsoil drains may be required to prevent soggy ground conditions. |

Consultant's
Initial
Submission

Items

SUBMISSION REQUIREMENTS

DID
Remarks

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| { } | 3.5.2.10 | The elevation of the top of the settled embankment shall not be less than 300mm (freeboard) above the water surface in the detention basin when the emergency spillway is operating at maximum design flow. |
| { } | 3.5.2.11 | All fill material in earthen embankments shall be suitable materials and should be free from brush, roots and other organic material subject to decomposition. The fill material should be compacted to at least 95% of the Modified Proctor method. |
| { } | 3.5.2.12 | The pond basins should be provided with signs that clearly indicate their purpose and their potential danger during storms. Signs should be located such that they are clearly visible at public access points and at entrances and exits to outlet structures. |
| { } | 3.5.2.13 | A proper pipe rail fence should be provided on steep or vertical drops such as headwalls and wingwalls at the inlet and outlet to a primary outlet structure to discourage public access for public safety. |
| { } | 3.5.2.14 | Wherever possible, designs should incorporate naturally shaped basins with landscaped banks, footpaths, and selective planting of vegetation to help enrich the area and provide a focal point for surrounding development. |
| { } | 3.5.2.15 | Maintenance access should be provided around the pond and to areas (such as sediment forebay, inlet and outlets structures etc). requiring regular maintenance and inspections |

Stormwater Quantity Control Requirements

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| { } | 3.5.2.16 | Analysis shall be done to cater for downstream drain/stream/channel capacity limitations. |
| { } | 3.5.2.17 | The post-development outflows (2, 50 and 100 year ARI) from the pond shall be designed to reduce the design flow discharges below the pre-development flows (2 year ARI) from the catchment. |
| { } | 3.5.2.18 | Primary outlets for detention basins shall be designed to reduce post-development peak flows from the pond below the pre-development peak flows for design storm ARI of 2 year. |
| { } | 3.5.2.19 | Two-staged outlet configuration (not including the emergency spillway), one outlet configuration to control the minor system design flow (1 in 2 year ARI) and an additional outlet configuration shall be adopted to control the major system design flow (1 in 2 year) in conjunction with the minor system outlet. |
| { } | 3.5.2.20 | Secondary outlets (spillway) for detention basins shall be designed to safely pass a minimum design storm of 100 year ARI through the basin. |
| { } | 3.5.2.21 | The design water level of 1 in 100 years ARI in the pond should not exceed the secondary outlet/ spillway crest level. |
| { } | 3.5.2.22 | Methods used to determine the Pre and Post-Development flows analysis into the proposed pond shall be elaborated. |
| { } | 3.5.2.23 | Methods used for Stage-Storage and Stage-Discharge calculations (account for Tailwater) shall be elaborated. |
| { } | 3.5.2.24 | Methods used for Reservoir Routing through the pond related structures shall be elaborated. |

Consultant's
Initial
Submission

Items

SUBMISSION REQUIREMENTS

DID
Remarks

{ }	3.5.2.25	Determination of the critical storm duration for the maximum basin storage shall be determined by routing post-development inflow hydrograph of different design storm duration (at least 3 times longer than Tc) through the basin.
{ }	3.5.2.26	If computer software is used for hydrologic, hydraulic and routing calculations, the methodology of the software shall be presented and the results presented.
{ }	3.5.2.27	Summary of the analysis shall include : <ul style="list-style-type: none">- Results presented in tabulation form- Model diagrams for pre and post-development analysis (should be comparable to the drainage plans. Use consistent symbols, areas, structures and cross section labels)- For each analysis point, include: drainage area, runoff coefficient, Tc and Q pre & post for the 2, 50 & 100 years storms- Include Q in, Q out and the design water levels for each design storm.
{ }	3.5.2.28	Show the Hydrographs (2, 50 & 100 year ARI) for pre-development flows, post-development flows without control (by-passing) and post-development flows with control.
{ }	3.5.2.29	Show the pre-development flows Hydrographs (2, 50 & 100 year ARI) superimposed with the post-development flows hydrograph (without and without control)
{ }	3.5.2.30	Show Stage-Storage and Stage-Discharge calculations, both composite and each individual structure within the outlet configuration.
{ }	3.5.2.31	Include a grading plan of the pond, and a detail of the outlet structure and emergency spillway with all dimensions and elevations.
{ }	3.5.2.32	Include calculations to justify tailwater and/or headwater conditions used in stage discharge calculation.
{ }	3.5.2.33	Include hydraulic or hydrologic routing calculations through the reservoir where applicable.
{ }	3.5.2.34	Adequate number of anti-Seepage Collars shall be provided at the pipe outlet below the pond embankment.
{ }	3.5.2.35	A cutoff trench shall be provided under the dam embankment to prevent seepage.
{ }	3.5.2.36	For the Dry Pond design, provision should be made to bypass the low flow (minimum of one half of 1 month ARI flow) through or around the detention basin.
{ }	3.5.2.37	Include calculation of exit flow velocities from the pond outlets under the range of design storms.
{ }	3.5.2.38	Adequate energy dissipaters and erosion/scour protection measures shall be provided at outlets.
{ }	3.5.2.39	Adequate bank erosion/scour protection measures shall be provided at critical areas within the reservoir area such as at inlet to the reservoir, inlet to the outlet structures etc.
{ }	3.5.2.40	Include sketch showing elevation of pond invert, permanent pool level, and proposed ground level, invert and soffit of pipe outlet (primary and secondary outlet), freeboard and design water levels for 2, 50 and 100 years flows ARI in the pond.
{ }	3.5.2.41	Include drawings showing the detail design covering among others the primary and secondary outlets arrangement.

Consultant's
Initial
Submission

Items

SUBMISSION REQUIREMENTS

DID
Remarks

Stormwater Quality Control Requirements

- { } 3.5.2.42 Permanent pool storage shall be sized to accommodate at least 3 month ARI of runoff or equivalent to 40mm rainfall depth (wet pond only) from the catchment without any overflow.
- { } 3.5.2.43 Ponds shall be able to capture and detain (for 24 hr) runoff volume generated by design storm of at least 3 month ARI (or equivalent 40 mm rainfall depth to capture and detain at least 90% of 24 hours storm events runoff volume)
- { } 3.5.2.44 Include calculations to verify that the permanent pool (wet pond) and extended detention storage (dry pond) can accommodate at least 3 month ARI of runoff.
- { } 3.5.2.45 The maximum depth of permanent pool shall be 2m while 50% of surface area (wet pond only) shall not be deeper than 1m.
- { } 3.5.2.46 Seasonally high ground water table is at or below the permanent pool elevation of a wet pond or at least 1m below the bottom of a dry pond.
- { } 3.5.2.47 Inlet zone shall be provided with sediment traps and debris boom or Gross Pollution Trap (SBTR type are preferable) to remove larger particles/debris including sediment.
- { } 3.5.2.48 Sediment forebays shall be sized adequately (wet pond only) by estimating sediment loading from the catchment and the calculations shall be shown to justify the sizing of forebays and sediment disposal area.
- { } 3.5.2.49 The sediment disposal area shall be allocated within the pond area.
- { } 3.5.2.50 Ponds should be long relative to their width in order to provide optimum flow circulation, with length to width ratio in the range of 3 to 5.
- { } 3.5.2.51 For wetland, the macrophyte zones shall be at least between 25-50% of the total pond area.
- { } 3.5.2.52 Water depth in the wetland shall range between 0.1m to 1m with an average of 0.5m. Changes in water level shall be limited to about 0.6m. Wetland which are associated with ponds used for flood control shall be designed to accomodate submergence to depths between 1m to 2m with the max velocity not exceeding 0.1 m/s.
- { } 3.5.2.53 Include final details.

3.5.3 **Onsite Detention (OSD) (Stormwater Quantity Control)**

- { } 3.5.3.1 On-site Stormwater Detention (OSD) shall be required for small scale development, which is defined as a site/project development where the developed area is smaller than 1,000 m² or 0.1 ha.
- { } 3.5.3.2 The OSD policy is capable to prevent increases of peak stormwater flows to downstream area for storms up to the 10 year ARI event.
- { } 3.5.3.3 The correct Permissible Site Discharge (PSD) and Site Storage Requirement (SSR) values have been used.
- { } 3.5.3.4 The OSD Design Summary Calculations are attached.
- { } 3.5.3.5 A completed "On-Site-Detention" Concept Plan is provided.
- { } 3.5.3.6 Site layout on the stormwater and OSD drawing corresponds with, and compliments Architectural and Landscape Drawings.

Consultant's
Initial
Submission
{ }

Items

SUBMISSION REQUIREMENTS

DID
Remarks

{ }	3.5.3.7	Outlet opening for OSD shall have a minimum internal diameter or width of at least 30 mm and shall be protected by an approved mesh screen to reduce the likelihood of the DCP outlet being blocked by debris.
{ }	3.5.3.8	An overflow system (such as pipe/weir) must be provided to allow the storage compartment to surcharge if the capacity of the system is exceeded due to a blockage of the outlet pipe or a storm larger than the storage design ARI (10 yr ARI).
{ }	3.5.3.9	Above-ground storage OSD (if any) shall comply with recommended maximum storage depths as follows;
{ }		- Pedestrian areas (50mm).
{ }		- Parking areas and driveways (150mm).
{ }		- Landscaped areas (600mm).
{ }		- Private courtyards (600mm).
{ }		- Flat roofs (300mm).
{ }		- Paved outdoor recreation areas (100mm).
{ }	3.5.3.10	For OSD above-ground storage, the warning signs and or fencing should be installed where the depth exceeds 600 mm or adjacent to pedestrian traffic areas.
{ }	3.5.3.11	The design has taken into consideration the following factors:
{ }		- The Gross Pollutant Trap is installed before the inlet point of OSD.
{ }		- The bottom slope of OSD must be at min of 2%.
{ }		- Bed surface slope towards the outlet is 1.5%,
{ }		- The side slopes should be 1V to 5H.
{ }		- Ventilation must be provided for underground storage.
{ }		- Access openings must be provided for maintenance.
{ }		- Inlet chamber and outlet chamber must be provided.
{ }		- Appropriate screen must be provided at inlet chamber and outlet.
{ }	3.5.3.12	All walls, kerbs or crests proposed for the OSD are indicated along with their respective levels. (eg top of wall level).
{ }	3.5.3.13	Retaining walls forming above ground storage basin/s are of watertight construction (ie: Masonry/Brick) and a typical section detail is provided.
{ }	3.5.3.14	Finished surface levels are indicated within all courtyards/driveways/detention storage areas.
{ }	3.5.3.15	A minimum grade of 1% has been provided on the base of the above ground detention basin located in landscaped/turfed areas and to direct flows to a grated collection pit.
{ }	3.5.3.16	Sub-soil drainage is indicated within above ground detention basins located in landscaped areas. (Note:- Subsoil drainage shall connect to the collection pits of the detention basin).
{ }	3.5.3.17	Finished ground floor levels of buildings and garages should be 300mm and 100mm respectively or more above the top of water level of the OSD
{ }	3.5.3.18	For underground storage, heavy access cover must be avoided to allow easy inspection of the critical parts of the storage from the surface. Concrete cover is not advisable. Opening must be wide enough to allow easy entry to the storage, minimum 600 x 600 (storages up to 600mm deep) and minimum 900 x 900 (storage greater than 600mm deep).

Consultant's Initial Submission	Items	SUBMISSION REQUIREMENTS	DID Remarks
{ }	3.5.3.19	Step irons or access ladders shall be installed where the depth of a below-ground storage or DCP is 1200 mm or greater.	
{ }	3.5.3.20	Satisfactory access is provided within the front setback area and/or rear courtyard into the detention storage area/s with maximum 1 in 4 batters or steps.	
{ }	3.5.3.21	Include final details.	
	3.5.4	Gross Pollutant Traps (GPTs) (Stormwater Quality Control)	
{ }	3.5.4.1	Gross Pollutant Traps (GPTs) shall be located at the downstream end of drains or engineered waterways which discharge to rivers, to reduce sediment load, litter, nutrients, oil and chemicals.	
{ }	3.5.4.2	GPTs shall be located as the pretreatment for flow into a pond or wetland or urban lakes to confine the area of deposition of coarse sediments.	
{ }	3.5.4.3	GPTs shall be located before the flow enters an infiltration device or filtration device to remove coarse sediment.	
{ }	3.5.4.4	The GPT must be designed so as to prevent any additional flow surcharge in the stormwater system in the event of partial or complete blockage.	
{ }	3.5.4.5	GPTs shall be designed to retain all litter and debris in the water quality design storm of 3 month ARI.	
{ }	3.5.4.6	Adequate provision for road access to the site by maintenance vehicles and equipment must be made. Suitable walkways, ladders and plinths shall be provided within the structure for access.	
{ }	3.5.4.7	The 'SBTR' trap if provided shall conform to the following:	
{ }		– The ratio length: width of the sediment trap should be between 2 and 3.	
{ }		– Velocity through the sediment trap should not exceed 1.0 m/second, to minimise re-suspension.	
{ }		– Bar spacing shall be capable of retaining a small plastic bottle or an aluminium drink can, with a maximum clear spacing of 50 mm between bars;	
{ }		– Trash racks shall be sized to operate effectively whilst passing the design flow without overtopping and with 50% blockage;	
{ }		– Trash racks shall be structurally stable when overtopped by flood events up to the major design storm when fully blocked;	
{ }		– Trash racks and their supporting structures shall be designed to withstand log impact together with drag loads or debris loads (100% blocked); and	
{ }		– The design must allow water to flow past or over the trash rack when the trash rack is blocked.	
{ }	3.5.4.8	Calculation of the average annual sediment loading estimate from the catchment is shown for the sizing of the trap	
{ }	3.5.4.9	Include all calculations necessary to demonstrate that the practice performs to the standard stated in MSMA.	
{ }	3.5.4.10	Include final details.	

Consultant's
Initial
Submission

Items

SUBMISSION REQUIREMENTS

DID
Remarks

3.5.5 Filtration (Stormwater Quality Control)

- { } 3.5.5.1 The types of stormwater quality filtration BMPs proposed for the site are;
- { } – Biofiltration swales
 - { } – Vegetated filter strips
 - { } – Media filtration
- { } 3.5.5.2 Biofiltration swales and vegetated filter strips (if applicable) are to be designed to treat the 3 month design storm of runoff from drainage area.
- { } 3.5.5.3 Drainage area and the peak discharge calculations for the water quality storm (3 month ARI) and 10 yr storms ARI for conveyance design shall be included.

Biofiltration Swales

- { } 3.5.5.4 The velocity of water shall not exceed 0.5 m/s along a swale of 60 m in length during the water quality design storm (3 month ARI).
- { } 3.5.5.5 The capacity design for biofiltration swale on the vegetation height equal to the design flow depth and the 3 month ARI design storm.
- { } 3.5.5.6 Swales shall be designed to accommodate flood passage of 10 years ARI, plus 300 mm freeboard. Runoff from large events will bypass the swale.
- { } 3.5.5.7 Swales with trapezoidal cross-section shall be recommended for ease of construction. Side slope shall not be steeper than 3H:1V while side slope 4:1 is recommended for safety reason.
- { } 3.5.5.8 Swales are recommended to have a minimum length of 60 m. If a shorter length must be used, increase swale cross-sectional area by an amount proportional to the reduction in length below 60 m, to obtain the same water residence time (minimum residence time is 2 minutes).
- { } 3.5.5.9 Swales must have longitudinal slope of at least 2% but no greater than 4% (underdrains required for slopes below 2% and rock check dams for slopes above 4%).
- { } 3.5.5.10 Below the design water depth, install an erosion control blanket, at least 100 mm of topsoil and the selected biofiltration seed mix.
- { } 3.5.5.11 Include biofiltration design calculations for the water quality storm (3 month ARI), and capacity check calculations for the 10 yr storm.
- { } 3.5.5.12 Include all calculations necessary to demonstrate that the practice performs to the standard stated in MSMA.
- { } 3.5.5.13 Include final cross-sectional details for all swales and plan layout.

Vegetated Filter Strip Design

- { } 3.5.5.14 Vegetated Filter Strips are more suitable for small, less intensely developed sites.
- { } 3.5.5.15 The minimum residence time for water quality treatment in the strip is about 5 minutes for peak flows of 3 month ARI.
- { } 3.5.5.16 The necessary length (parallel to flow) to produce a water residence time should be at least 5 minutes. The maximum drainage flowpath is 50 m and the flow depth of less than 25 mm for water quality purposes.

Consultant's
Initial
Submission

Items

SUBMISSION REQUIREMENTS

DID
Remarks

- | | | |
|-----|----------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| { } | 3.5.5.17 | Vegetated filter strips should not be used for slopes in excess of 10%. 100 mm of good quality topsoil is required on all the filter strip areas, to help develop a good ground cover. |
| { } | 3.5.5.18 | Include all calculations necessary to demonstrate that the practice performs to the standard stated in MSMA. |
| { } | 3.5.5.19 | Include final cross-sectional details and plan layout. |
| | 3.5.6 | Infiltration (Stormwater Quality Control) |
| { } | 3.5.6.1 | The stormwater quality infiltration BMPs proposed for the site are; |
| { } | | – Infiltration Trench |
| { } | | – Infiltration Basin |
| { } | | – Porous Pavement |
| { } | 3.5.6.2 | The design for stormwater runoff quality treatment to capture 3 month ARI design storm of runoff from the drainage area. |
| { } | 3.5.6.3 | Contributing drainage areas are shown and calculation is provided to present peak discharge computation for the water quality storm of 3 month ARI and 10 yr storms ARI for conveyance design. |
| { } | 3.5.6.4 | Soil bore log is shown to demonstrate infiltration characteristics of each of the proposed infiltration facility. Each soils log should extend a minimum of 3m below the bottom of the facility. |
| { } | 3.5.6.5 | Pre-treatment BMPs, such as grassed swales leading to the infiltration facility are recommended to remove coarse particulate contaminants and to reduce excessive pollutants entering the facilities. |
| { } | 3.5.6.6 | Stormwater runoff must infiltrate through at least 400 mm of soil which has a minimum infiltration rate (f_c) of 13 mm/hr. |
| { } | 3.5.6.7 | Soils with 30% or greater clay content or 40% greater silt/clay content shall not be used. |
| { } | 3.5.6.8 | The infiltration facilities shall be designed to drain completely within 48 hrs. |
| { } | 3.5.6.9 | Seasonally high groundwater elevation shall be at least 1.5m below the bottom of the facility. |
| { } | 3.5.6.10 | Infiltration facilities should be situated at least 7m downslope and 50m from building foundations. |
| { } | 3.5.6.11 | All basins should be located at minimum distance of 20m from any slope greater than 15%. |
| { } | 3.5.6.12 | Infiltration facilities shall not be installed on or at the top of slopes having natural angle of inclination exceeding 15% or in fill material |
| { } | 3.5.6.13 | Infiltration BMPs shall be limited in their ability to accept flows from larger drainage areas. The following drainage area limitations will be applied: |
| { } | | – Dispersion trenches, maximum of 500 m ² |
| { } | | – Infiltration sumps, maximum of 500 m ² |
| { } | | – Infiltration trenches, maximum of 4 hectares |
| { } | | – Infiltration basins, maximum of 15 hectares |
| { } | | – Pavement, maximum of 4 hectares. |
| { } | 3.5.6.14 | Inflow to infiltration facility, other than roof downspout systems, must first pass through a pre-treatment BMP in order to minimise the suspended solid load and prevent siltation of the infiltration facility. |
| { } | 3.5.6.15 | Final construction of infiltration facilities shall not be done until after other site construction has finished and the site has been properly stabilised with permanent erosion control practices. |

Consultant's Initial Submission	Items	SUBMISSION REQUIREMENTS	DID Remarks
{ }	3.5.6.16	The aggregate material (for trench) shall consist of a clean aggregate with a maximum diameter of 70mm and a min. diameter of 30mm.	
{ }	3.5.6.17	An overflow structure must be provided in the event that the facilities capacity is exceeded.	
{ }	3.5.6.18	Infiltration facilities shall be provided surface inlet and observation well.	
{ }	3.5.6.19	The bottom slope of bottom infiltration beds shall not exceed 5%.	
{ }	3.5.6.20	Include all calculations necessary to demonstrate that the practice performs to the standard stated in MSMA.	
{ }	3.5.6.21	Include final details.	
	4	MINIMUM REQUIREMENTS FOR FINAL DRAINAGE AND STORMWATER MANAGEMENT PLAN	
	4.1	General	
{ }	4.1.1	Location plan shall include a North Point indicator and the names of a minimum of two roads leading to the site.	
{ }	4.1.2	A copy of the approved layout plan together with copy of the planning permission shall be submitted.	
{ }	4.1.3	Proposed finished site levels on topographic plan with contours at intervals of 2 meters for gradients greater than 1:2 and there under, at intervals of 3 meters.	
{ }	4.1.4	A key plan showing the contour together with proposed layout and all existing natural watercourse and proposed main drains shall be submitted.	
{ }	4.1.5	The topographic plans shall include existing drainage patterns and flowpaths (together with flow direction) throughout the site with their catchment boundary and catchment area in Ha.	
{ }	4.1.6	If the site is located nearby to existing river and/or affected by flood, show the existing 100 year flood plain, maximum water level, flow regulating structures such as bridges, culverts, gates, etc. and the stormwater pollution issues all in the topographic plan.	
{ }	4.1.7	Drawings of the proposal shall be submitted to show project location and layout plan, relevant longitudinal and cross-section and details.	
{ }	4.1.8	A suitable index or key plan showing the reference sheet no for each portion of the development area shall be provided if the various portions of layout are shown on separate drawings.	
{ }	4.1.9	Structural details, if any, shall be indicated on separate drawings as these are submitted for record purposes only.	
{ }	4.1.10	Drawings shall not be bound together. All drawings submitted shall be neatly folded to A4 size, the title block on the front face and in a manner where the drawings can be opened from left to right.	
{ }	4.1.11	Title block shall be provided at the bottom right hand corner of all drawings and properly completed. Title of drawings must indicate the exact nature of works for which approval is sought. There should be a margin of at least 50mm all round the drawing.	
{ }	4.1.12	All drawings submitted must bear the signature of the submitting Engineer/Architect/Surveyor with his full name, address and relevant professional qualifications.	
{ }	4.1.13	All documents submitted for approval shall be certified by the submitting Engineer as following; "I hereby certify that these works have been designed by me in	

Consultant's
Initial
Submission

Items

SUBMISSION REQUIREMENTS

DID
Remarks

		accordance with sound engineering practice and that I take full responsibility for the design and proper performance of the same."
{ }	4.1.14	All drawings must be countersigned by the owner. The full name and address of the owner must be indicated.
{ }	4.1.15	Adequate empty space shall be allowed on all drawings for the Approval stamp.
{ }	4.1.16	Provide the drainage and stormwater management masterplan which clearly shows the location and sizes of proposed main drains and their outlets and other drainage and stormwater facilities such as swales, waterways, detention/retention pond, sediment forebay, wetlands, GPTs, wet/dry ponds, culvert, manhole, sediment trap, etc. and their respective reserves where applicable.
	4.1.17	Drawings must be suitably coloured as follows:
{ }		Proposed drains Red double continuous lines
{ }		Invert levels of proposed drains Red continuous lines
{ }		Proposed culverts Red double broken lines
{ }		Type and size of proposed culverts Red letters and figures
{ }		Proposed carriageway Grey
{ }		Footpath Pink
{ }		Green buffer zone Green
{ }		Kerbs Orange
{ }		Guard rails and crash barriers Brown
{ }		Existing drains Blue double continuous lines
{ }		Existing culverts Blue double broken lines
{ }		Proposed levels, invert, levels, drains sizes, etc. Mark in Red
{ }		Existing levels, invert levels, type of drains and sizes etc. Mark in Blue
{ }	4.1.18	Direction of flow in drains and culverts Indicate by arrows.
	4.1.19	Plan shall comprise of the following scales of;
{ }		– Location plan (1:1000)
{ }		– Site and layout plan (1:1000)
{ }		– Longitudinal section; Horizontal (1:1000), Vertical (1:100)
{ }		– Cross- section and other details (1:100).
{ }	4.1.20	The plans shall show the calculated pre-development peak discharges, post-development peak discharges, proposed drainage carrying capacity, regulated flows after controls at proposed control structures and at proposed drainage outlet points, and the existing carrying capacity of existing receiving water at outside project area.

Consultant's
Initial
Submission

Items

SUBMISSION REQUIREMENTS

DID
Remarks

Consultant's Initial Submission	Items		DID Remarks
	4.2	Drainage and Conveyance System Plans	
{ }	4.2.1	The catchment area draining into each watercourse or drain shall be clearly indicated in the drawing.	
{ }	4.2.2	Show the drainage divides and flow directions for each drainage area for post-development and show the changes resulting from grading. Include a contour plan of the finished grades at an appropriate scale (1:2000).	
{ }	4.2.3	Detail plans longitudinal and cross-section of the proposed drainage system shall be included.	
{ }	4.2.4	Longitudinal sections taken along centre lines of drainage shall be submitted to indicate: <ul style="list-style-type: none">– Reference marks as in site plan to indicate line along which the section is taken.– Existing ground profile to be indicated in broken lines. .– All proposed and existing drains including invert levels and gradients.– Water level profile for storms of designed ARI	
{ }	4.2.5	Location and dimensions of proposed and existing culverts shall be shown in the layout plan.	
{ }	4.2.6	Separate detailed plans shall be submitted to show: <ul style="list-style-type: none">– Typical proposed drain section inclusive of dimensions.– Typical sections of proposed roadside drains inclusive of manner of haunching, type of drainside wall, dimensions and finishes.– Details of precast concrete drain covers and/or m.s. gratings, if any.– Cross-sections and longitudinal sections of proposed culverts including dimensions, manner of haunching and gradients.– Typical sumps proposed.– Dimensions and details of scupper drains proposed.– Typical sections and dimensions of kerbs proposed.– Typical details of guard rails and crash barriers where relevant,– Typical entrance culvert and driveway detail.– Typical detail of pre-cast concrete slab for proposed footpath.– Details of proposed cascading drains where relevant.	
{ }	4.2.7	The points of entry and the invert levels of all incoming drains at the points of connection into the main drain shall be indicated in the longitudinal section of the main drain.	
{ }	4.2.8	The top water level of the incoming drains shall not be lower than those of the receiving drains at the points of discharge.	
{ }	4.2.9	Details of all existing outlets to which the proposed drains are to be connected shall be shown and where the capacities of these drains are not adequate to cope with the increased runoff, detail proposals for improving such outlets shall be included.	
{ }	4.2.10	All main drains shall have a free board of not less than 300mm above the TWL of the respective drain.	
{ }	4.2.11	All drains shall be connected in the general direction of flow with proper transition curves provided. Where more than two drains meets at a junction, the flow path of each shall be such as to provide a smooth transition.	
{ }	4.2.12	The soffit level of culverts shall not be lower than the TWL of the open drain downstream and upstream of it.	

Consultant's
Initial
Submission

Items

SUBMISSION REQUIREMENTS

DID
Remarks

{ }	4.2.13	All proposed stone pitching shall be provided with concrete capping of not less 450mm wide.
{ }	4.2.14	All open drains with depths exceeding 1.2m shall be provided with steps recessed into the side of the drain at 50m intervals for maintenance purposes.
{ }	4.2.15	All sumps or manholes shall be provided with concrete benching. All such manhole covers shall be of H.D. cast iron.
{ }	4.2.16	Steps of step irons shall be provided to the top of benching and toe holes provided in the benching.
{ }	4.2.17	Drain cross sections shall also show the minimum drain reserve.
{ }	4.2.18	Drainage reserve shown parallel to the road should not encroach onto the road reserve otherwise culverts shall be provided instead of open channels.
{ }	4.2.19	Guard rails/fence is to be provided to main drains that are sited close to carriageway and housing lots.
{ }	4.2.20	Detail plans showing proposals for connections of the main drains into the river shall be provided.
	4.3	Wet/Dry Pond Plans
{ }	4.3.1	The catchment area draining into proposed pond shall be clearly indicated.
{ }	4.3.2	Detail of layouts plan, longitudinal and cross-section of the proposed pond system shall be shown.
{ }	4.3.3	Detail of layout plan shall includes;
{ }		– Existing and proposed contours (0.5m intervals).
{ }		– Location of soil test borings, with seasonally high ground water elevation specified.
{ }		– Inflow and outflow channel/pipes with invert elevations, outlet channel and erosion/scour protection
{ }		– Emergency spillway and its outlet channel
{ }		– Sediment forebay area (wet pond only)
{ }		– Sloped bench, 3m wide, 0.3m above the permanent pool (wet pond only)
{ }		– Level bench 3m wide, 0.3m below the permanent pool (wet pond only) along the pond rim.
{ }	4.3.4	Cross section of the dam through the principal spillway shall be shown together with elevations for all elements in the cross section comprising:
{ }		– Existing ground.
{ }		– Proposed ground (slopes no steeper than 3:1 inside, 3:1 outside, top width at least 4m).
{ }		– Cutoff trench (bottom width and depth at least 1.5m; side slopes not steeper than 1:1)
{ }		– Impervious core top width, material, side slope and height (at least = 50 yr flood level).
{ }		– Outlet structure (size and elevation of all openings, trash rack, anti-vortex device, structural detail of the outfall and its foundation. Include all details with dimensions, elevations, and material specs)

Consultant's
Initial
Submission

Items

SUBMISSION REQUIREMENTS

DID
Remarks

{ }		- Pipe (specify inside diameter, material, length, slope and water tight couplings)
{ }		- Phreatic line (start at the permanent pool elevation for wet pond or the 5 yr flood level for dry ponds and follow a 4:1 slope, label the saturated length)
{ }		- Anti-Seep Collars (provide details and specify material, size, spacing and location on pipe)
{ }		- Bedding for concrete pipe (include detail)
{ }		- Emergency spillway (crest at least 1m below top of dam and 0.3m above top of the riser)
{ }		- Outlet protection. Provide plan and cross-sectional detail
{ }		- Top of the dam (must be at least 0.3m above the 100 year D.H.W.) constructed and design (constructed = design + 5% for settlement)
{ }		- Water surface elevation for permanent pool and all design storms
{ }		- Inlet and outlet inverts of all channel/pipes
{ }		- Means to drain the permanent pool
{ }		- Reverse slope and level benches (at least 3m wide)
{ }	4.3.5	Profile of the emergency spillway shall be shown to include:
{ }		- Existing ground
{ }		- Inlet Control Level and outlet sections
{ }		- Length and slope of the outlet channel
{ }		- Details for structural spillway shall be shown if emergency spillway is located at earth fill area
{ }	4.3.6	Cross section of the dam through the centerline shall be shown to include:
{ }		- Existing and proposed ground
{ }		- Type of soil to be used in dam, core and cut off trench
{ }		- Top of the dam, constructed and settled
{ }		- Location of emergency spillway
{ }		- Top of the impervious core and bottom of the cut off trench.
{ }	4.3.7	Methods of achieving adequate compaction for construction of dams shall be shown to include:
{ }		- Lift thickness
{ }		- Degree of compaction
{ }		- Method for compaction.
{ }	4.3.8	Sediment disposal area shall be shown to include:
{ }		- Area per proposed design
{ }		- Depth (maximum 0.3m)
{ }		- Slope (maximum 5%).

Consultant's
Initial
Submission

SUBMISSION REQUIREMENTS

DID
Remarks

Consultant's Initial Submission	Items		DID Remarks
	4.4	Onsite Detention (OSD) Plans	
{ }	4.4.1	Detailed OSD Drawing at a scale of 1:100 shall be provided (where development site size, excluding section details, requires more than two A1 drawing sheets at 1:100 scale, the drawing may be reduced in scale to 1:200).	
{ }	4.4.2	Site layout on the stormwater and OSD drawing shall correspond with, and compliment, Architectural and Landscape Drawings.	
{ }	4.4.3	All stormwater pipes shall be clearly shown, ie thicker linetype, from downpipes and pits to the outlet connection point into drainage system/kerb & gutter.	
{ }	4.4.4	The site stormwater connection point into drainage system/kerb & gutter shall be indicated on the drawing along with its invert level.	
{ }	4.4.5	All pipe sizes and grades are to be indicated adjacent to all pipes proposed on the site.	
{ }	4.4.6	All pit sizes, surface and invert levels are to be indicated adjacent to all pits proposed on the site. (Note :- minimum pit size 450mm x 450mm).	
{ }	4.4.7	All walls, kerbs or crests proposed on the site are to be indicated along with their respective levels. (eg top of wall level).	
{ }	4.4.8	Finished surface levels are to be indicated within all courtyards/driveways/ detention storage areas.	
{ }	4.4.9	A 1.2m high pool type fence/suitable barrier or railing shall be provided where a vertical drop into an above ground basin exceeds 500mm.	
{ }	4.4.10	All services within the site and footpath area are to be accurately indicated on the stormwater and OSD drawing.	
{ }	4.4.11	Detailed cross-section of the discharge control unit/below ground tank shall be shown.	
{ }	4.4.12	Typical section detail of a surface inlet pit shall be provided.	
{ }	4.4.13	A minimum grade of 1% shall be provided on the base of the above ground detention basin located in landscaped/turfed areas to a grated collection pit.	
{ }	4.4.14	Sub-soil drainage is to be indicated within above ground detention basins located in landscaped areas. (Note :- Subsoil drainage shall connect to the collection pits of the detention basin)	
{ }	4.4.15	Areas of the site that by-pass the detention system/s are to be clearly delineated on the Hydraulic Drawing.	
{ }	4.4.16	Satisfactory access is to be provided within the front setback area and/or rear courtyard into the detention storage area/s with maximum 1 in 4 batters or steps.	

Consultant's
Initial
Submission

SUBMISSION REQUIREMENTS

DID
Remarks

	4.5	Gross Pollutant Traps (GPTs) Plans
{ }	4.5.1	Adequate provision for road access to the site by maintenance vehicles and equipment must be made. Suitable walkways, ladders and plinths shall be provided within the structure for access.
{ }	4.5.2	The 'SBTR' trap relies on reducing the flow velocity sufficiently to allow settling by gravity. These principles apply to both Type SBTR-1 (major) and SBTR-2 (minor) traps;
{ }		– The ratio length: width of the sediment trap should be between 2 and 3.
{ }		– Bar spacing shall be capable of retaining a small plastic bottle or an aluminium drink can, with a maximum clear spacing of 50 mm between bars;
{ }		– The design must allow water to flow past or over the trash rack when the trash rack is blocked.
{ }	4.5.3	Include final details.
	4.6	Filtration Plans
{ }	4.6.1	Biofiltration Swales
{ }		– Existing and proposed contours at 0.2m intervals
{ }		– Inlet protection detail
{ }		– Locations and details for underdrains if slope is less than 2%, locations and details of rock check dams if slope is greater than 4%
{ }		– Vegetative specification per the Horner Publication
{ }	4.6.2	Sand Filters
{ }		– All necessary details and cross-sections
{ }	4.6.3	Other Filtration practices
{ }		– All details necessary to clearly demonstrate what is proposed.
	4.7	Infiltration Plans
{ }	4.7.1	Length, width and depth.
{ }	4.7.2	Specify type and location of geotextile.
{ }	4.7.3	Detail of surface inlet and observation well.
{ }	4.7.4	Cross-sectional detail.
{ }	4.7.5	Suspended solids filter shall accompany the practice, vegetative filters must be at least 5m in length.
{ }	4.7.6	Areas draining to the practice are stabilized and vegetative filters are established prior to runoff entering the system
{ }	4.7.7	Practices deeper than 1m shall be located at least 5m from basement walls.
{ }	4.7.8	Infiltration practice designed to handle parking lot runoff shall be located at least 50m from any public or private drinking water supply wells.
{ }	4.7.9	Details of the overflow system, including provisions to impede erosion along its length and at the outfall.

Consultant's
Initial
Submission

Items

SUBMISSION REQUIREMENTS

DID
Remarks

{ }	4.7.10	Location of soil boring, descriptive bore log, specify infiltration rate (at least 30 mm/hr), specify seasonally high groundwater elevation (at least 1m below practice).
{ }	4.7.11	Slope of bottom of the practice shall not exceed 5%.
{ }	4.7.12	Infiltration practices shall not be installed on or atop a slope whose natural angle of inclination exceeds 20% or in fill material.

ADDITIONAL REQUIREMENTS

COMMENTS

ANNEX C
SUBMISSION OF PLANS FOR EROSION AND SEDIMENT CONTROL –
REVIEW CHECKLIST

ANNEX C

SUBMISSION OF PLANS FOR EROSION AND SEDIMENT
CONTROL – REVIEW CHECKLIST

EROSION AND SEDIMENT CONTROL PLAN SUBMISSION

To:

JABATAN PENGAIRAN DAN SALIRAN

.....
.....
.....
.....

I hereby certify that the details in the plan(s), viz

On Lot (s)

Section

Jalan

Land Title No.

for

are in accordance with the Urban Stormwater Management Manual for Malaysia and I accept full responsibility accordingly.

I herewith enclosed the following:

- | | | |
|----|-----------------------------------------------|-----|
| 1. | Relevant Site Plans | { } |
| 2. | Engineering Drawings | { } |
| 3. | Stormwater Management Report and Calculations | { } |
| 4. | Submittal Checklist | { } |

Signature:

Professional Engineer (M) and Seal

Name:

Address:

Registration No:

**EROSION AND SEDIMENT CONTROL PLANS SUBMISSION
REVIEW CHECKLIST**

Project Title: _____ Engineering Firm: _____

Property Address: _____ Address: _____

Land Title No: _____ Phone No: _____

Contact Person: _____

DID USE ONLY
Submittal Date: _____ Review Date & Initials: _____
Submission Acceptable/Approval/ Rejected Date: _____ Approved/Rejected by: _____

- Legend:**
{ / } Complete
{ x } Incomplete/Incorrect
{ na } Not Applicable

This checklist has been developed to provide specific instructions to engineers. The purpose of this checklist is to expedite and facilitate the review process. This checklist gives the minimum requirements needed for review. All items are expected to be addressed in the first submittal, unless indicated otherwise. All items shall be checked as included or marked NA. Failure to do so will result in rejection of the submittal without review. Consultant shall review the entire check list, prior to first submittal, and check the box in the left-hand column ("Consultant's Initial Submission") to indicate compliance. Consultant must sign the first page.

TO THE CONSULTANT

Your submission for Landuse Conversion and/or Land Subdivision approval has been reviewed. The review was made per the following checklist. Please return the checklist and Plans comment sheets with your resubmittal. If you do not address a checklist item, including comments on the plan sheets, explain your reasoning.

I, the undersigned, acknowledge by signature that these documents meet or exceed the design standards of the Department of Irrigation and Drainage Malaysia and that they were prepared under my supervision. I, the undersigned, further acknowledge that to the best of my knowledge and belief, the products resulting from these documents will function as intended.

Consultant's Signature

Professional Seal

Date

Title

Company Name

Consultant's
Initial
Submission

SUBMISSION REQUIREMENTS

DID
Remarks

Consultant's Initial Submission	Items		DID Remarks
	1	GENERAL	
{ }	1.1	Name of proposed project development and address.	
{ }	1.2	Name of developer with address, and telephone number on first sheet.	
{ }	1.3	Name, address and telephone number of engineering firm or individual who prepared the plans.	
{ }	1.4	Seal, signature and license number of a Malaysian Professional Engineer on all sheets.	
{ }	1.5	Name and signature of License Surveyor on plans prepared by the surveyor.	
	2	SITE PLANS MINIMUM REQUIREMENTS	
{ }	2.1	Location plan with appropriate scale. A map showing the general location of the project and the state boundary where the project is located.	
{ }	2.2	Key plan with 1:50,000 scale showing the general vicinity of the project within 10 km radius and the river/main drain catchment.	
{ }	2.3	Site plan with 1:3,000 or 1:6,000 scale showing the lot to be developed and the surrounding lots showing existing developments if any, standard syit no, name of Mukim, district, rivers and streams, roads and infrastructure for rivers and drains.	
{ }	2.4	Topography Survey plan 1:500 or 1:1000 scale. The survey should be based on Ordinance Survey Datum and the datum (Bench Mark or Temporary Bench Mark) must be clearly shown. The contour line shall be at 0.5 m interval and site spot levels not more than 10m distance. (with extensions into adjoining properties to cover additional distance of 30 m for development < 10 hectares; 50m for development 10 - 50 hectares; 100 m for development > 50 hectares).	
{ }	2.5	Proposed layout plan 1:500 or 1:1000 scale showing the proposed main drain reserves, existing outlet drain/river reserve (if applicable) .	
{ }	2.6	A similar plan as per item 2.5 but superimposed with existing topography survey.	
{ }	2.7	Plans of the river/main drains if the land is crossed by the river/main drain. The plan comprises Cross-section Survey at every 20m intervals (at scale of 1:100 vertical, 1:100 horizontal) and Longitudinal Survey (at scale of 1:100 vertical, 1:1,000 horizontal) The survey should extend up to at least 150m at upstream and downstream of the lot boundary.	
{ }	2.8	Hydrographic survey of existing pond/lakes/sea if applicable (1:500 or 1:1000 scale) with spots level at 10m interval	
{ }	2.9	All plans submission shall be in hardcopy and digital format in RSO or CASSINI coordinate.	

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Initial
Submission

Items

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DID
Remarks

3 **EROSION AND SEDIMENT CONTROL PLAN (ESCP) REPORT MINIMUM REQUIREMENTS**

{ }

A loose leaf binder containing the erosion and sediment control report. The report shall include the minimum coverage of the following information:

3.1 **Project Location and Site Descriptions**

A ***Report Requirements;***

{ }

3.1.1 Description of the location of the proposed development. Include legal description of the site and a reference to adjacent properties and landmarks.

{ }

3.1.2 Description of the site such as

{ }

– general topography (slopes and slope lengths within the site)

{ }

– vegetation

{ }

– extent and nature of development

{ }

– drainage patterns

{ }

– critical areas within and in the vicinity of the proposed development site that have potential for serious stormwater problems

{ }

3.1.3 Identification of neighbouring features that might be affected by the land disturbance. Examples of these features are streams, lakes, residential and commercial areas, reserves, parks and roads.

{ }

3.1.4 Identification of existing drainage (pre-development) patterns and flowpaths (together with flow direction) throughout the site with their catchment boundary and catchment area in Ha.

{ }

3.1.5 Description of site soil characteristics (soil names, erodibility, permeability, depth, texture, and hydrologic group of each soil).

B ***Mapping Requirements***

{ }

3.1.6 Provide location plan showing:

{ }

- legal land description; and

{ }

- adjacent properties (streams, lakes, residential and commercial areas, reserves, parks and roadways).

{ }

3.1.7 Show the kinds of development on adjacent properties.

{ }

3.1.8 Provide the plan showing the river basin boundary where the project is located.

{ }

3.1.9 Provide land survey plan showing

{ }

– existing topography showing contours of the site

{ }

– existing drainage pattern and flowpaths (together with flow direction) through out the site

{ }

– any other main features such as drains, culverts, bridges, building, roads, lakes, ponds, or any others services with their invert level and soffit levels in detail.

Consultant's
Initial
Submission
{ }

Items

SUBMISSION REQUIREMENTS

DID
Remarks

- { } 3.1.10 Describe the areas that have the potential to present erosion or water quality problems due to the land disturbance from the proposed site. Show critical areas within or near the development such as:
- { } - Public Water Supply / Raw Water Intake
 - { } - Reservoir
 - { } - Swimming Beach
 - { } - Recreational/Tourism area
 - { } - Flood prone area
 - { } - Fishing area/aquaculture
 - { } - Mangrove Land Forest

3.2 Proposed Project Development

A *Report Requirements;*

- { } 3.2.1 The total project area that will be developed in Ha.
- { } 3.2.2 Provide a general description of the proposed development, which should include the breakdown details of project components, the development area in Ha of each component and percentage to total development area.
- { } 3.2.3 The proposed project implementation periods and stages/phases of project development with timing and duration.
- { } 3.2.4 Indicate the area and amount of grading volume that were proposed for each stage/phase.
- { } 3.2.5 Describe the permanent stormwater management system and the use of these facilities for sediment control during the construction period.

B *Mapping Requirements*

- { } 3.2.6 Show the boundary of each project component, the area in Ha and their project development stages/phases.
- { } 3.2.7 Show the limits of clearing and grading for each phase of the development. Each boundary line should be identified as to the timing and duration of disturbances.
- { } 3.2.8 Proposed layout plan with 1:500 or 1:1000 scale which clearly shows the proposed main drain reserve, outlet drain reserve and river reserve (if applicable).
- { } 3.2.9 Proposed layout plan of 1:500 or 1:1000 scale superimposed with topography survey details.
- { } 3.2.10 Show the drainage divides and flow directions for each drainage area after the development and show the changes resulting from grading. Include a contour plan of the finished grades using an appropriate scale (1:2000).
- { } 3.2.11 Indicate the location and sizes of permanent storm drain inlets, pipes, outlets and other permanent drainage facilities such as swales, waterways, detention ponds, etc.

Consultant's
Initial
Submission

Items

SUBMISSION REQUIREMENTS

DID
Remarks

3.3 Erosion and Sediment Controls

A *Report Requirements;*

- { } 3.3.1 Determine runoff quantities for pre-development and during construction stage for 3 and 6 months ARI (ie 40 mm and 50 mm rainfall depth for water quality control facilities) and 1, 2 and 10 year ARI (for water quantity control structure and erosion/scour protection).
- { } 3.3.2 The design flows for the water quality facilities within the construction site shall be based on the following criteria;
- { } – 3 month ARI (ie 40 mm rainfall depth to capture and detain at least 90% of 24 hours storm events runoff volume) for construction projects that will take 2 years or less to complete
- { } – 6 month ARI (ie 50 mm rainfall depth to capture and detain at least 95% of 24 hours storm events runoff volume) for construction projects that will take longer than 2 years to complete.
- { } 3.3.3 Each drainage area before and after development must be shown together with the respective dividing lines, sizes in ha, and the direction of flow.
- { } 3.3.4 The development schedule must be clearly defined, the completion date for each phase of development shall be indicated and a detailed sequence of construction must be documented.
- { } 3.3.5 Identification of critical areas; areas which have the potential to present serious erosion and sedimentation within the site, during pre-bulk grading stage and post-bulk grading stage.
- { } 3.3.6 Erosion and Sediment Control Plans (ESCP) shall be developed for pre-bulk grading stage and post-bulk grading stage.
- { } 3.3.7 Pre-Bulk Grading Plan shall include;
- { } – Grading phasing.
- { } – Quantity cuts and fills.
- { } – Specify where excess cut is to be stockpiled and where additional fill is to be obtained.
- { } – Plan shall be based on existing topography (based on appropriate datum) and shall not show the proposed development.
- { } – Perimeter controls based on existing drainage pattern of the site.
- { } – Delineation of drainage areas for controls.
- { } – Identify areas for soil stockpiles. Locate stockpiles on areas with little or no slope. Stockpiles must be surrounded by silt fence or other suitable sediment control practice.
- { } – Identify areas from where material required to construct perimeter controls will be obtained (include sediment controls for these areas as necessary).
- { } – Delineate areas intended for infiltration to ensure that such areas are not compacted during construction.
- { } 3.3.8 Post-Bulk Grading Plan shall include;
- { } – Proposed contours (based on appropriate datum) and proposed project development.
- { } – Project development phasing.
- { } – Modified and/or new sediment controls based on proposed drainage patterns.

Consultant's Initial Submission	Items	SUBMISSION REQUIREMENTS	DID Remarks
{ }	3.3.9	Transition from pre-bulk grading controls to post-bulk grading controls shall be consistent with the specified phasing of the project and reflected in the construction sequence.	
{ }	3.3.10	Existing vegetation shall be maintained as filters along contours to reduce velocity and improve water quality and act as buffers to minimise erosion.	
{ }	3.3.11	Stream buffers shall be retained. For small streams within a development site, the following could be used as a guide:	
{ }		– Intermittent watercourse (slope<15°; 10m and slope>15°; 20m)	
{ }		– Permanent watercourse (slope<15°; 20m and slope>30°; 30m)	
{ }	3.3.12	All excavated topsoil shall be stockpiled and later used for re-vegetation. Describe how such stockpile will be protected during construction and the intentions for final stabilization of such areas.	
{ }	3.3.13	All access roads to the site shall be stabilised and paved for a distance of at least 10 m from where these access roads join the existing paved roads. All vehicles should enter and leave the development site at a limited number of points. The exit points should provide for the washing of vehicles as they leave.	
{ }	3.3.14	Determine a drainage system (diversion channel) so that it does not flow across disturbed and unstable areas.	
{ }	3.3.15	Sediment controls (such as sediment pond or sediment trap) shall be proposed to intercept sediment from disturbed areas prior to release of the flow from the site.	
{ }	3.3.16	For hillside areas, slope drains must be constructed, such drains include berm drains, cascading drains, and sumps at the toes of the cascading drains to reduce the velocity of flow.	
{ }	3.3.17	Adequate velocity reduction control measures (e.g. check dam) are to be provided to reduce the flow velocity to less than 0.6 m/s.	
{ }	3.3.18	Soil stabilization should be the first line of defense and shall be completed within 2 weeks time. Describe how each portion of the site will be stabilized after construction is completed and during construction by using either permanent or temporary soil stabilization (vegetative and non-vegetative measures).	
{ }	3.3.19	Identify temporary and permanent control methods.	
{ }	3.3.20	List down good housekeeping practices.	
{ }	3.3.21	List down the types and scheduling of individual erosion control measures, including <u>interim</u> or <u>short-term</u> measures (less than 45 days duration).	
{ }	3.3.22	The locations of the erosion and sediment control and stormwater management practices to be used on the site must be shown clearly in drawing.	
{ }	3.3.23	Erosion and sediment control practices must be shown using appropriate symbols as illustrated in MSMA.	
{ }	3.3.24	CALCULATIONS used in designing all structural practices must be included.	
{ }	3.3.25	Any structural practices used must be illustrated with detailed drawings and specifications.	

Consultant's
Initial
Submission
{ }

Items

SUBMISSION REQUIREMENTS

DID
Remarks

- { } 3.3.26 Sediment retention facilities shall be installed prior to the grading or disturbance of any contributing area. Allowance must be made for sediment removal.
- { } 3.3.27 Permanent water quality control measures such as ponds can be temporarily used as sediment basins during construction.
- { } 3.3.28 Sediment basins shall be sized in accordance with MSMA to retain a minimum of 70% of coarse sediments greater than or equal to 0.02 mm for all storms of 3 month ARI and 6 month ARI
- { } 3.3.29 Adequate detention storage shall be provided to store the design runoff (3 month ARI and 6 month ARI) from the catchment. No overflow is allowed through the sediment basin for flows less than the design flow.
- { } 3.3.30 The design of sediment trap shall at least comply with the following criteria:
- { } – It is intended for use on small catchment areas which disturbed area less than 2 ha.
 - { } – The trap is a temporary measure with a design life of approximately 6 months.
 - { } – The length to width ratio should be greater than 2:1.
 - { } – The outlet of the trap must be stabilised with rock, vegetation, or another suitable material.
 - { } – The fill material for the embankment must be suitable material and shall be compacted during construction.
 - { } – A stable emergency spillway must be installed to safely convey flows up to and including 10 year ARI.
 - { } – Remove sediment when the sediment storage zone is no more than 300 mm from being full.
- { } 3.3.31 For areas greater than 2 ha, provide sediment basin at every outlet complying with the following criteria;
- { } – An overall particle removal target of 85% has been adopted.
 - { } – Construct before clearing and grading work begins.
 - { } – A stable emergency spillway must be installed to safely convey flows up to and including 10 year ARI.
 - { } – The basin length to settling depth ratio should not be less than 200:1.
 - { } – The basin length to width ratio should be greater than 2:1.
 - { } – Side slopes should not be steeper than 2(H):1(V).
 - { } – Sediment basin shall be capable of trapping smaller sediment particles with sufficient detention time more than 24 hours.
 - { } – The settling zone shall be at least 0.6 m deep to contain runoff and allow suspended sediment to settle.
 - { } – The sediment storage zone shall be at least 0.3 m deep to store settled sediment until the basin is cleaned out. In some cases, basins may be sized to trap sediment for the life of the construction activity.
 - { } – Temporary sediment basins should be kept in service until the works for which they were designed are completed and the contributing catchment has been stabilised.

Consultant's
Initial
Submission
{ }

Items

SUBMISSION REQUIREMENTS

DID
Remarks

- In highly erodible soils, adjust sediment storage volume to equal the 2-month soil loss from the catchment.

3.3.32 Types of Erosion and Sediment Control Measures proposed shall be shown including;

- Scheduling
- Preservation of Existing Vegetation
- Seeding & Planting
- Mulching
- Geotextiles and Mats
- Dust Control
- Temporary Waterway Crossing
- Construction Road Stabilisation
- Construction Access Stabilisation
- Diversion of runoff using earth bank
- Diversion of runoff using diversion channel
- Diversion of runoff using slope drain
- Drainage outlet protection
- Check Dam
- Sediment Fence
- Sand Bag Barrier
- Rock Filter
- Drainage Inlet Protection
- Sediment Traps
- Sediment Basins

Mapping Requirements

3.3.33 Indicate the locations, types and sizes/dimensions of the proposed temporary and permanent erosion and sediment control measures including ponds/sedimentation basins and inlet protection.

3.3.34 Show types, locations and dimensions of erosion and sediment control measures on a plan, for each phase of construction. Provide details of ESC measures as required.

3.3.35 The location and size of each stockpile should be indicated and annotated with the volume and height.

3.3.36 Show the locations and dimensions of silt fences, sedimentation traps/ponds, berms, etc.

3.3.37 Clearly indicate the measures to be maintained during the construction period.

Inspection and Maintenance

Report Requirements;

3.3.38 Provide a schedule of regular inspections and expected repairs of erosion and sediment control devices.

3.3.39 Record changes made to ESC Plan due to changing conditions.

3.3.40 Specify whose responsibility it will be to inspect and perform maintenance, to repair and stabilize erosion and sediment controls practices during construction.

3.3.41 Include the site inspection checklist and inspection log book.

3.3.42 A copy of the maintenance agreement for all erosion and sediment practices must be provided with the plan.

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Initial
Submission

Items

SUBMISSION REQUIREMENTS

DID
Remarks

4 **FINAL EROSION AND SEDIMENT CONTROL PLANS AND DETAILING MINIMUM REQUIREMENTS**

General

- | | | |
|-----|------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| { } | 4.1 | Plan view of the entire site at a reasonable scale (entire site appears on one sheet) showing limits of disturbance, wetlands, floodplains, steep slopes, other environmentally sensitive areas, project phasing, sediment controls by symbols, lot numbers, street addresses, a north arrow and names of adjacent property owners. |
| { } | 4.2 | Location plan shall include a North Point indicator and the names of a minimum of two roads leading to the site. |
| { } | 4.3 | A copy of the approved layout plan together with copy of the planning permission shall be submitted. |
| { } | 4.4 | Proposed finished site levels on topographic plan with contours at intervals of 2 meters for gradients greater than 1:2 and there under, at intervals of 3 meters. |
| { } | 4.5 | A key plan showing the contour together with proposed layout and existing natural watercourse and proposed main drains shall be submitted. |
| { } | 4.6 | The topographic plan should show existing drainage patterns and flow paths (together with flow direction) throughout the site with their catchment boundary and catchment area in Ha. |
| { } | 4.7 | Drawings of proposal including location and layout plan, relevant longitudinal and cross-section and details. |
| { } | 4.8 | A suitable index or key plan showing the reference sheet no for each portion of the development area shall be provided if the various portions of layout are shown on separate drawings. |
| { } | 4.9 | Structural details, if any, shall be indicated on separate drawings as these are submitted for record purposes only. |
| { } | 4.10 | Drawings shall not be bound together. All drawings submitted shall be neatly folded to A4 size, the title block on the front face and in a manner where the drawings can be opened from left to right. |
| { } | 4.11 | Title block shall be provided at the bottom right hand corner of all drawings and properly completed. Title of drawings must indicate the exact nature of works for which approval is sought. There should be a margin of at least 50mm all round the drawing. |
| { } | 4.12 | All drawings submitted must bear the signature of the submitting Engineer/Architect/Surveyor with his full name, address and relevant professional qualifications. |
| { } | 4.13 | All documents submitted for approval shall be certified by the submitting Engineer as following;
"I hereby certify that these works have been designed by me in accordance with sound engineering practice and that I take full responsibility for the design and proper performance of the same." |
| { } | 4.14 | All drawings must be countersigned by the owner. The full name and address of the owner must be indicated. |
| { } | 4.15 | Adequate empty space shall be allowed on all drawings for the Approval stamp. |
| { } | 4.16 | Specify whose responsibility it will be to repair and stabilize erosion and sediment controls practices during construction, including areas disturbed. |

Consultant's
Initial
Submission
{ }

Items

SUBMISSION REQUIREMENTS

DID
Remarks

- { } 4.17 Specify whose responsibility it will be to inspect and perform maintenance and/or repairs of the erosion and sediment control practices.
- { } 4.18 Specify inspection schedule and procedure for inspection and maintenance of erosion and sediment controls practices.
- { } 4.19 Legend for all symbols of sediment control devices shall be chosen as recommended in MSMA.
- { } 4.20 Provide the detail layout of erosion and sediment control plan which clearly shows the location and sizes of proposed diversion drains and their outlets and erosion and sediment control facilities such as waterways, check dam, sediment trap, sediment basin, temporary crossing culvert, etc.
- { } 4.21 Plan shall be prepared using appropriate scales as shown below;
{ } – Location plan (1:1000)
{ } – Site and layout plan (1:1000)
{ } – Longitudinal section; Horizontal (1:1000), Vertical (1:100)
{ } – Cross- section and other details (1:100).
- { } 4.22 All sheets of final Sediment Control package shall be numbered consecutively.
- { } 4.23 Match lines corresponding sheet to sheet shall be shown.

Plans

- { } 4.24 Show property lines, owners/legal description, and site owner name for adjacent properties.
- { } 4.25 Show and label existing and proposed improvements (utilities, streets, buildings, etc.).
- { } 4.26 Show existing and proposed topography (0.5m contour intervals maximum).
- { } 4.27 Pre- and post-development drainage areas - Dividing lines, number of Hectare, and the direction of flow for each drainage area before and after development must be shown. Use separate plan sheets for clarity.
- { } 4.28 Existing features to be lighter or screened from proposed improvements in CAD submission.
- { } 4.29 Limits of disturbance shall be outlined and labeled.
- { } 4.30 The boundaries of different soil types must be delineated.
- { } 4.31 Critical areas - Areas which have the potential to present serious erosion or water quality problems must be delineated.
- { } 4.32 erosion or water quality problems must be delineated.
- { } 4.33 Any designated wetlands (including 10m buffer) shall be delineated and labeled.
- { } 4.34 Proposed slopes shall not exceed 2:1; (3:1 on lawn maintenance areas)
- { } 4.35 No sediment control devices are to be located within 10m of building foundations.
- { } 4.36 Protection of existing interior trees that to be save and undisturbed areas as the buffer as shown on plans.
- { } 4.37 Protection of property adjacent to excavations shall be shown on plans.
- { } 4.38 The locations of the *erosion and sediment control practices and proposed sediment control devices* to be used on the site must be shown.

Consultant's
Initial
Submission
{ }

Items

SUBMISSION REQUIREMENTS

DID
Remarks

- { } 4.40 Sediment trap(s): Provide safety fences; inflow point protection; proper outlet location (maximizing flow length from inflow points); dewatering as necessary (include dewatering device detail); Provide trap data information on the sediment control plan as follows: trap type; existing drainage area; developed drainage area; storage required; storage provided; weir crest elevation; weir crest detailing; storage depth; top storage dimensions; bottom dimensions; cleanout elevation (1/2 design depth); channel depth of flow; maximum side slopes (specify cut and/or fill); bottom elevation; embankment elevation; riser dimensions; barrel dimensions.
- { } 4.41 Sediment basin(s): Include sediment basin design and construction information as required by MSMA, Low Hazard Class assured; barrel outfall cross-section; dewatering device detail; inflow point protection; safety fence; and baffles as necessary. Show and address construction access and stockpiling on sediment control plan and address sediment control during basin installation. Limit initial disturbance to installation of principle spillway. If there is a base flow, provide a clean water diversion; if there is no base flow, provide diversion dikes above disturbed area.
- { } 4.42 Earth dikes for off-site diversion of runoff must have channel treatment at a minimum.
- { } 4.43 Temporary storm drain diversion: Include in sequence of construction, show profile, give invert elevations of temporary pipe into trap on plan view, profile, and details, and show the diversion on the storm drain plan.
- { } 4.44 Sequence of construction. (Include pre-construction meeting and consider all stages of site conditions with regard to sediment control).
- { } 4.45 Off-site grading requires documentation of permission from owner (letter of permission on plan or grading easement document submitted).
- { } 4.46 Plan of storm drain system with topography for each outfall.
- { } 4.47 All outfalls must release runoff to an existing system, adequate receiving channel, or grounds having slope less than or equal to 2%.
- { } 4.48 Provide outfall cross-section detail(s) with the following information specific to each outfall: outfall dimensions, rip-rap or gabion slope, length, size and class; and filter cloth underneath.
- { } 4.49 Standard detail for sediment control devices shall be shown.
- { } 4.50 Detail drawings and specifications for structural practices - Any structural practices used must be illustrated with DETAILED DRAWINGS CONTAINING ALL DIMENSIONS AND SPECIFICATIONS.
- { } 4.51 Practices must conform to the specifications indicated in MASMA.
Soil stockpiles and borrow areas - The locations of stockpiles and borrow areas must be shown with adequate protection measures included. If these locations are off-site, an addendum to the plan must be submitted to show the areas.

ADDITIONAL REQUIREMENTS

COMMENTS

ANNEX D
EROSION AND SEDIMENT CONTROL
INSPECTION AND MAINTENANCE OF BMPs
- REVIEW CHECKLIST

ANNEX D

EROSION AND SEDIMENT CONTROL – INSPECTION AND
MAINTENANCE OF BMPs- REVIEW CHECKLIST

APPENDIX D: MAINTENANCE CHECK SHEETS

INSPECTION CHECK SHEET

Sheet ___ of ___

GENERAL INFORMATION

Project Name: _____ File No. _____
Developer Name: _____ Contractor Onsite: _____
Inspection Date: _____ Time: _____ Weather: _____ mm of Rain Last Week: _____
Inspection Type: { } Routine Weekly { } Pre-Rain { } During Rain { } Post Rain

STAGE OF CONSTRUCTION

{ } Pre-Construction Conference; { } Clearing and Grubbing; { } Rough Grading;
{ } Finish Grading; { } Building Construction; { } Final Stabilization;

INSPECTION CHECKLIST

Yes No NA (Not Applicable)

Part 1: Inspection on Erosion Controls Measures

- { } { } { } Is the clearing of the construction area carried out in phases?
- { } { } { } Are the areas which designated to be preserve of the existing vegetation intact is not disturbed?
- { } { } { } Are all erosion control devices in-place and functioning in accordance with the erosion control plan?
- { } { } { } Are all temporary stockpiles or construction material located in approved areas and protected from erosion?
- { } { } { } Are soil stockpiles adequately stabilized with seeding and/or sediment trapping measures?
- { } { } { } Have all denuded areas requiring temporary or permanent stabilization been stabilized?
Seeded? yes/no Mulched? yes/no Gravelled? yes/no
- { } { } { } Does permanent vegetation provide adequate stabilization?
- { } { } { } Are all exposed slopes protected from erosion through the implementation of acceptable soil stabilization practices?
- { } { } { } Are finished cut and fill slopes adequately stabilized?
- { } { } { } Is there any evidence of erosion of cut or fill slope?

Part 2: Inspection on Sediment Controls Measures

- { } { } { } Have sediment-trapping facilities been constructed as a first step in stripping and grading?
- { } { } { } For perimeter sediment trapping measures, are earthen structures stabilized?
- { } { } { } Are sediment basins, sediment traps, sediment fence/barriers and check dam/rock weir installed where needed as per ESC Plan?
- { } { } { } Are sediment basins, sediment traps, sediment fence/barriers and check dam/rock weir properly maintained, repairs and sediment was regularly removed and clean as per ESC Plan maintenance schedule?
- { } { } { } Are sediment controls in place at site perimeter and storm drains inlets?
- { } { } { } Is the water from the construction site adequately prevented from directly entering the permanent drainage system unless it is relatively sediment free (i.e. the catchment area has been permanently landscaped and/or any likely sediment has been treated)?

SOIL EROSION & SEDIMENT CONTROL REGULATIONS

- Are the sediment controls measure onsite adequately installed and the sediment are effectively treated from the stormwater runoff from the construction site?
- Is there any evidence that the sediment is leaving the construction site without adequately treated?

Part 3: Inspection on Conveyances and Flows Controls Measures

- Are on-site channels, inlet and outlet are adequately stabilized and protected?
- Do all operational storm drainage inlets have adequate inlet protection?
- Are stormwater conveyance channels adequately stabilized, protected and lined with suitable material at badly eroded stretches?
- Are stormwater conveyance channels, culvert, conduit, roadside ditches, toe of slopes etc. adequately stabilized and with proper inlet/outlet protection and energy dissipater?
- Are the outlet of sediment basins and sediment traps are adequately stabilized with proper outlet protection and energy dissipater?
- Are adequate check dam/rock weir or any others energy dissipater method which are used to reduce the erosive effects of flows velocity in the stormwater conveyance channels
- Are temporary stream crossings of non-erodible material installed where applicable?
- Are the stormwater conveyance channels, the riprap, check dam, rock weir, stream crossing, etc. properly maintained, repairs and deposited sediment was regularly removed and clean as per ESC Plan maintenance schedule?

Part 4: Others

- Are properties and waterways downstream from development adequately protected from erosion and sediment deposition due to increases in peak stormwater runoff?
- Are soil and mud kept off public roadways at intersections with site access roads?
- Are utility trenches stabilized properly?
- Is there any self-auditing of ESCP was carried out onsite (based on onsite records of inspection check sheets and inspection log book)
- Have all temporary control structures that are no longer needed been removed?
- Do any structural BMPs practices require repair or clean-out to maintain adequate function? If yes, indicate in details.

- Does the ESCP require revisions? If yes, explain:

Comments:

Inspected by: _____ Developer's Representative: _____

Position: _____ Position: _____

Signature: _____

Signature: _____

SOIL EROSION & SEDIMENT CONTROL REGULATIONS

EROSION AND SEDIMENT INSPECTION LOG

Site: _____ **Contractors on Site:** _____

Heavy Equipment on Site: _____ **Activities on Site:** _____

Date: _____ **Weather:** _____ **mm of rain in last week:** _____

Note condition of the following measures and sediment levels where applicable:

MEASURE	CONDITION/LOCATION	SEDIMENT LEVEL	ACTION REQUIRED YES/NO	TYPE OF ACTION	ACTION COMPLETED (DATE)	INITIALS
Silt fences						
Temporary Storage Facilities						
Outlet of Temporary Storage Facilities						
Interceptor Swales						
Steeper Slopes						
Cover of Rough Grades						
Catchbasins Filtering Controls						
Dust Control						
Mud Tracking						
Debris Control						

Other Comments (Summarize):

Inspectors Signature: _____ **Inspectors Name** _____



KETUA PENGARAH
JABATAN PENGAIRAN DAN SALIRAN MALAYSIA
KEMENTERIAN SUMBER ASLI DAN ALAM SEKITAR
Jalan Sultan Salahuddin
50626 Kuala Lumpur
Malaysia

<http://www.water.gov.my>