global Transport Knowledge Partnership

Southeast Asia Community Access Partnership **SEACAP**

LOW VOLUME ROADS WORKSHOP
Napier, New Zealand, July 2009

Low Cost Structures Manual

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Current Situation

- Basic road network is essential for economic development in low income countries
- Roads often passable for 95% of their length, but impassable at a water crossings
- Low volume road manuals usually only have a ‘chapter’ on structures
- Proven materials options such as masonry, brick, timber are usually ignored

Problems

- Insufficient attention has been paid to the use of local resources, proven materials and indigenous skills
- Locally trained engineers have often undertaken civil engineering courses based on European/US university syllabuses, standards & best practices.
- Lack of access to /availability of local 'design data'
- No 'standard' designs
- Many structures poorly designed & constructed
- Limited resources not used effectively

Issues To Be Addressed

- Increasing the level of construction of low cost and readily maintainable structures on rural roads (spot improvement strategy)
- Increased workload for, local labour, artisans and contractors
- Increased use of local materials and demand on local suppliers and material manufacturers
- Introduce appropriate standards & specifications with alternatives to reinforced concrete
- Improved maintenance of structures

Requirements of the Manual

- The manual is aimed at private contractors and consultants, local government highways departments and other organisations involved in Low Volume Rural Road infrastructure provision.

- Credibility of the manual with potential users through the involvement of project partners

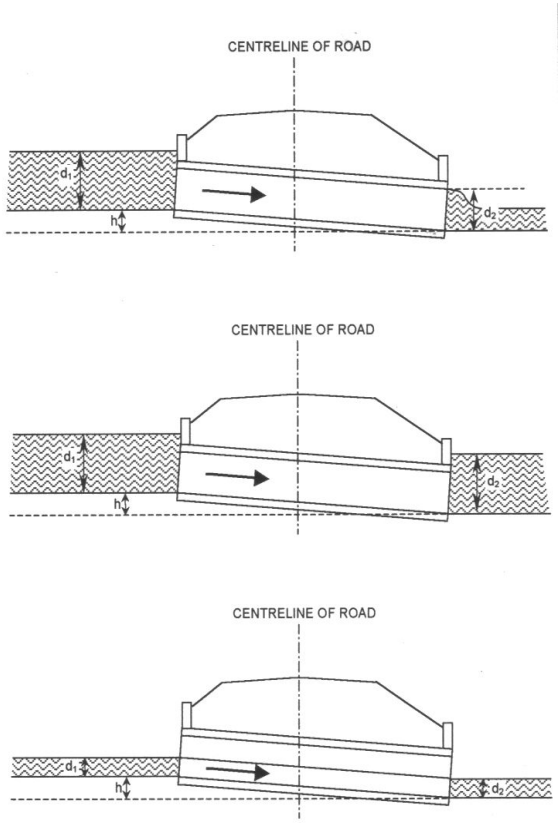
  TRL IRF
  *g*TKP SEACAP

- Applicable world wide – draft manual draws on case studies from 5 diverse countries

- All information contained in 1 manual (2 volumes design & drawings)

Aims of the Manual

- Concise and complete information in one place
- Provide the engineering background required to
  - Complete planning and assessment
  - Select the correct structure
  - Complete design
- Guidance on costing, construction and maintenance of structures
- Assist in the approval and adoption of low cost structural designs
- Utilisation of low cost labour, local materials & artisans
- Improving economic returns and reducing environmental impacts by using local resources



Low Cost Structures Manual

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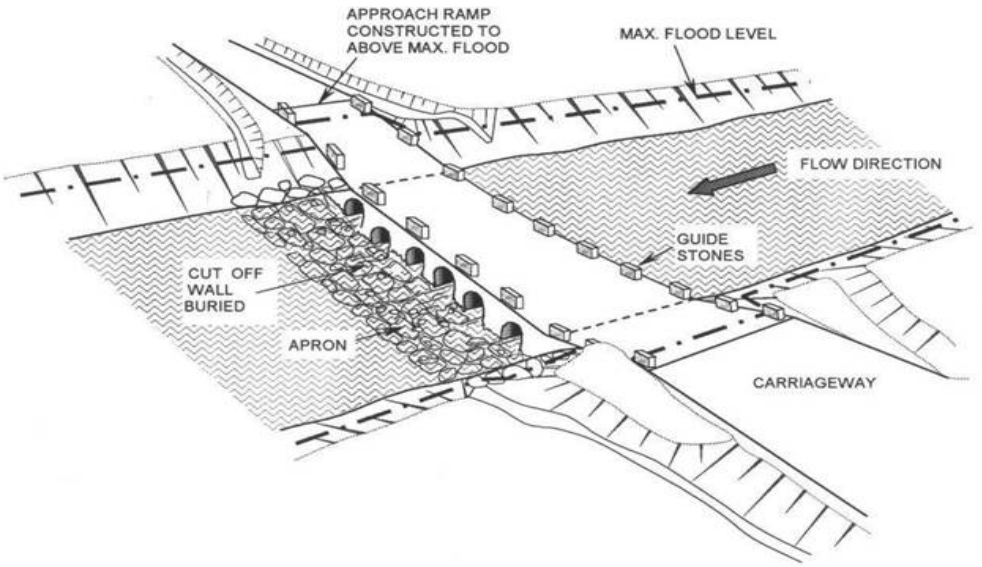
Volume 1 Design Manual

- Scour
- Foundations
- Structural slabs
- Cut off walls
- Pipes
- Headwall and wingwalls
- Apron
- Approach ramps
- Downstream protection
- Arches

- Bridge design

Volume 2 Standard Design Drawings

- Drifts
- Simple culverts
- Vented fords
- Large bore culverts
- Small bridges



Low Cost Structures Manual

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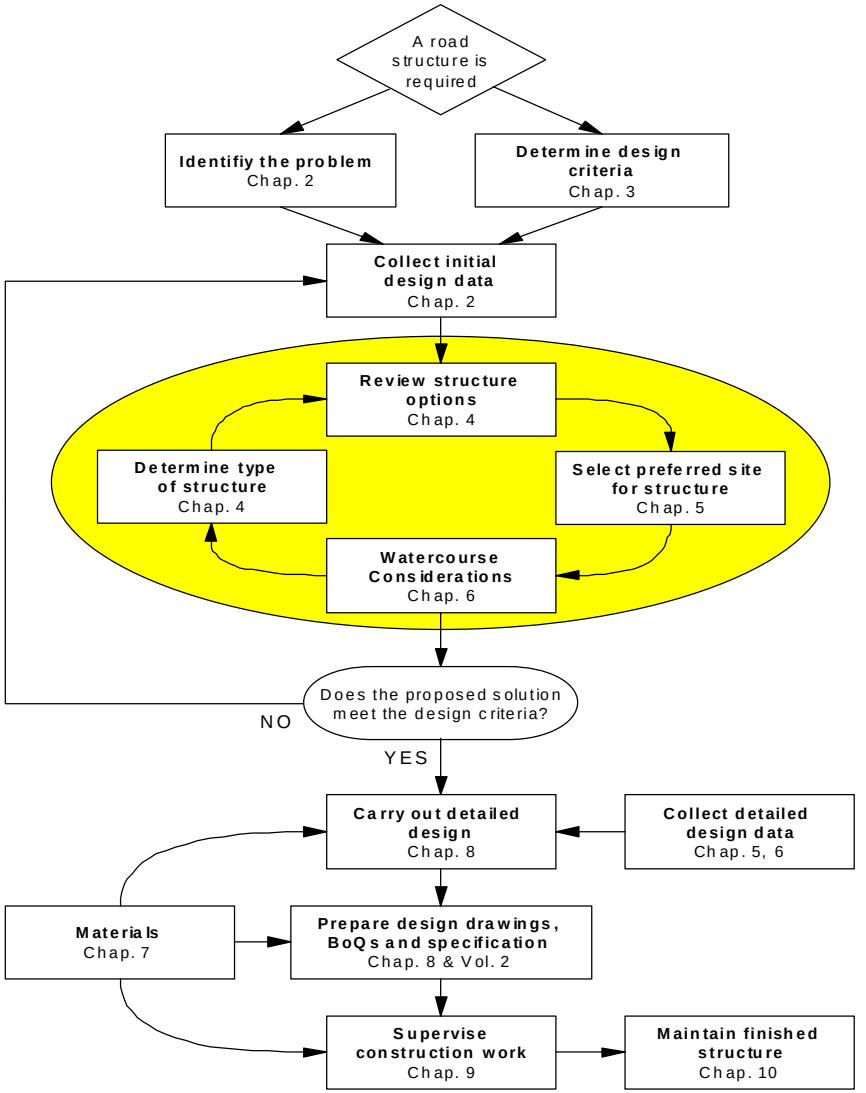
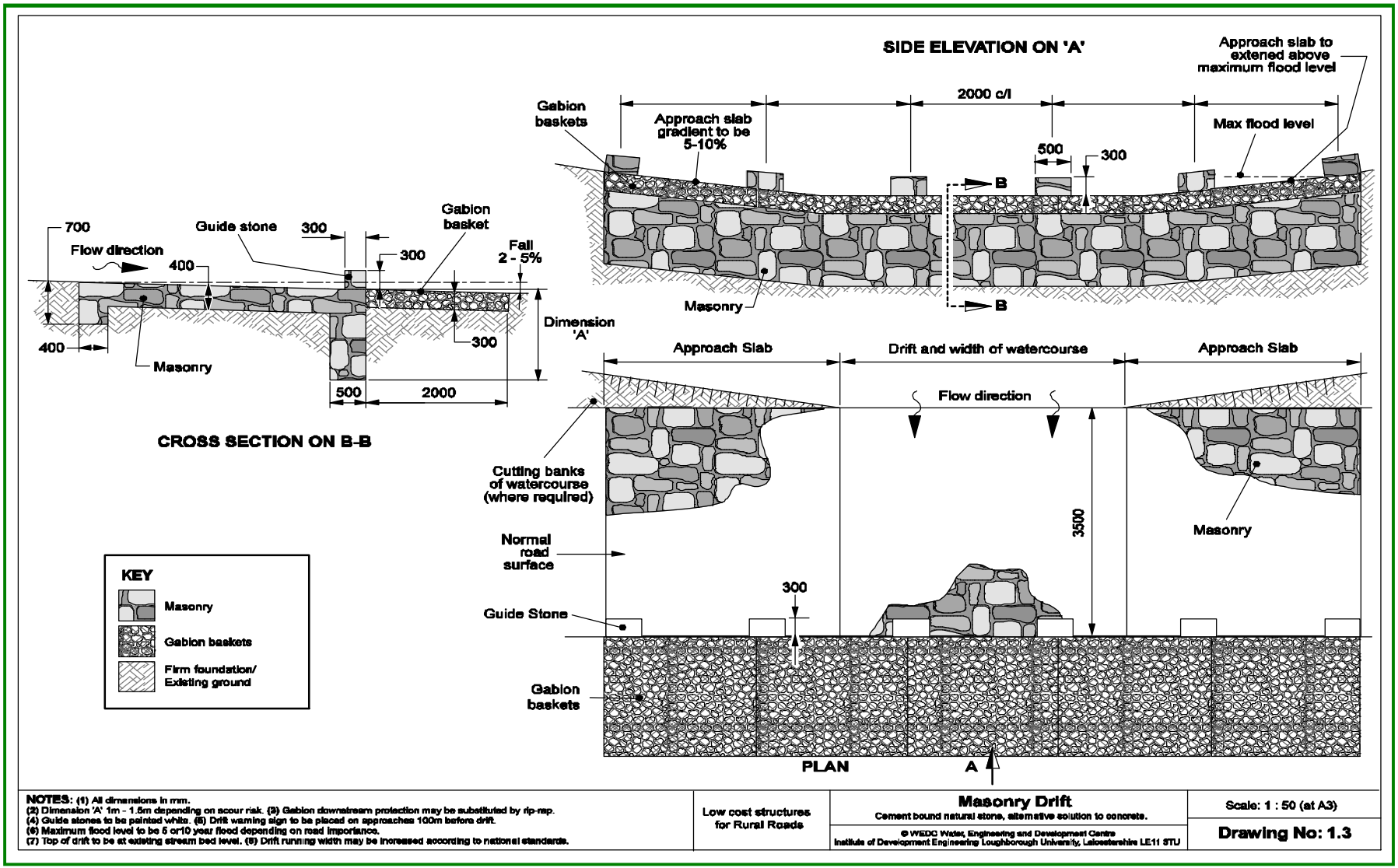
Volume 1 Design Manual

1. Introduction
2. Project Planning
3. Design Criteria
4. Structural Options
5. Site Selection and Appraisal
6. Watercourse Characteristics
7. Materials
8. Structural Design
9. Construction
10. Maintenance




SIDE ELEVATION ON 'A'
Approach slab to extened above maximum flood level
2000 c/l
Gabion baskets
Approach slab gradient to be 5-10%
Max flood level
500
300
B
B
Masonry
700
Flow direction
400
Guide stone
300
300
Gabion basket
Fall 2 - 5%
Dimension 'A'
400
Masonry
300
500
2000
CROSS SECTION ON B-B
Approach Slab
Drift and width of watercourse
Approach Slab
Flow direction
Cutting banks of watercourse (where required)
Normal road surface
3500
Masonry
300
Guide Stone
Gabion baskets
PLAN
A
KEY
Masonry
Gabion baskets
Firm foundation/ Existing ground
NOTES: (1) All dimensions in mm.
(2) Dimension 'A' 1m - 1.5m depending on scour risk. (3) Gabion downstream protection may be substituted by rip-rap.
(4) Guide stones to be painted white. (5) Drift warning sign to be placed on approaches 100m before drift.
(6) Maximum flood level to be 5 or10 year flood depending on road importance.
(7) Top of drift to be at existing stream bed level. (8) Drift running width may be increased according to national standards.
Low cost structures for Rural Roads
Masonry Drift
Cement bound natural stone, alternative solution to concrete.
© WEDC Water, Engineering and Development Centre
Institute of Development Engineering Loughborough University, Leicestershire LE11 3TU
Scale: 1 : 50 (at A3)
Drawing No: 1.3

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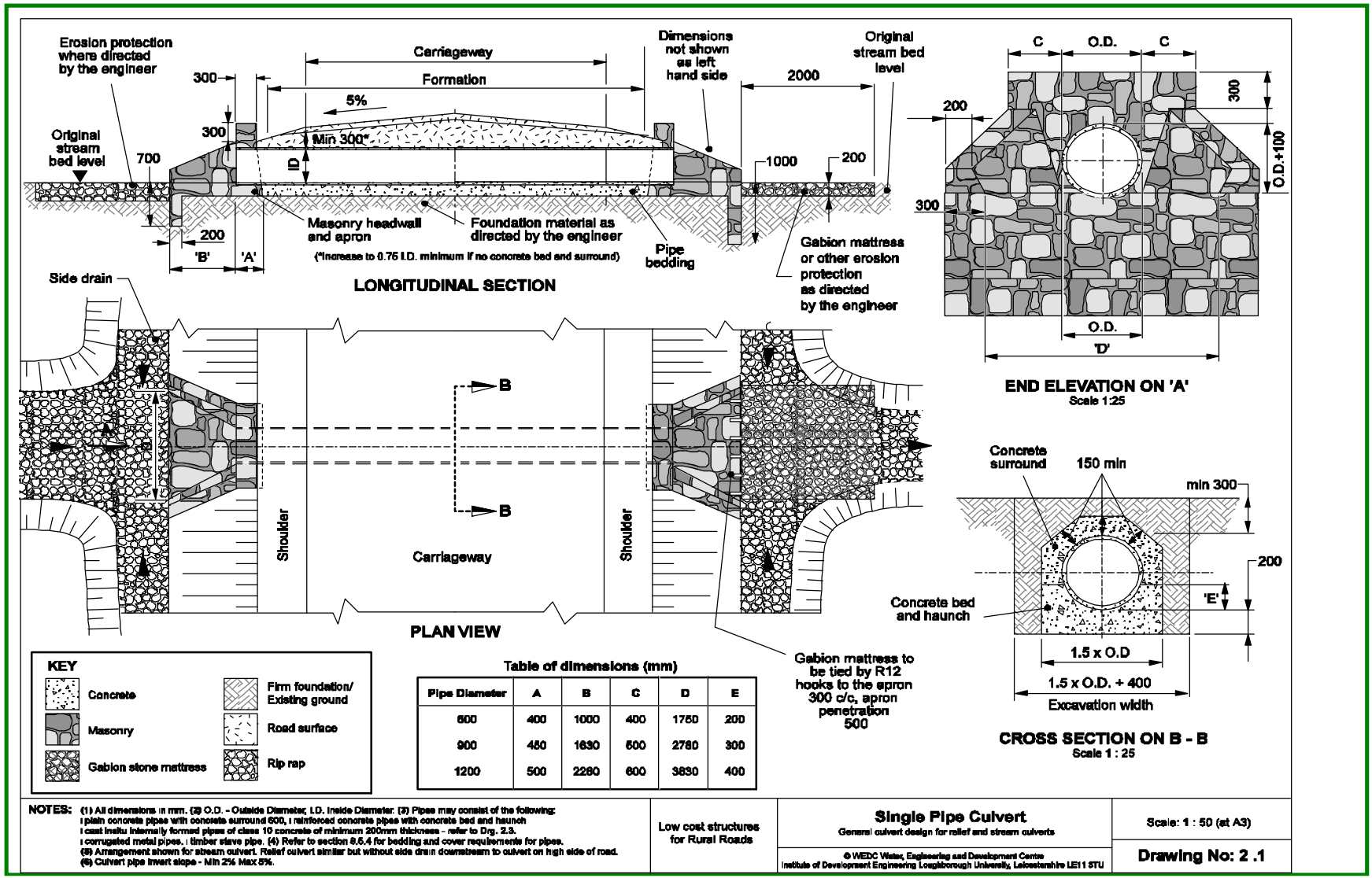

Table of dimensions (mm)

Pipe Diameter	A	B	C	D	E
600	400	1000	400	1750	200
900	450	1630	600	2780	300
1200	500	2260	800	3830	400

NOTES: (1) All dimensions in mm. (2) O.D. - Outside Diameter, I.D. Inside Diameter. (3) Pipes may consist of the following:
- plain concrete pipes with concrete surround 600, - reinforced concrete pipes with concrete bed and haunch
- cast insitu internally formed pipes of class 10 concrete of minimum 200mm thickness - refer to Drg. 2.3.
- corrugated metal pipes. - timber stave pipe. (4) Refer to section 9.6.4 for bedding and cover requirements for pipes.
(5) Arrangement shown for stream culvert. Relief culvert similar but without side drain downstream to culvert on high side of road.
(6) Culvert pipe invert slope - Min 2% Max 8%.

Low cost structures for Rural Roads

Single Pipe Culvert
General culvert design for relief and stream culverts

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Institute of Development Engineering Loughborough University, Leicestershire LE11 3TU

Scale: 1 : 50 (at A3)

Drawing No: 2 .1

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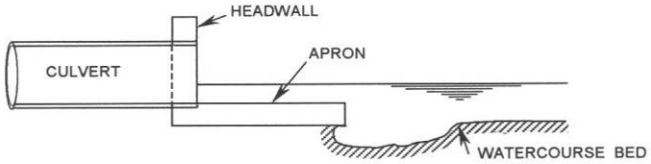
Next Steps

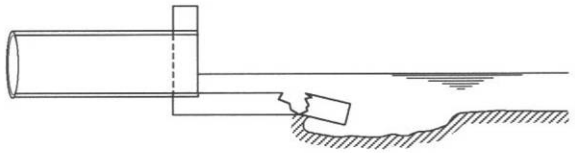
- Obtain practitioners comments on web published manual by October 2009

Visit
www.gtkp.com/sectors.asp?step=4&contentID=3319

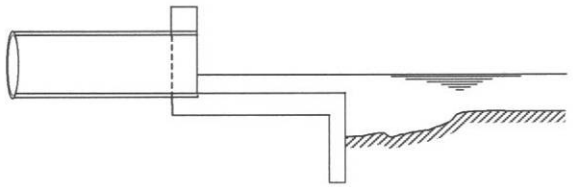
- Review and incorporate comments into final published version of the manual
- Training / mentoring of local engineers
- Demonstration of standard designs
- Review of designs against national standards and specifications
- Review of engineering curricula



WATER STARTS TO UNDERCUT
UNPROTECTED APRON



UNDERCUTTING CONTINUES
RESULTING IN BROKEN APRON



CONSTRUCTION OF A CUTOFF WALL
PREVENTS DAMAGE

Further Information

The following dissemination forums support Low Traffic Volume Rural Roads (LVRR) knowledge in the REAAA region:

global Transport Knowledge Partnership:

www.gtkp.com

SEACAP **Southeast Asia Community Access Partnership**:

www.seacap-info.org