

**DAY 2, SESSION 8: REVIEW OF GUAM'S STORM WATER MANUALS AND FEDERAL REQUIREMENTS**



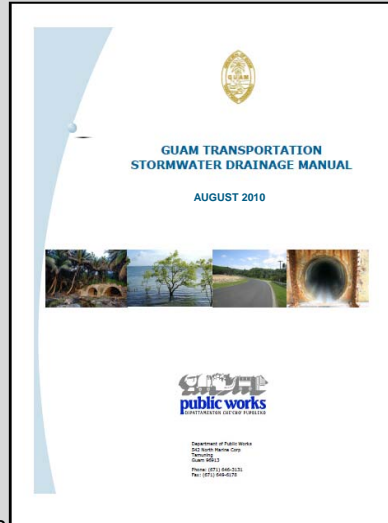
**Manuals and Plans**

- Transportation Stormwater Drainage Manual (TSDM) - 2010
  - Supplements 2006 Manual for Transportation
- Reviewed by Storm Water Task Force
  - EPA, GEPA, DPW, FHWA, BSP, ACOE, AG, CZM
- Additional Storm Water Documents:
  - Storm Water Drainage Master Plan (SWDMP)
    - Identifies and Prioritizes Projects Island-wide
    - Reviewed by Storm Water Task Force
    - Public Hearing/ Comment Phase Complete
    - Finalize Next Month
  - GRN Storm Water Implementation Plan (SWIP)
    - Specific to Guam Road Network
    - Addresses Military Buildup
    - Part of Environmental Document
    - Reviewed by Storm Water Task Force & DOD



# Transportation Stormwater Drainage Manual

- Ch 1 – Purpose and Scope
- Ch 2 – Stormwater Planning and Guam Drainage Policies
- Ch 3 – Minimum Requirements
- Ch 4 – Hydrologic Analysis
- Ch 5 – Hydraulic Analysis
- Ch 6 – Permanent BMPs
- Ch 7 – Construction Site BMPs
- Appendix I – Temporary E&SC
- Appendix II – Hydraulic Report
- Appendix III – Precipitation Data Analysis



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# Transportation Stormwater Drainage Manual

## ■ Purpose

- Provides drainage design guidelines for linear transportation projects:
  - Hydrologic Methodologies on-site and off-site
  - Criteria for pavement/ conveyance system drainage
  - Precipitation data converted to IDF curves
  - Typical BMPs for linear corridors
- Provides minimum requirements to achieve regulatory compliance (local and federal)
- Provides technical criteria for avoiding and mitigating water quality impacts
  - Source Control BMPs
  - Treatment BMPs
  - Flow Control BMPs
  - Construction BMPs
- Applies the Guam Erosion Control and Stormwater Management regulations



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# Transportation Stormwater Drainage Manual

## How to use the TSDM

- Used to integrate stormwater planning and design throughout project development
- Determine minimum stormwater requirements for compliance
- Design interception/ conveyance systems
- Design Post-Construction BMPs
- Prepare Temporary Erosion and Sediment Control Plan



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# Transportation Stormwater Drainage Manual

## Stormwater Planning and Design

- Scoping
- Preliminary Design/ Environmental Assessment
- Final Design/ Environmental Permitting
- Construction

Scoping	Scope Approval	Concept Approval
	Preliminary Design, Refinement, and Documentation	Environmental Permitting and Final Design
Preliminary identification of water quality and hydrologic impacts; conveyance and project flow patterns; and potential treatment and flow control BMP alternatives	Selection and refinement of stormwater conveyance and BMP facilities Provide drainage design support for the environmental assessments	Final design of stormwater facilities Obtain environmental permits
Project storm drainage summary including: <ul style="list-style-type: none"> <li>• Conducting preliminary stormwater summary and scope</li> <li>• Providing support for environmental reviews</li> <li>• Identifying additional right-of-way needs</li> <li>• Listing potential utility conflicts</li> </ul>	Project design report and environmental permit applications as supported by: <ul style="list-style-type: none"> <li>• Hydraulic Report including drainage calculations, soils analysis report, percolation test results, property maps, site plans, wetlands delineation map, drainage flow maps with land contours, etc.</li> <li>• Environmental Assessment Reports and Impact Statements as supported by stormwater design and coordination</li> </ul>	PS&E package: <ul style="list-style-type: none"> <li>• Temporary Erosion and Sedimentation Control (TESC) plans (Appendix I)</li> <li>• Provisions for Spill Prevention, Control, and Countermeasures (SPCC) plans</li> <li>• Stormwater plans and details</li> <li>• Specifications and special provisions</li> <li>• Project cost estimate and schedule</li> </ul> Contractual bids, selection of contractor, and start of construction
Cost estimates for stormwater facility design and construction alternatives	Project conceptual (preliminary) plans and cost estimate	Stormwater design support during construction

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## Transportation Stormwater Drainage Manual

### Stormwater Planning – 7 Step Process

- |         |   |
|---------|---|
| STEP 1- | Collect and analyze information on existing conditions.   |
| STEP 2- | Prepare a drainage map with conceptual layout.  |
| STEP 3- | Perform an off-site analysis.   |
| STEP 4- | Prepare a permanent stormwater management plan.   |
| STEP 5- | Prepare a temporary erosion and sedimentation control plan. This plan will be incorporated into the contractors' Construction Stormwater Pollution Prevention Plan (SWPPP). |
| STEP 6- | Prepare a hydraulic report.   |
| STEP 7- | Check compliance with all applicable minimum requirements.  |

## Transportation Stormwater Drainage Manual

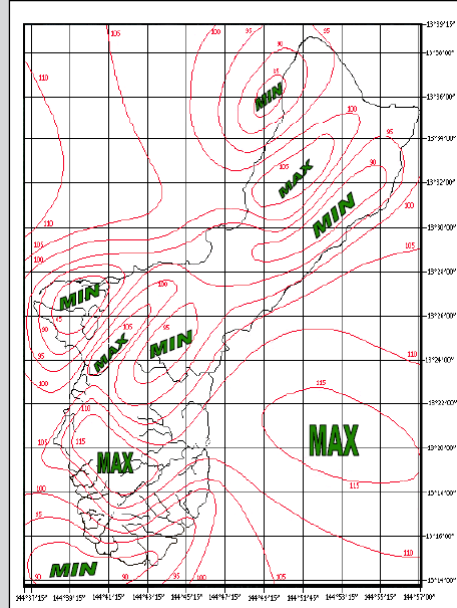
### 9 Minimum Requirements for Regulatory Compliance

- 1) Stormwater planning
- 2) Construction stormwater pollution prevention
- 3) Source control of pollutants
- 4) Maintenance of natural drainage
- 5) Runoff treatment
- 6) Flow control
- 7) Wetlands protection
- 8) Watershed-based planning
- 9) Operation and maintenance

## Transportation Stormwater Drainage Manual

### Hydrologic Data

- Precipitation statistics updated
- Design storm depths and frequencies statistically modeled to meet the unique characteristics of roadway projects
- Intensity-Duration-Frequency (IDF) Curves prepared



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## Transportation Stormwater Drainage Manual

### Hydraulics

- Basic criteria identified
- Basic hydrology/hydraulic design approaches identified
- References FHWA detailed hydraulic design procedures

Type of Structure	Storm Frequency (years)
Gutters	10
Storm Drain Inlets – On Longitudinal Slope	10
Storm Drain Inlets – Vertical Curve Sag	50
Storm Drain Laterals	10
Storm Drain Trunk Lines	25
Ditches – Roadside	10
Ditches – Outfall and canals	25
Culverts	50-year for main routes and 25-year for secondary routes.
Bottomless Culverts	50
Culverts – Check for Overtopping	100
Bridges – Design for Flow Passage and Scour	100
	Maintain 2 ft. clear between HW and lowest member. For spill through abutments, try to maintain 10 ft. between top edge of channel and toe of abutment.
Main Routes	10-year: Flow spread width not to exceed shoulder and 2 ft. of the adjacent lane. 100-year: No overtopping at bridges and culverts; one lane in each direction passable for emergency vehicles. Check for flow damage and provide protection as required.
Secondary Routes	10-year: Flow spread width not to exceed half of the inner lane. 100-year: Passable for emergency vehicles. Check for flow damage and provide protection as required.

Table 5-1: Recommended Frequency for Design of Hydraulic Structures

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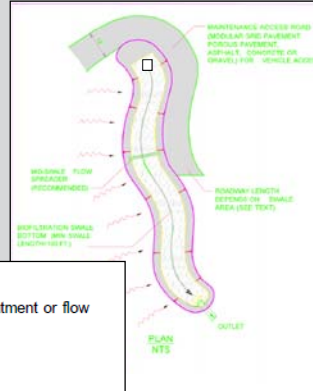
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# Transportation Stormwater Drainage Manual

## ■ Best Management Practices (BMPs)

- Provides design criteria for permanent stormwater treatment and flow control BMPs
- Consistent with 2006 Manual
- 3-step process



### Step 1. Determine the applicable Minimum Requirements.

Review the procedures in Chapter 3 of this TSDM. Even if no quality treatment or flow control BMPs are required, the designer should still proceed with Step 2.

### Step 2. Select design pollution prevention BMPs.

See Figure 6-1 for the selection of design pollution prevention BMPs.

#### Step 2 a. Select flow control BMPs.

Based on the Minimum Requirements in Step 1, use Figure 6-2 for selection of flow control BMPs.

#### Step 3. Select runoff treatment BMPs.

Based on the Minimum Requirements in Step 1, use Figure 6-3 for selection of runoff treatment BMPs.

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# Transportation Stormwater Drainage Manual

## ■ Construction Site BMPs

- Soil Stabilization
- Sediment Control
- Wind Erosion Control
- Tracking Control
- Non-Stormwater Control
  - Dewatering
  - Temporary stream crossings
  - Clear water diversions
  - Vehicle and equipment operations
  - Pile driving
  - Concrete curing/ finishing/ washout
  - Work over or adjacent to waterbody
  - Waste management



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## Transportation Stormwater Drainage Manual

### ■ Conclusion

- TSDM provides guidelines for the planning and design of stormwater facilities for transportation projects on Guam
- Establishes Minimum Requirements
- Provides uniform technical criteria for avoiding and mitigating water quality impacts
- Consistent with the Guam Erosion Control and Stormwater Management Regulations

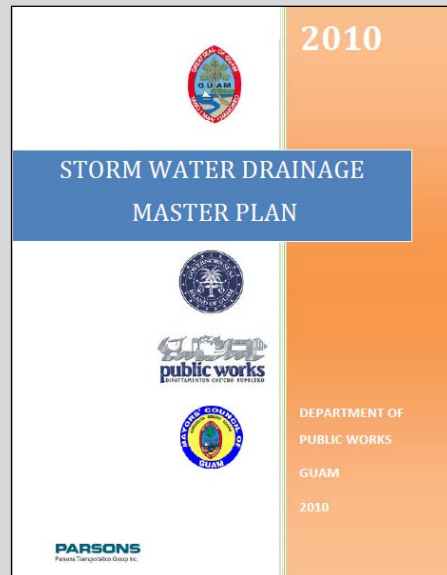


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## Storm Water Drainage Master Plan

- Introduction
- Watershed Overview
- Methodology
- Summary of Projects
- Implementation
- Appendices



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# Storm Water Drainage Master Plan

## ■ Purpose

- Identify existing storm water runoff patterns
- Identify existing storm water conveyance systems
- Characterize drainage, erosion control and treatment BMP improvements
- Prioritize potential Capital Improvement Plan projects
- Provide potential funding sources

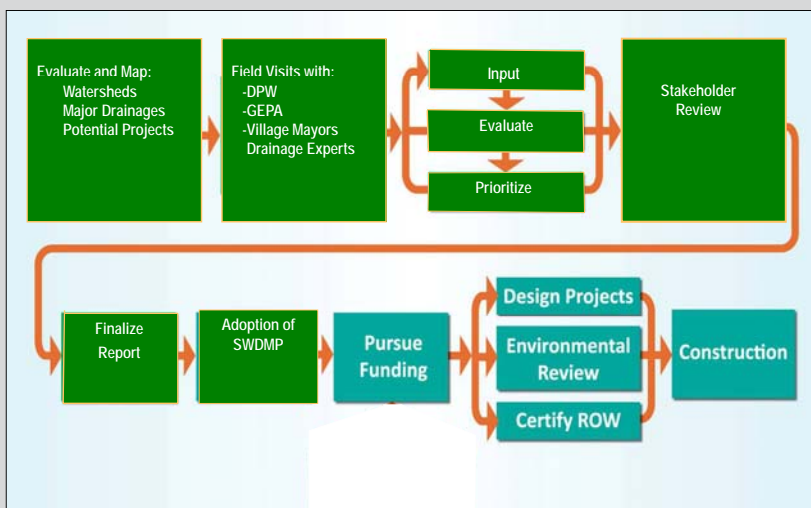


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# Storm Water Drainage Master Plan

## Methodology for Project Identification to Implementation



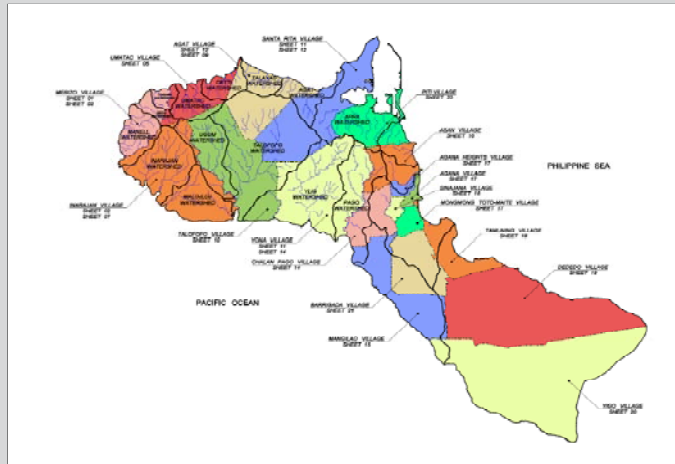
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# Storm Water Drainage Master Plan

Identifies and Prioritizes on a Village Basis



Watershed and Village Map of Guam

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# Storm Water Drainage Master Plan

Maps Projects on Watershed and Village Basis



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## Storm Water Drainage Master Plan

### Classifies Projects by Work Types

WORK TYPE	DESCRIPTION
Erosion Control	Locations where stream bank erosion, channel deformation, and down cutting were observed. Erosion control includes streambank protection, such as riprap revetment or installation of gabion retaining walls along steep cliff sides, control of hillside erosion with hydroseed, and mulch and/or bonded fiber matrix to control mass erosion.
Conveyance Improvements	Locations where the design and installation of offsite drainage conveyance structures, such as culverts, associated headwalls and wingwalls, channels, ditches, cross culverts, and bridges, are required. Examples include providing increased capacity, as well as replacing structures that are beyond repair.
Conveyance Maintenance	Locations where rehabilitation of conveyance structures or maintenance within conveyance structures is required. Examples include headwall and/or wingwall repair, removal of sediment and debris within and around culverts, and utility encasement or relocation within the conveyance facility.
Treatment BMP Improvements	Includes the design and installation of biofiltration strips/swales, detention devices, media filters, and infiltration trenches/basins for treatment of storm water runoff.
Treatment BMP Maintenance	Includes vegetation management, debris removal, sediment or vegetation removal, and/or side slope stabilization at locations where treatment best management practices (BMPs), such as infiltration basins, are present.
Coastal Protection	Locations where the coastline is within the limits of a routed road and the road has little to no protection. In areas that exhibit coastal erosion encroaching within the roadway ROW, coastal erosion protection in the form of riprap revetment or gabions has been recommended.
Storm Drain Maintenance	Includes locations where sediment/debris removal is required within the storm drain system.
Storm Drain Improvements	All locations where capacity improvements or storm drain replacement is required. Examples include design and installation of storm drain systems, including catch basins, roadway ditches, storm drain pipelines, and storm drain outlets to offsite conveyance systems. Also included are storm drain outlet structures that convey flow to the groundwater regime, such as infiltration basins, infiltration trenches, or underground injection chambers.

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## Storm Water Drainage Master Plan

### Summarizes Projects on Data Sheets:

- 300 Total Projects
- Identified per Village
- Work Type
- Site Assessment
- Proposed Improvements
- Cost Estimate



AS-106

LOCATION: Niño Perdido St & Santa Ana St

MITIGATION TYPE: Erosion Control/ Storm Drain Maintenance/ Storm Drain Improvements

SITE ASSESSMENT: A concrete lined channel discharges to an inlet located behind the sidewalk and this inlet discharges to a double grated inlet on the street. There is significant debris and sediment from hillside, the receiving inlet is clogged. Erosion control is needed upstream, and possibly a debris basin needs to be added downstream to prevent inlet from getting clogged.

RECOMMENDED IMPROVEMENTS: Erosion control, maintenance and improvements to the storm drain system are needed at this site. A quarter acre of debris removal and placement of one acre of hydromulch with bonded fiber matrix is recommended along the hillside to eliminate further sedimentation and clogging of the downstream inlet. As per the Flood Control Document, the connecting storm drain needs to be replaced with a 100"x24" RCP.

COST: \$170,000

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# Storm Water Drainage Master Plan

Evaluates Projects Based on 10 Factors

	PRIORITY SCORE	CRITERIA	RANKING FACTORS			
			HIGHEST SCORE (X3)	MODERATE SCORE (X2)	LOW SCORE (X1)	NO SCORE (X0)
EVALUATION CATEGORIES	10	Public Safety Risk	Inaction poses significant risk to public safety, potential loss of life.	Inaction poses moderate risk to public safety, potential injury.	Inaction poses low risk to public safety.	No risk to public safety.
	10	Environmental Severity	Directly impacts aquifer.	Directly impacts coastal area.	Directly impacts surface water (e.g., river, stream, or lake).	No environmental risk.
	3	Maintainability	Low maintenance projects with easy accessibility.	Moderate maintenance requirement, moderately accessible.	Difficult to maintain and/or difficult to access.	Very difficult to maintain and/or very difficult to access.
	3	Flooding Severity	Unacceptable damage caused by flood events.	Moderate damage caused by flood events.	Flood events cause nuisance damage.	No flood hazard.
	3	Floodplain	Inside floodplain.	N/A	N/A	Outside floodplain.
	3	Erosion Severity	Unacceptable damage caused by erosion.	Moderate damage caused by erosion.	Erosion damage considered nuisance.	No erosion hazard.
	3	Number of Affected Properties	Greater than 4 properties affected.	3 to 4 properties affected.	1 to 2 properties affected.	No properties affected.
	3	Type of Roadway	Highway	Arterial	Collector	Private
	3	Right-of-Way Requirement	Requires no ROW.	N/A	N/A	Requires ROW.
	10	Estimated Cost	Cost < \$200,000	\$200,000 < Cost < \$1,000,000	\$1,000,000 < Cost < \$10,000,000	Cost > \$10,000,000

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# Storm Water Implementation Plan

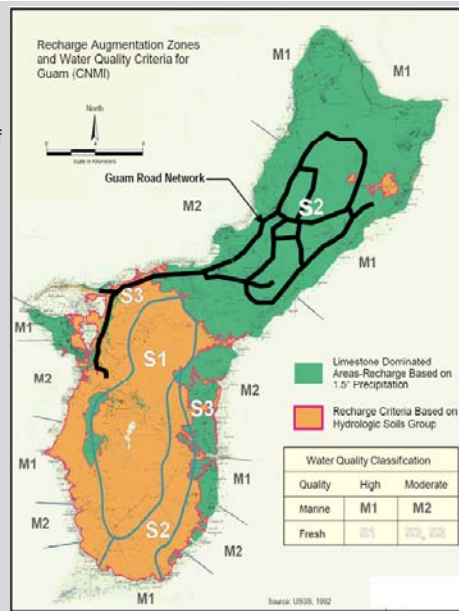
## Guam Road Network

- Collection of Projects that Best Represents Construction Proposed for Military Build-Up
- Requires Special Attention for Evaluation of Collective Impact and Mitigation

## SWIP Purpose

- Identify Stormwater Management Plans for GRN Corridors
- Identify Typical BMPs for GRN Corridors
- Identify Regulatory Coordination Process
- Identify Pertinent Stormwater Elements
  - Curbed/ Uncurbed Roads
  - Northern Guam Lens Aquifer
  - Existing Production Wells
  - Proposed Production Wells
  - Underground Injection Chambers
  - Ponding Basins
  - Sinks
  - Wetlands
  - Watershed Boundaries
  - Existing Drainage

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# Storm Water Implementation Plan

## 5 Project Categories

- Pavement Strengthening
- Road Widening
- Intersection Improvements
- Bridge Improvements
- New Roadways

Table of Project Categories

Type of Work	General Scope Elements
Pavement strengthening, no shoulder widening	Pavement rehabilitation without increasing existing pavement footprint (impervious area)
Pavement strengthening & shoulder widening	Pavement rehabilitation with a minor (2-ft to 8-ft wide) increase in impervious area.
Road widening for capacity increase	Roadway improvements with an increase in impervious area.
Intersection improvements	Reconfiguration of one or more streets, addition of turning lanes, pavement widening, cleaning and grading, and an increase in impervious area.
Bridge Improvements	Beam, pier wall, wingwall and/or deck rehabilitation or replacement with upstream and/or downstream channel erosion control.
New Roadways	New paved roads with increase in impervious area.

Sample Table of Pavement Widening Project

Project Type	SRP Project Number	Component Segment	Project Limits	Existing Drainage System Type	Proposed Drainage System	Flow Control Structure	Flow Control Structure Type	Flow Control Structure Location	Flow Control Structure Details	Flow Control Structure Notes	Flow Control Structure Construction	Flow Control Structure Cost	Flow Control Structure Status	Flow Control Structure Location	Flow Control Structure Notes	Flow Control Structure Construction	Flow Control Structure Cost	Flow Control Structure Status	
Pavement Widening Capacity Improvement, Shoulder Widening, New Roadway	9	Rte 1, Area 2	NCTC Freeway to Rte 78	Sheet Flow Off Pavement	Very Embankments	Runoff Routed to Infiltration Basins & Thru Basins	Runoff Routed to Infiltration Basins & Thru Basins	Runoff Routed to Infiltration Basins & Thru Basins	Grade Slopes to Drain to Infiltration Basins	Grade Slopes to Drain to Infiltration Basins	Grade Slopes to Drain to Infiltration Basins								
	10	Rte 1, Area 2	NCTC Freeway to Rte 9	Sheet Flow Off Pavement	Very Embankments	Runoff Routed to Infiltration Basins & Thru Basins	Runoff Routed to Infiltration Basins & Thru Basins	Runoff Routed to Infiltration Basins & Thru Basins	Grade Slopes to Drain to Infiltration Basins	Grade Slopes to Drain to Infiltration Basins	Grade Slopes to Drain to Infiltration Basins								
	21	Rte 8A	Route 8A to NAVCAMS Interchange	Sheet Flow Off Pavement	Very Embankments	Flow New Infiltration Basins on South Side	Runoff Routed to Infiltration Basins & Thru Basins	Runoff Routed to Infiltration Basins & Thru Basins	Grade Slopes to Drain to Infiltration Basins	Grade Slopes to Drain to Infiltration Basins	Grade Slopes to Drain to Infiltration Basins								
	16	Rte 8	Route 8 to NAVCAMS Interchange	Sheet Flow Off Pavement	Very Embankments	Runoff Routed to Infiltration Basins & Thru Basins	Runoff Routed to Infiltration Basins & Thru Basins	Runoff Routed to Infiltration Basins & Thru Basins	Grade Slopes to Drain to Infiltration Basins	Grade Slopes to Drain to Infiltration Basins	Grade Slopes to Drain to Infiltration Basins								
	17	Rte 9	Route 9 to NAVCAMS Interchange	Sheet Flow Off Pavement	Very Embankments	Runoff Routed to Infiltration Basins & Thru Basins	Runoff Routed to Infiltration Basins & Thru Basins	Runoff Routed to Infiltration Basins & Thru Basins	Grade Slopes to Drain to Infiltration Basins	Grade Slopes to Drain to Infiltration Basins	Grade Slopes to Drain to Infiltration Basins								
	20A	Rte 9	Route 9 to NAVCAMS Interchange	Sheet Flow Off Pavement	Very Embankments	Runoff Routed to Infiltration Basins & Thru Basins	Runoff Routed to Infiltration Basins & Thru Basins	Runoff Routed to Infiltration Basins & Thru Basins	Grade Slopes to Drain to Infiltration Basins	Grade Slopes to Drain to Infiltration Basins	Grade Slopes to Drain to Infiltration Basins								
	26	Rte 26	Route 26 to Rte 5	Sheet Flow Off Pavement	Very Embankments	Runoff to flow through grass shoulders	Runoff to flow through grass shoulders	Runoff to flow through grass shoulders	Grade Slopes to Drain	Grade Slopes to Drain	Grade Slopes to Drain								
	23	Rte 5	Route 5 to Rte 17	Sheet Flow Off Pavement	Very Embankments	Runoff to flow through grass shoulders	Runoff to flow through grass shoulders	Runoff to flow through grass shoulders	Grade Slopes to Drain	Grade Slopes to Drain	Grade Slopes to Drain								
	21	Rte 5	Route 5 to Rte 17	Sheet Flow Off Pavement	Very Embankments	Runoff to flow through grass shoulders	Runoff to flow through grass shoulders	Runoff to flow through grass shoulders	Grade Slopes to Drain	Grade Slopes to Drain	Grade Slopes to Drain								
	29	Rte 29	Route 29 to Rte 26	Sheet Flow Off Pavement	Very Embankments	Runoff Routed to Infiltration Basins	Runoff Routed to Infiltration Basins	Runoff Routed to Infiltration Basins	Grade Slopes to Drain	Grade Slopes to Drain	Grade Slopes to Drain								
	28	Rte 28	Route 28 to Rte 15	Sheet Flow Off Pavement	Very Embankments	Runoff Routed to Infiltration Basins	Runoff Routed to Infiltration Basins	Runoff Routed to Infiltration Basins	Grade Slopes to Drain	Grade Slopes to Drain	Grade Slopes to Drain								
26	Rte 15	Route 15 to Rte 26	Sheet Flow Off Pavement	Very Embankments	Runoff Routed to Infiltration Basins	Runoff Routed to Infiltration Basins	Runoff Routed to Infiltration Basins	Grade Slopes to Drain	Grade Slopes to Drain	Grade Slopes to Drain									
51	Rte 28	Route 28 to Rte 15	Sheet Flow Off Pavement	Very Embankments	Runoff Routed to Infiltration Basins & Thru Basins	Runoff Routed to Infiltration Basins & Thru Basins	Runoff Routed to Infiltration Basins & Thru Basins	Grade Slopes to Drain to Infiltration Basins	Grade Slopes to Drain to Infiltration Basins	Grade Slopes to Drain to Infiltration Basins									
128	Freeway Connection	Route 1 and Route 16	Sheet Flow Off Pavement	Very Embankments	Runoff Routed to Infiltration Basins	Runoff Routed to Infiltration Basins	Runoff Routed to Infiltration Basins	Grade Slopes to Drain	Grade Slopes to Drain	Grade Slopes to Drain									
11	OK Legions	Route 1 to Route 15	Sheet Flow Off Pavement	Very Embankments	Runoff to flow through grass shoulders	Runoff to flow through grass shoulders	Runoff to flow through grass shoulders	Grade Slopes to Drain	Grade Slopes to Drain	Grade Slopes to Drain									

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# Storm Water Implementation Plan

## Overview - North Guam

- Includes Routes 1, 3, 9, 15, 16, 25, 26, 27, 28
- Drainage to Natural Depressions
- Upstream Pre-Treatment Main BMP Requirement
- Many Existing Routes w/ Natural Treatment (Swales/Strips) or Existing Ponding Basins
- Concern over Limestone Aquifer - Main Source of Water for Island



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# Storm Water Implementation Plan

## Overview South Guam

- Includes Rte 1, 2A, 5, 8, 10, 11
- Limited Recharge Capacity (except Rte 10)
- Receiving Water – Small streams and coastal zone
- No New Impervious Area Except Interchanges



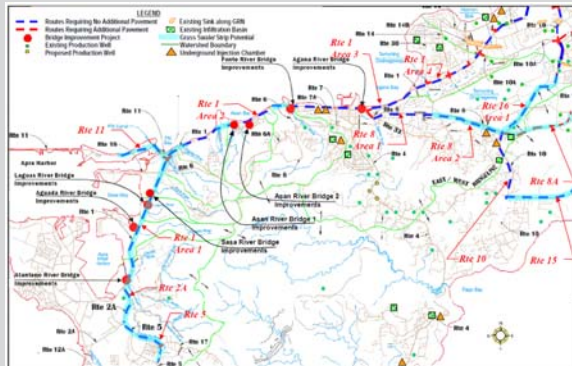
Rte 1 at Laguas



Tamuning Outlet



Rte 1 at Aguada



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# Storm Water Implementation Plan

## Identifies Regulatory Agency Coordination Process

Local/ Federal	Agency	Permit or Clearance	Implementation	
			Design <sup>1</sup>	Construction <sup>2</sup>
Local	Guam Department of Public Works	Building Permit		X
		Clearing and Grading Permit		X
	Guam EPA	Underground Injection Control Permit	X	
		Aquifer Protection Review	X	
		Section 401 Water Quality Certification	X	
		Environmental Protection Plan (EPP)		X
		Erosion Control Plan (ECP)		X
Storm Water Pollution Prevention Plan (SWPPP)		X		
Bureau of Statistics and Plans	Federal Consistency Certification	X		
Federal	US EPA, Region 9	Sole Source Aquifer Protection	X	
		Wellhead Protection Program		X
		Section 402 National Pollutant Discharge and Elimination System (NPDES) Permit / Storm Water Pollution Prevention Plan (SWPPP)		X
	US Army Corps of Engineers	Storm Water Runoff Requirements – Section 438 of the Energy Independence and Security Act of 2007 (EISA)	X	
		Section 404 Discharge of Dredged or Fill Material into Waters of the United States	X	

1) Design phase, prior to advertisement for construction bids.  
2) Construction phase, prior to Notice to Proceed.

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## Questions and Answers



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