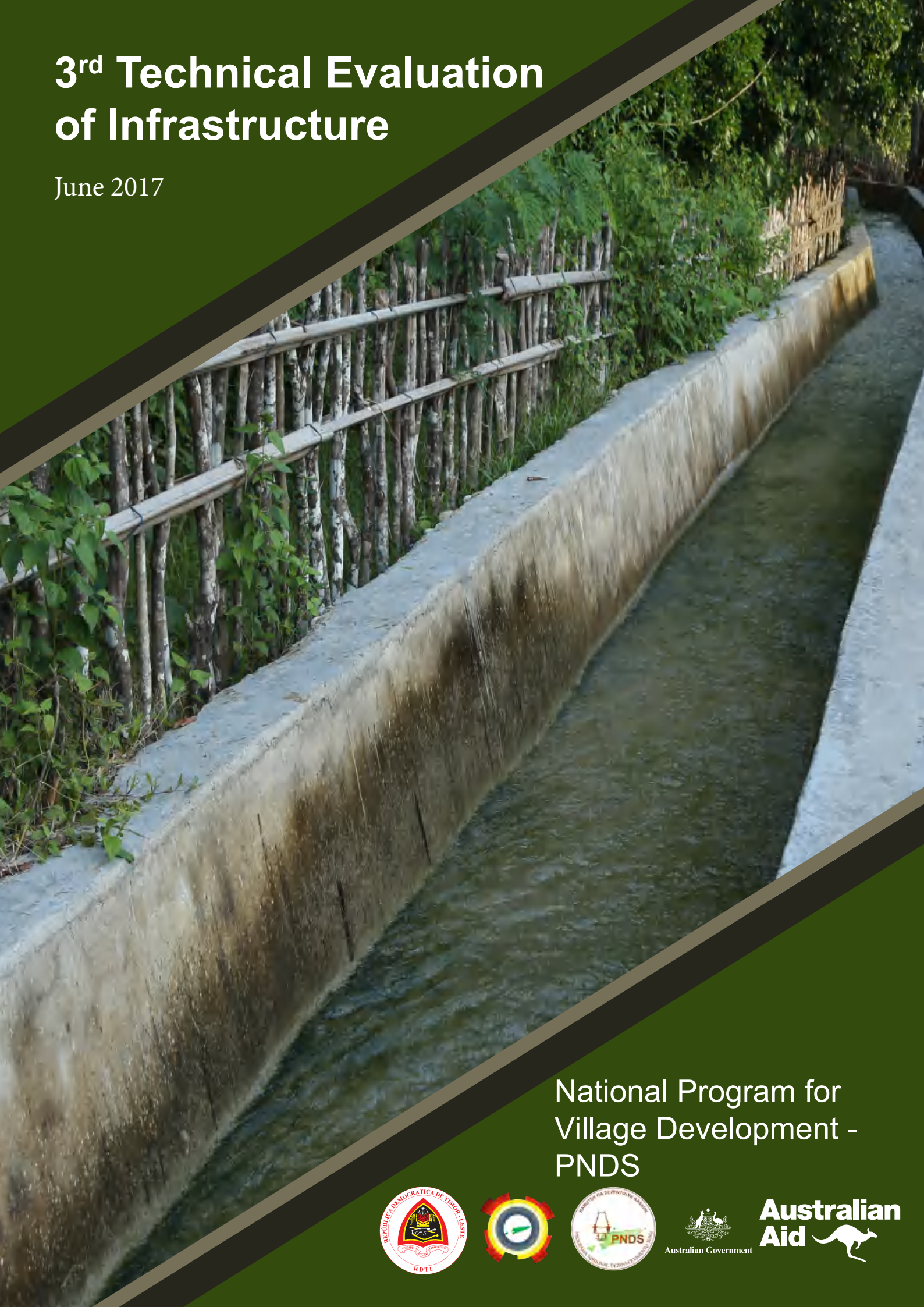
3rd Technical Evaluation of Infrastructure

June 2017



National Program for Village Development - PNDS

Australian Government

Australian Aid

Third Technical Evaluation of Infrastructure
June 2017

National Program for Village Development (PNDS)

Final Report

Findings and Recommendations

Neil Neate, P.Eng. & Su'udi Noor, Civil Engineer
Consultants to Government of Australia Aid Program
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Third Technical Evaluation of Infrastructure, PNDS, 2017

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List of Abbreviations and Acronyms

AP	Administrative Post, the administrative level between the village (Suku) and the municipality
APTF	Administrative Post Technical Facilitator
BoQ	Bill of Quantities
EIP	Ekipa Implementasaun Projetu Project Implementation Team, at village level
EOM	Ekipa Operasaun no Manetensaun Operation and Maintenance Team, at village level
EVAS	Ekipa Verifikasaun, Avaliasaun no Supervizaun Munisipiu Municipal Verification, Assessment and Supervision Team
FfP	Fitness for purpose
KPA	Komisaun Planeamentu no Akuntabilidade Planning and Accountability Commission, at village level
MCK	Mandi–Cuci–Kakus A bathing, washing and toilet facility
MIS	Management Information System
NSD	National Standard Drawing
O&M	Operation and maintenance
POM	Program Operations Manual
PNDS	Programa Nasional Dezenvolvimentu Suku National Village Development Program
PNPM	Program Nasional Pemberdayaan Masyarakat (Indonesia) National Program for Community Empowerment
SEDIF	Sub-Project Evaluation Data Input Forms
SP	Sub-Project
TCS	Technical Construction Standards
TE	Technical Evaluation
TF	Technical Facilitators
TEC	Technical Evaluation Checklists

Executive Summary

The Programa Nasional Dezenvolvimentu Suku (PNDS), or National Program for Village Development, is a nation-wide community development program of the Government of Timor-Leste. Launched in June 2012, it is contributing to rural development by funding the 'missing link' to services – basic village infrastructure – and providing jobs and training. The project fully encompasses the nation's 442 villages.

This technical evaluation follows similar audits in 2015 and 2016, and has assessed the quality of a random sample of infrastructures that have been completed, as well as some that are not yet finished construction. The random sampling was based on sub-projects from five Sectors – Sector 1 – Health; Sector 2 – Water and Sanitation; Sector 3 – Education, Culture and Sport; Sector 4 – Agriculture, Food Security, Livelihoods; and Sector 5 – Roads, Bridge and Flood Control. **A total of 65 sub-projects were evaluated during this exercise**.

The technical evaluation was conducted by Neil Neate, P.Eng. and Su'udi Noor, Civil Engineer, reprising their involvement with prior audits. Both of these engineers have extensive experience with Community Driven Development projects, and particular involvement with PNPM in Indonesia. Their technical reviews were largely based on information contained in the Community Project Proposals but also included a general overview of all technical aspects of the PNDS project.

The field teams used technical inspection checklists that are identical to the 2016 PNDS audit (and very similar to those used in the 2015).

The technical field instruments separated sub-projects into components or aspects, each of which is rated by the field team members. Components of a building, for example, are Foundation, Walls, Columns, etc., while aspects of these are Reinforcement, Dimensions, etc. The ratings used by the evaluators were 'Meets Specification', 'Slightly Below Specification' and 'Below Specification'. The specifications consulted by the evaluators are those found in the Community Project Proposals, which for phase III onwards are based on PNDS Technical Construction Standards (TCS).

- **Considering the aggregated total of the sub-projects evaluated, it was found that 78% of the technical components of the structures have been constructed in accordance with the plans and specifications as set out in the Community Project Proposals and the TCS.** This is slightly below the 2016 audit results of 80% for a similar aggregate.
- Bridge sub-projects (SPs) were found on the higher side of this – 84% of technical components were found meeting specification (four bridge SPs were evaluated). On the other end of the scale, however, several instances of poor reinforced concrete practices for bridges gave this infrastructure type the highest Below Specification rating: 13%.
- Road/drainage/retaining wall and irrigation SPs were also found to be higher than the average, with 82% and 83%, respectively, of technical components observed to Meet Specification (23 road and 4 irrigation SPs evaluated). Buildings were evaluated as 79% Meeting Specification, just above the average of all SPs.

- Water supply SP components were observed to be less often conforming to their community proposal specifications. Only 71% of water supply SPs were considered to Meet Specification, with 19% Slightly Below and 11% Below Specification.

The technical evaluation teams also rated other criteria. Where possible, local members of the village implementation committee (EIP) were questioned regarding their community's use of and the ongoing functionality of the infrastructure. This audit noticed a lesser number of members from the Operations and Maintenance Team (EOM) attending our visits, but when someone was available they were questioned about their activities and whether or not user fees are being collected. The sub-projects were also examined and rated in regard to how well the designs and construction efforts met the program's environmental safeguards.

- **A total of 93% of sub-projects were judged of Good or Excellent 'Fitness for Purpose'** which examines whether a SP has been over or under-designed and whether it is meeting the needs of the users.
- **94% of the sub-projects evaluated were rated as being Good or Excellent in terms of the construction's environmental impact**.

The remoteness of villages was found to have a weak correlation with technical quality in the audit results this year: less remote SPs are of a higher quality than the more remote SPs. Previous audits found that the remoteness of villages did not affect the technical quality of the sub-projects. This year's results should cause PNDS to doubly ensure that its man-power resources are equitably shared amongst municipalities, with those regions with a greater number of remote villages receiving additional resources.

Technical facilitation by PNDS staff was also examined by the evaluation teams. It was found, considering an aggregate of all the sub-projects evaluated, that **Technical Facilitators visited 82% of the village sub-project sites an average of at least once per week.**

This report provides an updated summary of the major deficiencies noted for the five infrastructure types, and makes suggestions to improve the PNDS construction program Recommendations for corrective measures and proper construction methodologies are presented throughout the report and summarized in Annex 1.

Final Report – Findings and Recommendations

1. Background

The Programa Nasional Dezenvolvimentu Suku (PNDS), or National Program for Village Development, is a nation-wide community development program of the Government of Timor-Leste. Launched in June 2012, it is contributing to rural development by funding the 'missing link' to services – basic village infrastructure – and providing jobs and training. The project fully encompasses the nation's 442 villages.

The Government is providing each village with a grant of around US$50,000 to plan, construct and manage their own small-scale infrastructure projects. Approximately 275 social, technical and finance facilitators have been allocated across the country to every Administrative Post to support villagers to plan and implement sub-projects. These facilitators are supervised and assisted by Municipal accountants and engineers.

PNDS is being implemented in phases – phase I (149 suku), phase II (91 suku) and phase III (202 suku). These three groups are currently moving through the PNDS cycle on an alternative schedule.

The first technical quality audit in 2015 evaluated a sample of projects from the initial pilot, phase I and phase II. The 2016 audit evaluated a sample of phase II and phase III projects only. This 2017 evaluation sampled sub-projects from phases I (cycle 2), phase II (cycle 2), and phase III (cycle1).

The sampling features infrastructure from six Sectors: Sector 1 – Health; Sector 2 – Water and Sanitation; Sector 3 – Education, Culture and Sport; Sector 4 – Agriculture, Food Security, Livelihoods; Sector 5 – Roads, Bridge and Flood Control; and Sector 6 - Other sectors.

2. Technical Evaluation Scope

The main objectives of technical evaluation are as follows:

The infrastructure audit team will use Technical Evaluation Checklists to assess and make recommendations in regard to the following:

- Design and technical working drawing of each infrastructure project
- Construction quality including:
  - Comparison between project design (project proposal) and actual construction
  - Comparison between project design (project proposal) and PNDS Technical Construction Standards [compliance]
  - Analysis and comparison of the final result between infrastructure audit round #1 and round #2
  - Workmanship, specifically on concrete work
- Functionality (Fitness for Purpose)
- Environmental safeguards
- Operations and Maintenance
- Frequency of technical facilitation
- Accessibility (for gender needs and people with a disability)
- Impact of geographic location (village remoteness)
- Comparison between PNDS project and other government built infrastructure projects in the village in terms of construction quality and maintenance

Recommendations of the Technical Evaluation are presented throughout the text of this report, and gathered together in Annex 1 for convenience.

3. Technical Evaluation Members and Field Teams

The technical evaluation was conducted by Neil Neate, P.Eng. and assisted by Su'udi Noor, Civil Engineer. Two technical evaluation field teams were led by them, and included members of the PNDS National Program Secretariat and Municipal/Administrative Post PNDS staff for logistical/safety support. The team led by Neil Neate went to the Municipalities of Ainaro (Maubisse, Hato-Builico and Hate-Udo Administrative Posts), Manufahi (Tricia, Same, Alas and Flaubertian APs) and Dili (Dom Alexia, Nain Feta and Vera Cruz APs); the other team evaluated sub-projects in the Municipalities Aileu (Remedios AP), Dili (Cristo Rei and Atari APs), Lautem (Iliomar, Lospalos, Tutuala, Lautem and Luro APs), and Oecusse (Nitibe, Oesilo, Passabe and Pante Macassar APs).

Neil Neate has worked with international rural development projects for over thirty years. He has provided consulting engineering advice, mentorship, technical evaluation, monitoring, and project management services to projects in Indonesia, Thailand, Lao PDR, Cambodia, Madagascar, Belize and elsewhere. Neil conducted this technical evaluation of PNDS in a similar manner as the audits in 2015 and 2016, and will draw comparisons with results of those last years.

Su'udi Noor completed a degree in civil engineering in Yogyakarta in 1986. He began his career with the Indonesian Department of Public Works, working on improvements to bridges and roads throughout the archipelago. In 1995, Su'udi began to work for rural development projects, starting with National Management Consultant (NMC) and other organizations. He has spent much time consulting to the PNPM project as a senior rural infrastructure specialist. Su'udi is well versed in all types of rural constructions, and has helped to produce field manuals for roads, bridges and other types of infrastructure. He has worked in Timor-Leste in 2012 as a technical review consultant to The Youth Development Project and assisted with the 2016 audit of PNDS.

4. Site Selection Procedure and Sampling Methodology

The focus for the 2017 technical audit are sub-projects from the Pilot (Cycle 1), Phase I (Cycle 2), Phase II (Cycle 2) and Phase III (Cycle 1). The projects cover five sectors in six municipalities (i.e. Aileu, Ainaro, Dili, Lautem, Manufahi and Oecusse), resulting in a total population of 288 projects (see Table 1). Apart from Aileu, none of other five municipalities was included in the technical audit of either 2015 or 2016. Aileu has been part of all technical audits, to make it possible to do some longitudinal study.

Table 1: Total Population of Suku Projects for the 2017 Technical Audit

Municipality	Sectors					Total
	Agriculture, food security and livelihoods	Water and sanitation	Roads, bridges and flood control	Education, culture and sports	Health	
Aileu	1	19	28		4	52
Ainaro		10	18	1		29
Dili		31	32	4	3	70
Lautem	2	36	19	8	1	66
Manufahi	1	20	23	2		46
Oecusse	2	8	10	3	2	25
Total	6	124	130	18	10	288

The sampling of projects in 2017 was done in a two-step approach:

- Sampling of projects from the municipalities Aileu, Ainaro, Dili, Lautem and Manufahi.
- Additional sampling of projects from Oecusse.

The initial idea for the 2017 technical audit was that it would cover only five municipalities, and that Oecusse projects would be assessed in a next round. Preparations for the technical audit were already well advanced when a last-minute decision was made to include Oecusse in the current audit as well.

For the sampling, it was decided to keep the sample that had already been drawn from the 263 projects in the five initial municipalities, and to add to it the number of projects from Oecusse that a sampling for 288 projects in six municipalities would give.

Using an online sample size calculator[1], for a population of 263, with a 90% confidence level and a 10% margin of error, the recommended sample size is 54. As there are many more water & sanitation, and roads & bridges projects than from the

other three sectors, a stratified random sampling approach was used, to ensure that the sample was representative from a sector perspective.

The row 'sample' in Table 2 shows how many projects from each sector are needed to have a proportional representation. Given the small number of agriculture, health and education projects, two extra agriculture, one extra education and one extra health

[1] Here http://www.raosoft.com/samplesize.html was used.

project were added to the sample. The adjusted sample thus has in total 58 projects.

Table 2: Total Population and Sample Size of Suku Projects for the 2017 Technical Audit

Municipality	Sectors					Total
	Agriculture, food security and livelihoods	Water and sanitation	Roads, bridges and flood control	Education, culture and sports	Health	
Total	4	116	120	15	8	263
Sample	1	24	24	3	2	54
Adjusted sample	3	24	24	4	3	58

To ensure a random sampling of the projects for each sector, the following approach was followed:

a) The projects list was sorted by sector. A random list of numbers was generated, from 1 to the total number of projects in that sector, and each project was assigned a randomly generated number[2].

b) A second list of random numbers, as specified in Table 2 for that sector was generated (e.g. 24 for water and sanitation), with the numbers being chosen between 1 and the total number of projects for that sector (i.e. 116 for water and sanitation). The selection of random numbers was again done with a random generator.

This random sampling resulted in the 58 projects being selected in the sectors and municipalities as shown below in Table 3.

Table 3: Survey sample

Municipality	Sectors					Total
	Agriculture, food security and livelihoods	Water and sanitation	Roads, bridges and flood control	Education, culture and sports	Health	
Aileu	1	1	8		2	12
Ainaro		3	4			7
Dili		6	4	3	1	14
Lautem	1	8	3	1		13
Manufahi	1	5	6			12
Sub-Total	3	23	25	4	3	58
Oecusse	2		2	2	1	7
Total	5	23	27	6	4	**65**

The same sampling approach was also done for the total of 288 projects, which resulted in seven projects from Oecusse being randomly selected. With these seven additional projects, the total number of projects to be assessed became 65.

[2] The random numbers were generated with https://www.randomizer.org/

Since Aileu projects have also been included in the technical audits of 2015 and 2016, there was an additional check if any of the currently selected projects had been included in those earlier technical audits. There was one road project, in suku Tohumeta, which had been surveyed in 2016. It was replaced in the sample with the other road project in the same suku.

It was also decided to replace an assessment of a public waste storage bin in Kampong Alor, Dili, with an assessment of another project in the same suku: a road upgrading project. This reduced the total of water and sanitation projects with one, and increased the number of roads projects with one.

5. Technical Evaluation Methodologies

5.1 PNDS Sectors vs. Sub-Project Types

As described above, the PNDS sub-projects included in this evaluation were randomly selected based on Sector. As described in the last technical evaluation reports, the occurrence of certain infrastructure types in multiple sectors (notably buildings in sectors 1, 2, 4 and 5) creates problems for computer coding and analytical sorting techniques, so that this 2017 evaluation will again use a coding system based on infrastructure 'type'.

The sampled sub-projects were therefore divided into five sub-project (SP) 'types', allowing each SP evaluated to be assigned a SP type code. The SP types identified for the PNDS menu are as follows:

Table 4: PNDS Technical Evaluation 2017 Sub-Project types

Type	Sub-Project Type Descriptor	Number of Sub-Projects Evaluated	Sectors Represented Within This Sample
1	Building	14	1, 2, 3, 4
2	Bridge	4	5
3	Water Supply	20	2
4	Road, Drainage, Retaining Wall	23	5
5	Irrigation	4	4

The SP sampling stratification methodology, based on Sector, remains random and valid. The analysis within this report is, however, based upon the above SP types, and the findings for each specific SP type apply across all sectors in which such infrastructure is found. For example, the technical evaluation's conclusions regarding reinforced concrete practices will apply equally to buildings found in most Sectors, to concrete reservoirs in Sector 2, to concrete bridges in Sector 5, to concrete road structures, drainage channels and retaining walls in Sector 5, etc.

5.2 Technical Evaluation Checklists

The technical evaluation (TE) teams used unique Technical Evaluation Checklists (TEC) for each SP type, using the field tools similar to the 2016 audit. The TEC are attached to this report in Annex 2 - Technical Evaluation Checklists.

The field checklists divided the SP type structures into a number of technical components, each to be rated separately. The components for the infra type Building, for example, started at the base: Foundation, Ground Beam, Wall, Column, etc., proceeding up to the Roof Structure. Where a particular component had several distinct aspects that could be evaluated separately, the component was subdivided, for example: Ring Beam - Reinforcement and Ring Beam - Dimension.

This field instrument also collected other SP quality ratings (Overall Construction Quality, Fitness for Purpose, etc.) that are more fully discussed in Section 5.4 below. Space is

provided on all the checklists for comments to be written. Much of this commentary is recorded in the Brief SP Reports that are provided for each SP evaluated.

5.3 Technical Rating System

Each component or aspect of a SP was rated as being one of five choices: Meets Specification.; Slightly Below Specification.; Below Specification.; Not Inspected; and Not Applicable. The component or aspect was examined in its current condition and reasonable allowances were made for normal wear-and-tear and degradation.

These ratings are defined for this technical evaluation as follows:

- **Meets Specification** (Meets Spec) – The SP component or aspect meets the plans, specifications, or criteria as set out in the Sub-Project Proposal.
- **Slightly Below Specification** (Slightly Below Spec) – The SP component or aspect displays certain characteristics that could be improved upon within its design/construction/operation/maintenance or environmental conditions to meet the plans, specifications or criteria presented in the Community Proposal. This rating will normally be accompanied by written commentary describing improvements that can be made to improve technical quality and sustainability.
- **Below Specification** (Below Spec) – The SP component or aspect was either (i) not constructed according to the approved plans or specifications in the Community Proposal, or (ii) presents a clear and present danger to the life or safety of users. This rating will normally be accompanied by written commentary describing improvements that must be made to ensure technical quality and sustainability.
- **Not Inspected** – It may occasionally be impossible for the TE team to inspect a certain aspect of a SP. For example, many completed buildings feature ceilings with limited or no access to the attic. TE teams may not be able to inspect the interior of a building's roof structure in these instances. The TE team will question the village and AP/municipal personnel in this instance to verify SP details as much as possible.
- **Not Applicable** – Some components or aspects will not be applicable to SPs. For example, the component Ceiling is included in the Building Checklist, but many building SPs do not include such installations.

Evaluators take into account normal deterioration of components over time. The use of this rating system assumes that standard O&M tasks have been carried out. Undue degradation stemming from poor O&M is not the infrastructure's fault (where the SP works were well designed and installed).

5.4 Quality Ratings and Other Criteria

The second page of the TEC offers the evaluator an opportunity to rate the sub-project's construction quality as well as in several more general and less-technical areas. These "Overall Project Assessment" categories are as follows:

- Overall Construction Quality (rated Excellent, Good or Poor), with opportunity to write a comment
- Fitness for Purpose (rated Excellent, Good or Poor (or None if the SP is not yet finished)), with opportunity to write a comment
- Environmental Considerations (Good, Average, Poor), with opportunity to write a comment
- Frequency of Technical Facilitation and Supervision (frequency was provided in a number of ways; it was simply noted down)

Definitions of Ratings

Overall Construction Quality

Excellent – Sub-Project fully complies with or exceeds Community Proposal requirements and displays outstanding workmanship, consistent use of specified materials and proper construction methodologies.

Good – Sub-Project displays moderate shortcomings that do not have a material impact on compliance with Community Proposal requirements. Workmanship is good with no problems that require major attention to correct or improve.

Poor – Sub-Project displays significant shortcomings that will affect the achievement of development objectives. Workmanship is poor with problems that require attention to correct or improve. Major work is needed to enable the infrastructure to operate effectively.

Fitness for Purpose

Excellent – Sub-Project has been neither over nor under-designed, fully complies with or exceeds Community Proposal requirements in regard to adequate and appropriate sizing of infrastructure, operational complexity and maintainability for its users. (This rating is an empirical judgment, and might be represented, for example, by a Sub-Project where the recipient community or user group have independently added to, improved or used a Sub-Project in ways to increase its usefulness. Actions of this nature would be a very large vote of confidence in the original PNDS works as an instigator of further self-directed community development activities.)

Good – Sub-Project has been neither over nor under-designed, and has fulfilled the requirements of the recipients and the Community Proposal.

Poor – Sub-Project is either not operable (having been poorly designed, located in a bad or inappropriate position, or improperly constructed) or is very much over or under-designed for its intended purpose.

Environmental Considerations

Excellent – Sub-Project fully complies with or exceeds the PNDS POM Guiding Principles in regard to environmental safeguards and is observed to be adding value to the local community and its environment.

Good – Sub-Project complies with appropriate environmental safeguards and has not adversely affected the local environment or community.

Poor – Sub-Project displays environmental shortcomings that will affect the achievement of development objectives. Work is needed for improvements to safeguard the environment.

These quality ratings are further discussed below in Section 7, in separate sections for each. Analysis of the SP quality ratings gathered in this part of the TEC is presented along with some commentary. A listing of the 65 SPs evaluated is provided in Section 6 below, along with a complete summary of the technical evaluation's individual quality ratings in Annex 3.

The second page of the TEC also provides space for the evaluator to write a brief SP description and add comments regarding particular issues that were noted during the evaluation. Brief SP Reports for each infrastructure visited have been created that records this information and are included with this report in Annex 4.

5.5 Field Checklist Data Input

The data from the Technical Evaluation Checklists were input to digital spreadsheets in the office after the fieldwork was complete. The digital spreadsheets are patterned after the TEC and are called Sub-Project Evaluation Data Input Forms (SEDIF). These forms allow input of the field data in a format very similar to that in which it was gathered, thereby reducing input errors. The digital spreadsheets allow the field data to be systematically filed, grouped and analyzed using computer sorting techniques. The data within the sub-project spreadsheets can, for example, be sorted by age, by location or by the rating evaluations under Construction Quality or Environmental Considerations. Sorting procedures can be used to reveal trends or to highlight problem areas.

5.6 Use of Technical Construction Standards

The National Standard Drawing (NSD) set has now been introduced to the Municipal PNDS offices and is being used for the majority of the current SPs, although a slightly lesser percentage than found in the 2016 audit.

It was found, for the SP documents evaluated, that 56% of the Community Proposals contained some or all of the National Standard drawings for the subject infrastructure type (only 57 of 65 SP proposals were available for audit).

Some of the files examined contained the NSD title sheet and several more pages, but were missing the complete NSD set, which include cross sections and details. Very few NS drawings were revised to show the infrastructure resized to fit local conditions. Workers are obliged to consult the Bill of Quantities for accurate dimensions – this is a concern since some sites may not have someone onsite who is capable of this.

Community Proposals containing the appropriate TCS infrastructure drawings can also be examined by Municipality, as in the following table.

Table 5: Use of Technical Construction Standard Drawings by Municipality

	Aileu	Ainaro	Dili	Lautem	Manufahi	Oecusse
Use of TCS	90% (9 of 10) [2 no files]	100% (6 of 6) [1 no files]	43% (6 of 14)	23% (3 of 13)	100% (7 of 7) [5 no files]	14% (1 of 7)

Discussion

Use of the TCS appears to have become standard practice in some municipalities while in others, Dili, Lautem and Oecusse in this audit, the drawings and details are less commonly used. It is noted, however, that the more recent SP in Lautem (less than one year old) used the drawings more commonly (3 of 4 SP used the TCS).

Recommendation 1: The TCS drawings and details should be used by all TF when developing designs. The standard TCS drawings should be revised to show the planned dimensions of the infrastructure in conformance with the Bill of Quantities.

6. Sub-Projects Evaluated

No.	Municipality	Administrative Post	Suku	Status	Sub-Project
1	Aileu	Aileu Vila	Bandudato	Remote	Rural Road
2	Aileu	Aileu Vila	Hoholau	Very Remote	Rural Road
3	Aileu	Aileu Vila	Seloi Craic	Remote	Irrigation
4	Aileu	Aileu Vila	Seloi Craic	Remote	Bridge - concrete
5	Aileu	Aileu Vila	Seloi Malere	Remote	Rural Road
6	Aileu	Aileu Vila	Suco Liurai	Remote	Rural Road
7	Aileu	Laulara	Talitu	Remote	Rural Road
8	Aileu	Laulara	Tohumeta	Remote	Rural Road
9	Aileu	Remexio	Faturasa	Very Remote	Water Supply – gravity fed
10	Aileu	Remexio	Suco Liurai	Very Remote	Housing - Health Post
11	Aileu	Remexio	Maumeta	Remote	Rural Road
12	Aileu	Remexio	Maumeta	Remote	Health post
13	Ainaro	Maubisse	Maubisse	Remote	Water Supply – gravity fed
14	Ainaro	Maubisse	Maubisse	Remote	Water Supply – gravity fed
15	Ainaro	Maubisse	Horai-Quic	Very remote	Bridge - concrete
16	Ainaro	Hatu Builico	Mau Chiga	Very remote	Water Supply – gravity fed
17	Ainaro	Maubisse	Aituto	Very remote	Rural Road
18	Ainaro	Maubisse	Manelobas	Very remote	Rural Road
19	Ainaro	Hatu Udo	Foho-Ai-Lico	Very remote	Retaining wall
20	Dili	Dom Aleixo	Bairro Pite	Urban	Water Supply
21	Dili	Dom Aleixo	Bairro Pite	Urban	Water Supply
22	Dili	Dom Aleixo	Comoro	Urban	Health post

No.	Municipality	Administrative Post	Suku	Status	Sub-Project
23	Dili	Dom Aleixo	Kampung Alor	Urban	Urban Road
24	Dili	Nain Feto	Lahane Oriental	Urban	Water Supply – gravity fed
25	Dili	Vera Cruz	Caicoli	Urban	Drainage
26	Dili	Vera Cruz	Colmera	Urban	Pipe Culvert
27	Dili	Vera Cruz	Dare	Remote	Water Supply – gravity fed
28	Dili	Vera Cruz	Vila Verde	Urban	Drainage
29	Dili	Atauro	Beloi	Remote	School extension
30	Dili	Atauro	Macadade	Very Remote	School extension
31	Dili	Cristo Rei	Becora	Urban	Water Supply – pump
32	Dili	Cristo Rei	Hera	Urban	Water Supply – gravity fed
33	Dili	Cristo Rei	Meti-Aut	Urban	School – primary
34	Lautem	Iliomar	Aelebere	Very Remote	Irrigation
35	Lautem	Iliomar	Fuat	Remote	School – primary
36	Lautem	Lospalos	Bauro	Remote	Water Supply – well
37	Lautem	Tutuala	Tutuala	Urban	Retaining wall - gabion
38	Lautem	Lospalos	Muapitine	Remote	MCK
39	Lautem	Lospalos	Muapitine	Remote	Drainage
40	Lautem	Lautem	Pairara	Remote	Water Supply – gravity fed
41	Lautem	Lautem	Com	Remote	Drainage
42	Lautem	Lautem	Parlamento	Remote	Water supply – catchment dam
43	Lautem	Luro	Lacawa	Very Remote	Water Supply – gravity fed
44	Lautem	Lautem	Maina II	Very Remote	Water supply – catchment dam
45	Lautem	Lautem	Serelau	Remote	Water Supply – gravity fed

No.	Municipality	Administrative Post	Suku	Status	Sub-Project
46	Lautem	Lautem	Ililai	Very Remote	Water Supply – pump
47	Manufahi	Turiscai	Caimauc	Urban	Bridge – concrete
48	Manufahi	Turiscai	Manumera	Urban	Bridge – concrete
49	Manufahi	Turiscai	Mindelo	Remote	MCK
50	Manufahi	Turiscai	Fatucalo	Very remote	Rural Road
51	Manufahi	Turiscai	Matorec	Remote	Rural Road
52	Manufahi	Turiscai	Foholau	Very remote	MCK
53	Manufahi	Turiscai	Orana	Remote	Rural Road
54	Manufahi	Same	Daisua	Remote	Rural Road
55	Manufahi	Alas	Mahaquidan	Urban	Water Supply – pump
56	Manufahi	Fatuberliu	Clacuc	Urban	Water supply
57	Manufahi	Fatuberliu	Clacuc	Urban	Water Supply – well
58	Manufahi	Same	Holarua	Urban	Water Supply – gravity fed
59	Oecusse	Nitibe	Lela-Ufe	Very Remote	Market
60	Oecusse	Nitibe	Lela-Ufe	Very Remote	Housing - teachers
61	Oecusse	Nitibe	Usi-Taco	Very Remote	Irrigation
62	Oecusse	Oesilo	Usi-Taqueno	Very Remote	Clinic - maternity
63	Oecusse	Passabe	Malelat	Very Remote	Concrete Road
64	Oecusse	Pante Macassar	Costa	Remote	Concrete Road
65	Oecusse	Pante Macassar	Cunha	Remote	School - primary

7. Technical Findings

7.1 Technical Specifications vs. As-Constructed Infrastructure

The PNDS infrastructure was evaluated using the same field tools as the previous 2015 and 2016 audits. These tools allow each component or aspect of the individual sub-project types to be rated as being one of three choices: Meets Specification; Slightly Below Specification; or Below Specification. The rating is a reflection of how the component/aspect has followed the SP Proposal and specifications, the quality of its material composition/inputs, and its consistency with the bill of quantities (BoQ). The rating system of Meets Specification/Slightly Below Specification/Below Specification is roughly analogous to Good/Fair/Poor.

In order to understand the technical quality of the full breadth of SP works, all of the ratings assigned the components/aspects of all the SPs can be aggregated, providing a useful overview of the entire PNDS construction program.

An analysis of these ratings shows that, when **considering an aggregate of all sub-project components, 78% of the sub-projects have been constructed in accordance with the plans and specifications contained in the Sub-Project Proposals and considered to Meet Specification, with a further 15% rated Slightly Below** in terms of meeting the intent of the sub-project proposal. **Only 7% of technical ratings are rated Below Specification.** This compares favorably to an aggregate from the 2016 audit results of 78% Meets Specification /13% Slightly Below Specification /9% Below Specification. These figures are shown in the following table for ease of reference.

Table 6: Aggregate of 2016-2017 Technical Evaluation Ratings for all SPs

Year	Meets Specification	Slightly Below Specification	Below Specification
2016	78%	13%	9%
2017	78%	15%	7%

Discussion

The aggregated percentages in the table above are derived from component/aspect ratings gathered from 56 SPs in 2015 and 65 SPs in 2017. Each infra type is divided into about 15 different components or aspects, each of which are separately rated. Thus, approximately 840 and 975 ratings were gathered in these respective years, allowing a large amount of certainty to be attached to these findings.

This aggregation of data reveals two significant things:

- **The technical quality of PNDS' constructed works has been maintained at about the same level as last year**
- **The project has successfully reduced the occurrence of poorly executed works (reducing the Below Specification from 9% to 7%).**

The first conclusion above is not too surprising, as changing construction practices with widely spread resources and rural stakeholders is a difficult and slow thing to do. The downward trend for Below Specification components is encouraging. It can also be noted that the aggregate of technical quality ratings from the 2015 audit was also found to be roughly consistent with the 2016 findings, so that it can be observed that the technical quality of PNDS' works is progressing in the right direction, albeit slowly.

Following is a chart that provides a visual representation of the 2017 technical audit findings.

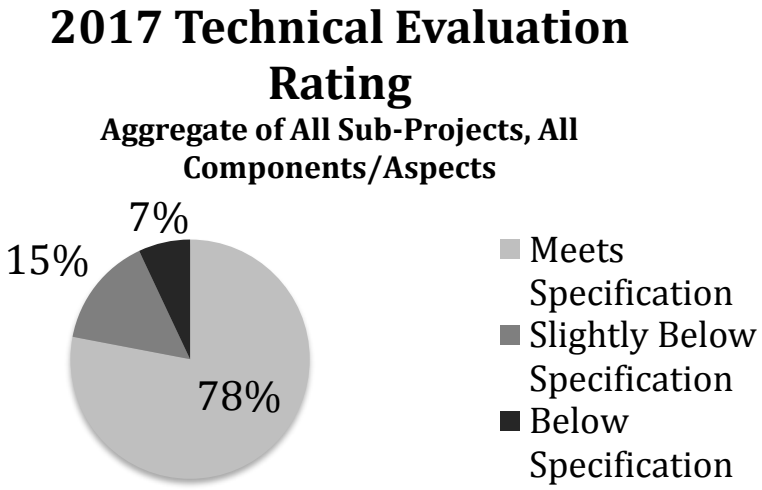


Chart 1: Technical Evaluation Rating for 2017 Audit

These aggregate ratings can be examined using other parameters, including infra types, age of the infrastructure, its location (by municipality, for example, or remoteness within an administrative post), or by component groupings (for example, comparing concrete results between the different infra types).

The following table separates the current SP data on the basis of the age of the infra. The number of years (or months) since the completion of each evaluated SP were recorded to facilitate this analysis. SPs that were incomplete or completed within six months of the evaluation were deemed "0" years old; those completed between six and 18 months ago were one year old; etc. The evaluation examined 27 SPs that were age 0; 36 SPs that were age one; and two SPs that were age two.

Table 7: Aggregate of 2017 Technical Ratings, by Age of Infrastructure

Age (No. of SPs)	Meets Specification	Slightly Below Specification	Below Specification
0 year (27)	74%	19%	8%
1 year (36)	81%	12%	7%
2 years (2)	100%	-	-

Discussion

The data above shows a lesser quality of infra in more recently constructed SPs (81% of components of 1-year-old SPs Meet Specification versus only 74% of newer infra). This apparent trend should not be extended to the 2-year-old SPs as there are too few to make a sound judgment. The decrease in quality in these more recent SPs may be associated with other factors that affect these totals, for instance, SP infra type. This hypothesis will be examined in Table 8.

Table 8 presents totals for each of the SP infra types evaluated. It should be noted that there was only four bridges and four irrigation SPs inspected during this technical evaluation so that extrapolation of these technical findings over PNDS' entire portfolio of such SP types may be tenuous.

Table 8: Summary of Aggregate Technical Ratings by SP Type, All SPs

Infrastructure Type (Number of SPs Evaluated)	Meets Specification	Slightly Below Specification	Below Specification
Building (14)	79%	17%	4%
Bridge (4)	84%	3%	13%
Water Supply (20)	71%	19%	11%
Road, Drainage, Retaining Wall (23)	82%	10%	8%
Irrigation (4)	83%	17%	0%
Average over 65 sub-projects	**78%**	**15%**	**7%**

Discussion

The aggregate percentages of Meets Specification components for SP infra types **Bridge, Road and Irrigation are all well above average** and are appropriate for the fourth year of the PNDS rural construction program. The current **success of road 'spot improvement' methodologies has much improved this infra type** (Road, 2016: Meets Specification 78%, Slightly Below Specification 4%, Below Specification 18%).

The Slightly Below Specification totals can be added to the Meets Specification column to show that PNDS **building works are also in a favorable position**, with very few instances where specific components are considered Below Specification (Building, 2017: Below Specification 4%).

Water supply SPs have experienced a downturn in their quality from the 2015 audit, a topic that will be explored in detail later in this report. A disappointingly high number of water system components were considered Slightly Below or Below Specification; this has caused the Meets Specification percentage to fall far below the average. Last year's report saw some encouraging data returned from the field evaluations, but it appears that some of these design and construction problems have persisted and perhaps grown more prevalent.

The **PNDS road programme continues to show promising results with its turn toward spot improvement methodologies**. The technical audit in 2015 made this recommendation: that PNDS should avoid attempting to improve lengthy sections of rural earth or gravel road and instead concentrate upon so-called spot improvements. These are small, local improvements featuring drainage infrastructure, retaining walls,

small bridges or steep road section civil works. The 2016 audit witnessed a turn toward this style of road SP. That audit found the few road opening or lengthy track widening SP had been executed with mixed to poor results, whereas the majority of the spot improvement works were suitably installed. This year's results offer similar conclusions: PNDS lengthy road or track improvement SPs (6 of them) delivered very disappointing results but **the spot improvement SPs featured, for the most part, components that had been appropriately designed and installed, with 88% Meeting Specifications.** The results for 2017 are in Table 9 below.

Table 9: Summary of Aggregate Technical Ratings by SP Type, All SPs, by Components/Aspects

Infrastructure Type (Number of SPs Evaluated)	Meets Specification	Slightly Below Specification	Below Specification
Spot Improvement SP only (17)	88%	8%	4%
Lengthy track or road SP only (6)	56%	22%	22%
Combined	82%	10%	8%

Discussion

It is apparent from these findings that road SPs that involve lengthy road or track improvement works are much more prone to suffering poorly designed or installed infrastructure. The data in Table 9 above reflect technical quality ratings applied only against a series of road improvement works that are used in both spot improvement and lengthy widening SPs: retaining wall, culvert, small bridge, steep section and drainage channel.

The figures in Table 9 make it evident that where road SP works are diverted toward lengthy road or track improvements, the technical quality of important road infrastructure is greatly lessened (only slightly more than half of the components inspected were considered to Meet Specification). Evidence of the poor quality of the lengthy road works was also gathered, using the second part of the Road evaluation field instrument. This facet of the road evaluation is more fully described and results presented in Section 8 Best Practices and Recommendations, 8.4 Road, Drainage and Retaining Wall (particularly Table 26).

7.2 Remoteness

The PNDS MIS classifies each village with a degree of remoteness, which is linked to the Suku Grant allocation level. The degrees are as follows:

Not Remote	< 10 km from Municipal Capital
Remote	10 – 30 km
Very Remote	30 – 55 km
Extremely Remote	> 55 km

This audit's sampling contains a number of SPs that are within the 'urban' areas of the Dili or municipal centres. Although technically classified as Not Remote, for the purposes of refined analysis, these SPs have been sub-classified as Urban:

Urban Within Municipal or National Capital urban boundaries

The results from 2015 and 2016 did not show a distinct trend toward lower technical quality with increasing remoteness. This does not hold true, however, for the 2017 audit. Table 10 below shows the aggregate percentage of "Meets Specification" component ratings for each individual sub-project type, shown for each degree of remoteness, along with the aggregate sum of all sub-projects evaluated.

Table 10: Aggregate of "Meets Specification" components for Sub-Project Types vs. Remoteness - % (Number of SPs in each degree of remoteness)

Infrastructure Type (Number of SPs Evaluated)	Urban	Not Remote	Remote	Very Remote
Building (14)	83% (1)	80% (1)	82% (6)	76% (6)
Bridge (4)	85% (2)	-	89% (1)	78% (1)
Water Supply (20)	74% (5)	40% (2)	82% (8)	68% (5)
Road, Drainage, Wall (23)	100% (4)	75% (1)	77% (11)	86% (7)
Irrigation (4)	86% (1)	-	67% (1)	100% (2)
All Sub-Projects (65)	**82% (13)**	**54% (4)**	**80% (27)**	**78% (21)**

Discussion

The current audit has found a slight trend toward lesser quality of technical works with increasing remoteness. Consulting the bottom line in Table 10 above, the urban SPs are, on average, meeting specifications 82% of the time, with remote SPs 80% and very remote SP works 78%. (The finding for the Not Remote sites is heavily influenced by two poorly executed water supply SPs in the suburbs of Dili.) Each of the infrastructure types shows a somewhat similar trend for lesser quality in more remote places with some anomalies that might be associated with small sampling numbers (or poorly executed water supply SPs).

This finding does not reveal large discrepancies in technical quality, however, so that PNDS planning for technical extension services to the more remote parts of Timor-Leste can likely continue in its current state with vigilance accorded to ensuring that remote areas continue to receive their due attention. Relating to this aspect of the PNDS program is this report's examination of TF visits to SP sites. This will be examined in detail in Section 7.10 of this report.

7.3 Age of Infrastructure by Infra Type

Spreadsheets were further sorted to determine if there are any apparent trends in technical quality based upon when each of the SP types were constructed. The main difference that might influence technical aspects of SPs according to the age of the infrastructure is the frequency and quality of technical facilitation and supervision (assuming that quality of material supply and local skilled labour remain the same). The influence of technical facilitation is examined more closely below in Section 7.10,

Frequency of Technical Facilitation. The difference in technical quality by age of the entire audit sample has already been examined, in Table 7 above, which showed that the number of infrastructure components meeting specification decreased from 81% for 1-year-old SPs to 74% for more current or unfinished SPs.

Table 11 examines each SP type to see if the trend toward lessening quality is demonstrated in all infrastructure types.

Table 11: Aggregate of "Meets Specification" components for Sub-Project Types by Phase - % (Number of SPs within each Phase Only Age 0 and 1 year old)

Infrastructure Type (Number of SPs Evaluated)	Age 0	Age 1
Building (14)	80% (7)	77% (7)
Bridge (4)	89% (1)	83% (3)
Water Supply (19)	60% (6)	76% (13)
Road, Drainage, Wall (22)	70% (10)	90% (12)
Irrigation (4)	80% (3)	100% (1)
All Sub-Projects above (63)	74% (27)	81% (36)

Discussion

Observations from the table above can also be tied to conclusions derived from Table 8 above. For example, in that table it was observed that the water supply SPs have been found to have a low Meets Specification combined average percentage. This is shown in Table 8 where the water supply SPs have been rated the lowest for all infra for both years-of-construction (ages 0 and 1).

In the Table 11 above, it is seen that **buildings have improved in this last year with the Meets Specification rating rising from 77% to 80%. Bridges have also moved up from 83% Meets Specification to 89%.**

Irrigation have too few within the sample to make a judgment on this aspect.

Roads show a decrease in quality from age 1 to age 0, largely stemming from the presence in the Age 0 sample of 3 lengthy track or road widening efforts that had many components/aspects rated more heavily toward Slightly Below or Below Specification. This again demonstrates that road spot improvement methodologies should be pursued within the PNDS road program.

7.4 Overall Construction Quality

The second page of the Technical Evaluation Checklists features a section where the evaluator, having evaluated the Community SP Proposal and each of the components of the infrastructure itself, can review the sub-project as a whole entity, disregarding slight imperfections or deficiencies in some components and aspects of the construction. The ratings are Excellent, Good and Poor.

78% of the infrastructure examined during this evaluation was considered to be Good in its overall construction quality (51 of 65 sub-projects), with 8% (5 SPs) rated Excellent. 9 SPs were rated Poor.

These are somewhat less stellar results than the 2016 audit. A comparison of the two years is shown in the table below.

Table 12: Overall Construction Quality, 2016 vs. 2017 - % (No. of SPs)

Year	Excellent	Good	Poor
2016 2017	7% (4) 8% (5)	84% (47) 78% (51)	9% (5) 14% (9)

Chart 2 below shows the 2017 ratings pictorially.

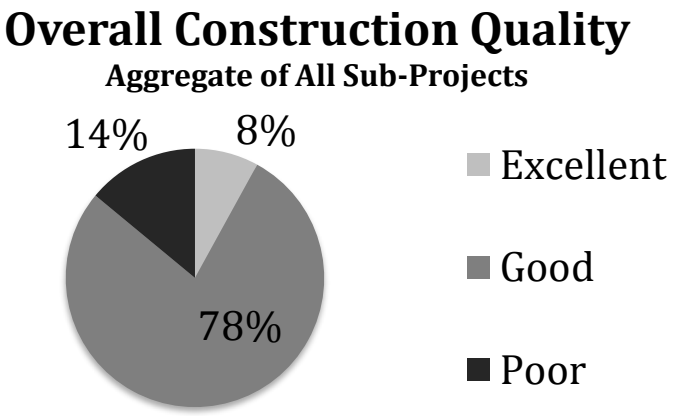


Chart 2: Overall Construction Quality

The finding that 86% of infrastructure works are of Good to Excellent construction quality indicates that the PNDS construction program continues to provide adequate support to communities as they plan and develop their rural infrastructure.

Discussion

This subjective finding is somewhat lower than that found in 2016. An examination of the data indicates that the 'Poor' SPs are populated by 2 water supply SPs (with poorly planned distribution networks), 2 bridges (with poor reinforcement) and 4 lengthy road or track SPs (with many individual problems).

The slightly lower percentage for this indicator (2016 found 91% Good to Excellent) does indicate that more attention should be directed at the SP types highlighted with the poor ratings.

This data can also be examined by infrastructure type, to reveal successes or deficiencies in particular sectors.

Table 13: Overall Construction Quality - % of SPs Evaluated (No. of SPs)

Infrastructure Type (Number of SPs Evaluated)	Excellent	Good	Poor
Building (14)	7% (1)	93% (13)	-
Bridge (4)	-	50% (2)	50% (2)
Water Supply (20)	-	90% (18)	10% (2)
Road, Drainage, Wall (23)	4% (1)	74% (17)	22% (5)
Irrigation (4)	75% (3)	25% (1)	-
All Sub-Projects (65)	**8% (5)**	**78% (51)**	**14% (9)**

Discussion

It can be seen that buildings and irrigation SPs are being executed in a good and proper manner. Two bridges were deemed poorly done, mostly due to poor steel reinforcement practices, as will be described later in this report. A great majority of water supply SPs were rated Good, but this encouraging figure is somewhat spoiled by two disappointing water supply SPs in Dili that were rated Poor, with community social difficulties reducing the effectiveness of these investments. The road SPs that concentrated on spot improvements were all Good to Excellent, while those that tried to make lengthy road widening efforts were considered to be poorly done.

7.5 Fitness for Purpose

Fitness for purpose is defined as whether or not the infrastructure is still operating as originally planned or intended, and is neither over nor under-designed. Are the users easily able to use and care for the infrastructure? Instances where the users have added to or augmented the infrastructure may deserve a higher rating, and will inform designers for future efforts.

If the infrastructure has fulfilled the requirements of the recipients and is neither over nor under-designed, then a rating of 'Good' would be considered appropriate. An Excellent rating for this aspect of the evaluation is an empirical judgment, and might be represented by a SP where the recipient community or user group have independently added to, improved or used a SP in ways to increase its usefulness. Actions of this nature would be a very large vote of confidence in the original PNDS works as the instigator of further self-directed community development activities. Conversely, a Poor rating for Fitness for Purpose will represent a SP that is either not operable (having been poorly designed or constructed) or is very much over or under-designed for its intended purpose.

The excellent Fitness for Purpose (FfP) SPs were represented by 3 buildings, 1 bridge, 3 water supply systems and 2 irrigation schemes. The SPs that were rated Poor for FfP were all water supply systems (4 SPs).

The following chart shows that:

93% of sub-projects have been judged to be of Good or Excellent Fitness for Purpose. This compares to 83% from last year's technical audit.

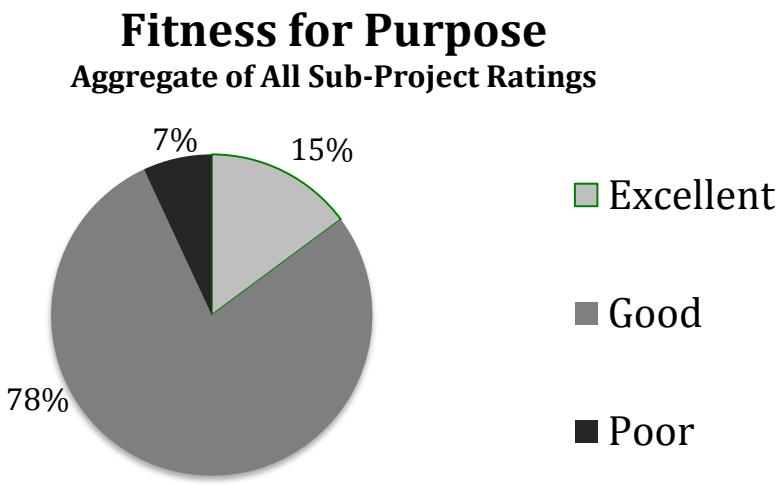


Chart 3: Fitness for Purpose, All Sub-Projects

A selection of the sub-projects that were rated Excellent is as follows:

- A sanitation and washing facility in Suku Foholau, AP Turiscai, Manufahi has been added off to the side of a community building in this village.

The villagers have maintained the fence and pathways that lead to this facility. The building is used regularly by most of the villagers who live in this aldeia. Toilets, showers and a communal laundry tub make this a focal point of the village.

- A water catchment reservoir in Suku Parlamento-Moro, AP Lautem, Lautem is very well fenced and maintained for water purity. The reservoir is large, allowing settlement of fines before the water is piped to four villages. The excess water is also used for irrigation and fisheries ponds, helping the sustenance and economy of these villages

- An irrigation scheme in Suku Seloi Craic, AP Aileu Vila, Aileu was judged excellent due to the extra impacts that were beyond the original expectations of the community. The irrigation waters are now flowing to other lands that had not

been in use prior to this SP. The community is now growing rice and vegetables on approximately 2 hectares of new land.

Examples of sub-projects that were rated Poor are as follows:

- A water supply scheme in Dili that is not operable and being used only be a few home owners. The transmission water pipe has been dug up by home owners and broken. The system reservoir is empty, the public tapstand abandoned and derelict. Individual neighbourhoods of this area appear to be in disagreement with one another about the requirements of this SP. Insufficient social facilitation in regard to the expectation of this community may be the cause of these difficulties.

- A water supply SP in Suku Ililai – Titilari, Lautem involving a drilled well and submersible pump. Tapstands have not been working for approximately 6 months. Improper design may be the cause of this failure. The villagers appear uncertain of where to go for help in restoring this system.

This data can be aggregated by infrastructure type:

Table 14: Fitness for Purpose - % of SPs Evaluated (No. of SPs)

Infrastructure Type (Number of SPs Evaluated)	Excellent	Good	Poor
Building (11)	27% (3)	83% (8)	-
Bridge (4)	25% (1)	75% (3)	-
Water Supply (20)	15% (3)	65% (13)	20% (4)
Road, Drainage, Wall (22)	-	100% (22)	-
Irrigation (4)	50% (2)	50% (2)	-
All Sub-Projects (61)	**15% (9)**	**78% (48)**	**7% (4)**

Discussion

Similar to the Overall Construction Quality findings above, buildings and irrigation SPs again show good results against the other infrastructure types. All of the road works were rated fit for their purpose (even though poorly executed in some cases – the assignment of this rating is questionable in some of the lengthy road widening SPs). Bridges were considered Good to Excellent and water supply SPs display mixed results (some of these are likely due to community social issues).

7.6 Land Donation Certificate

The 2017 technical audit has continued to find that in many cases land donation letters and proper forms are not being created for many SPs that require them.

Table 15: Land Donation Documentation Records

	Yes	No
Land donation required *	11 SPs	29 SPs
Land donation paperwork filed	3 SPs	8 SPs

* Note: 25 of 65 SPs did not provide the Community Proposal paperwork for this to be checked and verified.

Discussion

Most new water supply SPs require that a portion of the pipe networks, reservoirs, tapstands and other system elements traverse or sit upon private lands. The 2017 audit evaluated several drainage schemes in Dili that also feature channels or pipes that are on private property.

It is necessary to have these pieces or narrow sections of private land either donated for public use or provided as a public right-of-way. We understand that some aldeia have traditional elders who have made such agreements on behalf of groups of households or entire villages. PNDS needs to convince such village committees that each separate household needs to sign on their own behalf.

Water supply and drainage SPs most commonly require the construction of public works on private properties. All affected property owners should be consulted and asked to sign the appropriate forms for either the donation of the lands (preferable) or the granting of a public right-of-way (useful in denser neighbourhoods, such as Dili). A public right-of-way does not take away ownership of the land but rather allows a public body (the Community Project Implementation Committee and the O&M Committee) to come onto the land, make improvements, operate and maintain the public utility, in these cases water pipes and appurtenances, or drainage channels.

Recommendation 2: PNDS should engage a municipal lawyer to review the land donation forms and paperwork and advise accordingly. The lawyer should make recommendations regarding the legality of village elders signing on behalf of communities. The lawyer should advise PNDS in regard to the granting of rights-of-way for such infrastructure as drainage channels or water piping in dense neighbourhoods.

7.7 Environmental Considerations

PNDS operational cycle Step 6 stipulates that engineers and planners prepare and verify a proposed SP with due regard to environmental risks associated with it. The 2017 technical audit evaluated the sampled site with respect to this.

The results of this evaluation show that:

92% of the SPs evaluated were rated as Good, with 2% (1 SP) rated Excellent and 6% (3 SPs) rated Poor.

This is a slight improvement on last year's audit results, as shown below.

Table 16: Environmental Considerations, All SPs

Year	Excellent	Good	Poor
2016	4% (2)	89% (46)	7% (4)
2017	2% (1)	92% (61)	6% (3)

Discussion

The combined Good and Excellent ratings for the last two years are roughly equal percentages. The 2017 Poor rating however, and with a larger sampling, has gone down which is good. PNDS should continue its current operations toward the environment.

The SP Rated Excellent for Environmental Considerations:

- A road improvement SP in Suku Costa – Lacufoan, AP Pante Macassar., Oecusse. This SP featured the construction of a concrete road that has greatly benefited the environment in this area. Great damage was done to a river and a steep slope area by trucks visiting this agricultural area. This SP has moved trucks away from the riverbed, hardened the steep road surface and now prevents the land from eroding further.

Sub-Projects Rated Poor for Environmental Considerations:

- Two road SPs in Aileu and one in Manufahi. The drainage aspects of these roads were not adequately considered during design, with the result that much of the SP work is being degraded, with erosional channels forming, slopes being endangered, siltation in local streams and rivers, etc.

This data can also be examined by infrastructure type:

Table 17: Environmental Considerations - % of SPs Evaluated (No. of SPs)

Infrastructure Type (Number of SPs Evaluated)	Excellent	Good	Poor
Building (14)	-	100% (14)	-
Bridge (4)	-	100% (4)	-
Water Supply (20)	-	100% (20)	-
Road, Drainage, Wall (23)	4% (1)	83% (19)	13% (3)
Irrigation (4)	-	100% (4)	-
All Sub-Projects (65)	**2% (1)**	**92% (61)**	**6% (3)**

Discussion

Most of the SPs of all infrastructure types have been rated Good. Three lengthy road widening efforts have been deemed to be Poor, due to poorly designed storm drainage facilities and excess erosion concerns.

7.8 Operations and Maintenance

The 2017 technical audit did not receive sufficient participation from village O&M committee members for robust analytical results to be reported. The number of SPs where O&M committee members that attended the evaluation visits were as follows:

Table 18: Number of O&M Committees Attending Audit

Infrastructure Type	O&M Committees attending
Building	5 of 14 SPs
Bridge	0 of 4 SPs
Water Supply	6 of 20 SPs
Road, Retaining Wall, Drainage	4 of 23 SPs
Irrigation	2 of 4 SPs
Total	26%

Discussion

The field tool provides a section where the O&M committee members can be quizzed about their normal or extraordinary works for the infrastructures evaluated. Questions or data included the following, as a sample:

- Routine maintenance tasks
- Major repairs performed
- Major repairs required (nature of defect?)
- Infrastructure user fee details
- Contributions for other sources
- Affordability of user fees (% of households able to easily afford)
- Government inputs
- O&M training

The results of the (very few) interviews indicate that O&M Committees are generally not active and seem disinterested (with the odd exceptional person) in the specific tasks by which their particular village infrastructure should be maintained. Table 19 displays a typical example of this information collected from the SPs.

Table 19: O&M Information from Building EOM/Committee Members

O&M Information	Yes	No
O&M Committee in place and functioning	1 SP	13 SPs
Routine maintenance tasks done *	Average <0.5 Task/SP	9 SPs **
Major repairs required	1 SP	12 SPs
O&M User Fee being collected (13 reporting)	-	14 SPs
Contributions from Other Sources	-	13 SPs
O&M Training received	12 SPs	2 SPs

* Note: Up to nine typical routing maintenance tasks were outlined to O&M Committee members. Villagers admitted that an average of only <0.5 tasks had been done.
** Note: Nine villages have done no maintenance of their SPs (discounting villages where the SP was not yet finished)

Discussion

It can seem that there is little effort put into the O&M requirements of the PNDS infrastructure extended to most parts of Timor-Leste. This will have a long-term effect of slow degradation, deterioration and erosion of the infrastructure. In many cases it will eventually lead to an abandonment of the SP works.

An O&M Committee member in Mindelow, AP Turiscai, Manufahi was heard to say that the training that he received for O&M of a building was purely theory with no applied, hands-on practice. Many people absorb information more readily in a participatory environment.

There are various project efforts around the world that specialize in the maintenance of sector-specific infrastructure, many using Labour-Based methodologies. PNDS would benefit from establishing a relationship with one or more of these projects. This might involve a study tour to investigate other methods of relaying proper O&M practices in a rural, labour-rich environment.

Recommendation 3: PNDS should consider investing in actions specifically aimed at increasing the participation and activity of O&M Committee members.

7.9 As-Built Drawings

The POM states in Project Cycle Step 11 that the PNDS APTF and the EIP are to "ensure 'as-builts' (engineering designs adjusted to show any agreed deviations from the original design…) are provided to KPA and explained to the EOM" and that all final documents should be on file at the Suku.

No as-built drawings of completed infrastructures were found in the Community Proposals and village files (of 62 completed sub-projects evaluated).

PNDS may wish to delete the requirements for this SP operational step from the POM during the next revision to this document.

7.10 Frequency of Technical Facilitation and Supervision

The technical evaluation questioned members of the SP building committee at each site regarding the frequency of PNDS technical facilitation visits, making note on the checklists. All frequency results were found to lie within the following choices:

- 8 times/month (twice a week)
- 4 times/month (once a week)
- 2 times/month (once every two weeks)

The frequency of technical facilitation recorded at SP sites has been analyzed. For all sub-projects evaluated the aggregated results indicate that:

Most sub-projects (82%) are being visited by technical facilitators at a frequency of once/week or greater. This compares to a figure of 87% in the 2016 audit.

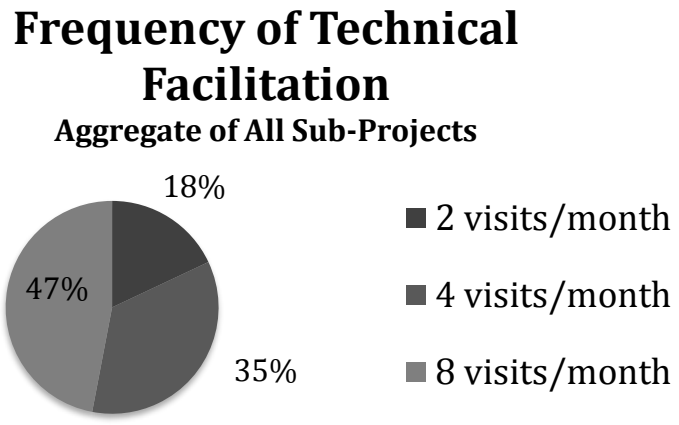


Chart 4: Frequency of Technical Facilitation, All Sub-Projects

Discussion

From the data gathered, it is evident that the frequency of technical facilitation of this year's audit sampling is reduced slightly from that recorded last year.

7.11 Universal Accessibility

The PNDS POM stipulates that infrastructures developed under the program will provide suitable accessibility features for elderly or disabled users. The buildings and water system elements used by the public were evaluated for their adherence to these requirements.

In the buildings where this standard would be applicable, the evaluation documented the presence of ramps and handrails and the condition of them:

Table 20: Ramp and Handrail Installations

	Meets Specification	Slightly Below Specification	Below Specification
Number of SPs	3 SPs	5 SPs	2 SPs

Water system tapstands are similarly lacking in this respect:

Table 21: Tapstand Universal Accessibility - % (No. of SPs)

	Meets Specification	Slightly Below Specification	Below Specification
Tapstand - Accessibility	7 SPs	5 SPs	2 SPs

Discussion

The provision of ramps for buildings and tapstands represents very small percentages of total budgets, often as little as 1 or 2%. These investments will build useful ramps that provide access to the young, elderly, infirm and to wheeled devices such as wheelbarrows or baby strollers. Many water tapstand ramps end with a step down to ground level. Some of these steps can be 150mm high. The PNDS NSD set should be altered to show this ramp ending flush with the natural ground level to permit old, young and those carrying water easy access to the platform.

This tapstand has been constructed high above the natural grade. One can see where the villagers have inserted a sloped rock to enable their one-wheeled water carrying cart access.

PNDS TF and SF must spend time ensuring that this does not happen!

Recommendation 4: Building and tapstand ramps are an important part of these installations to guarantee easy and safe access for all users. Ramps should not be constructed steeper than 16% and should have rough/non-slip surfaces. Backfilling and compaction of granular materials should take place at the base of the ramp to join with adjacent pathways. TF and SF should ensure that the EIP do not neglect during the SP implementation.

8. Best Practices and Recommendations

Aggregates of the technical ratings of SP components and aspects have been discussed in Section 7 of this report along with analyses and discussions of several whole project ratings (overall quality, environmental considerations, etc.). The data can also be sorted and studied at a component/aspect level within each SP type. This section will look at each SP type, divided into each specific infra components and aspects. Additional information regarding key design and construction issues was gathered in Field Tool 5, Key Issues. The use of this checklist allowed the technical evaluators to further define problems noted with the various components and aspects of the infrastructure. Where applicable and helpful, the aggregated percentages of these key issues are cited below.

8.1 Buildings

Most of the buildings examined during this technical evaluation met the specifications set out for them (79% of building components Meet Specification) or were considered Slightly Below Specification (17%). Only 4% of the building components evaluated were rated Below Specification.

For technical rating purposes buildings were divided into 21 components/aspects that were individually assessed and rated. An examination of this data shows that those components/aspects most often considered Slightly Below Specification or Below Specification are as shown in the following table. Not all building components and aspects are shown, for brevity.

Table 22: Building Components/Aspects Considered Slightly Below or Below Specification - % (No. of SPs)

Building Component/Aspect (No. of SPs Evaluated)	Percentage of SPs Rated Slightly Below Specification	Percentage of SPs Rated Below Specification
Column - Reinforcement (8)	-	38% (3)
Ring Beam – Dimension (10)	10% (1)	-
Truss – Structural Assembly (10)	20% (2)	-
Truss – Connection to Ring Beam (10)	-	20% (2)
Plastering (13)	31% (4)	-
Ceiling (9)	44% (4)	-
Doors and Windows (13)	46% (6)	-
Toilet (8)	25% (2)	
Septic Tank (6)	67% (4)	17% (1)
Drainage (8)	38% (3)	-

Discussion and Recommendations

Column reinforcement was observed to be poorly done, of improper diameter, and sometimes exposed and in danger of exposure and rusting in 3 of 8 cases where the evaluators were able to examine this component of construction. Additional time should be spent by the TF at SP reinforced concrete building sites to ensure that at least one villager thoroughly understands this work (who could be appointed Quality Control

monitor for the reinforcing steel portion of the work). TF should be issued calipers to allow them to more easily verify the diameter of reinforcing bars.

Ring beams are those structural members that connect the columns at the top of building walls. The dimensions and connections of these beams (either wood or reinforced concrete depending on the structural design) is an important facet of the building's strength in hurricanes and earthquake events. Only one of ten beams inspected was smaller than the size shown on the Community Proposal documents. This is an improvement from the 2016 audit where 1 of 6 SPs was found to be deficient in this aspect.

Trusses were evaluated in regard to two aspects: structural assembly standards and conformance with drawings. Eight of 10 SPs were considered to Meet Specification in these two aspects. Two trusses, however, were considered Below Specification with very poor connection to the ring beam.

The use of proper connections from a building's trusses to the ring beam is very important. This detail is vague on PNDS design TCS drawings and missing on most local Municipal design drawings. Local builders often use nails to fasten the truss to the ring beam. Nails provide a very weak connection and can be pulled loose during high winds, allowing the roof to 'lift off' from the building, causing great damage. The use of bolts for truss interconnections and to connect the truss to the ring beam or columns of a building is imperative.

Plastering materials were found to be deficient in 4 of 13 buildings inspected. Coarse sands have often been used in making the plaster, materials from local mountain streams. These coarse grains do not allow the plasterers to make a smooth final wall finish. A highly granular and porous surface will grow dirty very fast and be difficult to clean. As the walls visually degrade, a general sense of building degradation can become common, promoting a general malaise and disinclination to care for other aspects of the building. A source of fine sand (local or purchased) should be found to allow workers to place a final thin topcoat of smooth plaster.

Ceilings are often lacking access portals. These are easy to install and important for future maintenance purposes.

Doors and windows were frequently noted as being Slightly Below Specification (46% of SPs, 6 of 13, up from 33% last year). These ratings are normally aimed at sagging and fractured panels that have not been installed long.
Toilet facilities: Typically problems with these installations are leaking pipes, broken faucets, poorly graded floors that have pools of stagnant water, exposed plastic pipe and poor access to septic tank for inspections and cleaning. Many faulty faucets were noted on the field evaluation forms.

Septic tanks were again highlighted with most installations lacking a lid to permit periodic emptying and cleaning.

Finally, **drainage** at 3 of 8 sites visited was considered to be Slightly Below Specification. Designers should always examine the local topography in order to provide adequate and well-thought-out channels for stormwater runoff.

Recommendation 5: Calipers should be issued to all TF (or several pairs held at the office for use at all sites where RC activities are taking place.)

Recommendation 6: Revisions should be made to the drawings for more certainty in villagers understanding the need for attic accesses. Training of the TF should reinforce this requirement, as well as for the other components and practices detailed above: truss to ring beam connections; fine sands for final plastering; higher quality doors and windows; toilet and septic tank issues; ensuring proper drainage.

8.2 Bridges

Four examples of the current PNDS bridge program were evaluated (one recently completed and three that are one year old).

Reinforcement steel was found to be exposed on the underside of the bridge concrete beams at two of these sites, worrisome instances where the structural integrity of these important deck beams might be compromised in the future. The steel stirrups that bound the longitudinal steel are visible at the underside beam surfaces at one site and slightly beneath the surface at the other. As steel corrodes (rusts) it becomes larger, pushing the concrete apart. Over time, the damp from underneath a bridge will work its way into the beam's reinforcing steel. Eventually the beam will fail (crack) under a heavily loaded truck. Remediation of this is difficult but worthwhile.

At one bridge site in Lautem it was noticed that the local floodwater elevation might be too close to the underside of the bridge deck. At another site, it was noted that deck beams have trapped rainwater on the surface of the bridge. These beams are not in the NSD; basins and drainage channels should be installed to allow this water to escape.

Recommendations 7: Correct reinforced concrete practices must be followed at all sites using this methodology. TFs should review training materials before such SPs start construction. The appointment and training of a local Quality Control monitor for this part of the work might be a logical way for PNDS to ensure that these important practices are followed.

Recommendation 8: Bridge designs need to be thoroughly checked by senior personnel, with flood elevation and proper deck drainage in mind.

Recommendation 9: The bridges with shallow/exposed reinforcing should be closely examined. A protective coating of a high-quality sealant should be applied to the underside of the beams as soon as possible (seek information from a local concrete supplier for recommendations of appropriate locally-available products).

Recommendation 10: All TF should be re-informed about the importance of ensuring an adequate depth of cover for all reinforcement within concrete.

Recommendation 11: TF should schedule their time to ensure that their inspections of reinforced concrete coincide with the most important parts of the infrastructure.

Following is a table containing other components/aspects of bridge construction that may require some adjustments in PNDS' rural construction program.

Table 23: Bridge Components/Aspects Component/Aspect Ratings - % (No. of SPs)

	Percentage of SPs Rated **Slightly Below Specification**	Percentage of SPs Rated **Below Specification**
Erosion protection (4)	-	25% (1)
Apron/ramp (3)	-	33% (1)

Erosion protection was noted as Below Specification at one bridge site. This was directed at a gabion basket that had been installed on the stream bed, downstream of the structure's apron. The basket had been greatly deformed by the flows that had passed on top of it. Gabion baskets are not capable of withstanding any forces; they are weakly tied wire of hand-placed stone. Gabion baskets should only be used for gravity-based retaining walls where no fast-flowing water is moving.

Bridge deck **aprons** form the structure's integration with the adjacent roads. Backfill materials beside a bridge are liable to compact over time if not protected with an appropriate concrete apron. These aprons will often crack as the earthen fill around the bridge settles over time. Fresh concrete should periodically be laid on top of cracked aprons. The settlement will slow down and stop eventually, as long as the structure's drainage has been adequately handled.

8.3 Water Supply Systems

The 2017 audit has detected a decline in the technical quality of water SPs from that observed last year, for unknown reasons.

Table 24: Water Supply Component/Aspect Ratings - % (No. of SPs)

Water Supply Component/ Aspect	Percentage of SPs Rated **Slightly Below Specification**	Percentage of SPs Rated **Below Specification**
Water System Design (16)	19% (3)	13% (2)
Pump System (5)	20% (1)	20% (1)
Reservoir – Ease of cleaning (15)	31% (5)	-
Transmission and Distribution Pipe (13)	23% (3)	23% (3)
Public Tap – Platform (14)	36% (5)	14% (2)
Public Tap – Drainage (15)	27% (4)	7% (1)
Public Tap – Fencing (7)	-	57% (4)

Discussion and Recommendations

Water system designs for 2 SPs were considered Below Specification. There were 3 SPs rated Slightly Below for this aspect and 11 rated Meets Specification. PNDS will benefit from examining the characteristics of those SPs that were assigned lower ratings to learn for future community proposals.

Pump systems were noted as exhibiting problems in 2 of 5 installations. Each of these is unique and should be examined for lessons to be learned for future designs.

A third of the **reservoirs** were rated Slightly Below Specification for the **Ease of Cleaning**. This is most often an omitted cleanout, a cleanout pipe installed too high or a reservoir floor that is not properly sloped to drain toward the cleanout.

Water transmission pipes (that transport water from the catchment reservoir/tank to the village) and **distribution pipes** (that deliver water to public tapstands or community connections) have been found laying on the ground surface, contrary to the drawings and requirements for plastic pipe.

Public tapstand platforms, drainage and fencing have high percentages of Slightly Below and Below Specification ratings. Imperfections are generally similarly to last year's assessment: faulty faucets; poorly installed and leaking pipes; improperly graded concrete platforms that allow water to pool; inadequate ditching to lead waste water away from public areas; and lack of fencing to prevent animals and small children from visiting the tapstand.

Recommendation 12: National Standard Drawings should be altered to clearly show reservoirs with 5% sloped floors to a cleanout pipe installed in a sump lower than the floor. The pipe outside the reservoir should be equipped with a shut-off ball valve operated by wrench. Schematic designs of the system layout will be helpful to workers, with pipe layouts, connections, valves clearly labeled. The NSD for water tapstands needs to be altered to show the ramp edge meeting ground surface (rather than ending in a step).

Recommendation 13: PNDS should consider a requirement for all trenches to be excavated before delivery of the pipe is allowed to the SP site.

Recommendation 14: PNDS engineering department should provide adequate support and guidance to communities for pipe-bridge design and installation.

8.4 Road, Drainage and Retaining Wall

The majority of PNDS road SPs are now consisting of spot improvements along existing road or track alignments (as recommended in previous technical audits). These spot improvements generally are drainage works beside or crossing the alignments, such as drainage channels or road culverts; slope retention works such retaining walls; and improvements to steep road sections. Spot improvements of this kind have generally found to be well executed and performing satisfactorily.

The spot improvement road components that received ratings of Slightly Below and Below Specification are as follows:

Table 25: Road Component/Aspect Ratings - % (No. of SPs)

Road Component/Aspect (No. of SPs Evaluated)	Percentage of SPs rated **Slightly Below Specification**	Percentage of SPs rated **Below Specification**
Retaining wall – weep holes (11)	-	45% (5)
Retaining wall – constr. materials (16)	13% (2)	-
Retaining wall – erosion protection (13)	8% (1)	-
Culvert – Layout (13)	8% (1)	-
Culvert – Construction materials (13)	8% (1)	-
Small bridge – construction techniques (3)	33% (1)	-

Discussion and Recommendations

Retaining walls were judged to be Below Specification in five cases where weep holes had not been properly installed as per the design. Two walls were constructed from materials that were not specified, although the works were done in a suitable manner. **Gabion basket** walls have occasionally been used in inappropriate spots. Gabion basket walls are gravity structures that do not have any capability to withstand horizontal forces. They are suitable as massive gravity structures to retain slopes or protect surfaces from erosion by slow-moving water. Fast water will rapidly degrade and destroy gabion baskets. Gabion baskets cannot be placed upon unstable soil since water will travel through them, taking soil particles away. The installation will become undermined and will collapse.

Culverts are generally done in a proper fashion. Only one instance in each of the Layout and Construction Material aspects were considered to be slightly below specification.

A **small bridge** in Aileu Vila, Suku Bandudato, was considered to have been constructed using slightly improper techniques.

Many **drainage channels** constructed alongside roads feature high inner walls that do not permit the draining of the road into the channel, resulting in muddy conditions on the road surface.

Recommendation 15: Revise the NSD set: 1) drainage channel drawing to clearly show the roadside wall level with the adjacent road. 2) Develop an isometric picture of a cross-section of a typical wall, showing the weep hole pipe installed correctly (with a piece of

filter cloth wrapped around the inside end and packed in gravel). 3) Create a set of "spot improvement" drawings that will allow TFs to show the range of road improvement techniques that are available to villages. The normal road cross sectional drawing should be reserved for steep roads. 4) Create a NSD for causeways, showing appropriate downstream apron and energy dissipation blocks.

There were 6 road improvement SPs that featured lengthy improvements to existing roads or tracks. For the most part, SPs of this type were rated of lesser quality than the spot improvement types. This was discussed in Section 7.1 and shown in Table 9 above.

Lengthy road works were evaluated in 100 m lengths with 12 typical road construction problems being recorded on a percentage basis (how much of the road length is affected with the problem) or a count (for missing drainage structures and safety concerns). This evaluation system was introduced in 2016 so that a more precise understanding of the extent of specific road building problems can be extrapolated from the field data. The 12 problem areas are as follows:

1 Cross Section (Crown or Camber) - % of road affected
2 Surface below standard - %
3 Pavement below standard - %
4 Improper construction materials - %
5 Narrow width - %
6 Inadequate roadside ditches - %
7 Steep and slippery when wet - %
8 Low and muddy during rain - %
9 Unstable slope above (too steep) - %
10 Unstable slope below (too steep) - %
11 Missing drainage structure – number count
12 Safety concerns – number count

Thus, for each individual 100 m length of road alignment, the percentage of each of these problem areas can be tabulated, helping senior engineers understand where additional efforts must be directed during design and construction to improve the durability of PNDS road SP works.

There were six SPs where lengthy sections of road were constructed or improved.

Table 26: Road or Track Upgrade SPs - % of Alignment Affected by Problem

		Suku Seloi Malere, AP Aileu Vila, Aileu	Suco Liurai, AP Aileu Vila, Aileu	Suku Hoholau, AP Aileu Vila, Aileu	Suku Beremana, AP Turiscai, Manufahi	Suku Orana, AP Turiscai, Manufahi	Suku Kampung Alor, AP Dom Alexio, Dili
	Length of Road Improvements (m)	5,500	1,400	3,000	1,000	4,000	160
1	Improper Cross Section (Crown or Camber) - %	34%	19%	49%	33%	50%	0
2	Inadequate roadside ditches - %	42%	28%	58%	33%	40%	0
3	Missing drainage structure – count	0	0	0	30	25	0
4	Improper construction materials - %	30%	13%	43%	0	50%	0
5	Steep and slippery when wet - %	23%	15%	41%	0	0	0
6	Low and muddy during rain - %	19%	7%	38%	0	0	0
7	Unstable slope above (too steep) - %	5%	7%	11%	27%	7%	0
8	Unstable slope below (too steep) - %	0	3%	0	0	0	0
9	Narrow width - %	0	1%	2%	0	0	0
10	Surface below standard - %	39%	15%	54%	0	7%	0
11	Pavement below standard - %	0	0	0	0	0	0
12	Safety concerns – count	0	3	34	0	0	0

Discussion

Similar to the 2016 technical audit, the lengthy road or track improvement SPs tend toward generally substandard works spread over a long section of existing road. The lack of proper drainage facilities (line 2 above where most of the SPs show a serious failure to provide adequate roadside ditching) is indicative of poor construction techniques that are typically employed for these lengthy works. Lack of proper drainage will be the primary cause of emerging road failure points along these alignments.

The commentary from the 2016 technical audit continues to hold true for road improvement SPs of this nature. An edited version of it is repeated below:

Road shape, crown and surface issues – the shape and crown of a road cross section is important to properly shed stormwater runoff. Poor cross sections were recorded for up to 50% of some of the lengthy road improvement SPs within this audit.

Improper construction materials were observed at up to 50% of the road surfaces evaluated. Roads must be constructed using layers of properly sized rock and gravel that is not rounded. Many native granular soil deposits in Timor-Leste are composed of rounded stone, which will not compact to form a stable long-term road surface.

Inadequate ditches are responsible for the majority of road problems. Properly shaped and adequate roadside drainage is vital to the long-term stability of road surfaces. As

described above for road surfaces, care and attention must be directed at ensuring roads are adequately drained. This component, almost more than any other, determines the viability of PNDS road sub-projects into the future.

Items 5 and 6 in Table 26 above, pertaining to **slippery and muddy conditions** on roadways relates to both the construction materials that were used to build the road and the drainage infrastructure that has been provided (*or not*) to keep the road drained and dry. The use of properly graded fractured gravel products must be used to maintain stable driving surfaces.

Cut slope embankments were found to be too steep for many of the roads evaluated. These slopes will exhibit constant raveling of material as rainfall runs down the steep inclines. Large slope failures will occur with increasing frequency as drainage gullies get wider and deeper. The construction of retaining walls is one solution to the problem of steep slopes.

Drainage structures are critical pieces of road infrastructure and must be included in all PNDS road SPs. These will include roadside channels, culverts, small bridges or slope protection from erosion. The success and longevity of road works often rests predominantly upon the proper design of its drainage infrastructure.

Safety concerns were highlighted in two of the roads. Both involve the safety of road users associated with potential slope failures.

8.5 Irrigation

There were 4 PNDS irrigation SPs evaluated during this evaluation. Most components of these structures were considered to Meet Specification. The following table provides a summary of those components/aspects that were rated Slightly Below or Below Specification.

Table 27: Irrigation Components/Aspects Ratings - % (No. of SPs)

Irrigation Component/Aspect (No. of SPs reporting)	Percentage of SPs rated **Slightly Below Specification**	Percentage of SPs rated **Below Specification**
System Layout (4)	25% (1)	-
Weir (2)	50% (1)	-
Culvert and pipes (2)	50% (1)	-
Retaining wall – erosion protection (1)	100% (1)	-

Discussion and Recommendations

One of the irrigation schemes was judged to have a **System Layout** or design that was Slightly Below Specification. Similarly, one of the two **weirs** examined and one of the **culverts** were judged Slightly Below Specification. These SPs can be examined by senior engineers to determine how future irrigation schemes can be designed to better withstand hydraulic forces.

Wooden irrigation channel control gates have been used at some PNDS installations with success. Other irrigation SPs are lacking these basic and necessary controls.

Recommendation 16: Downstream aprons of irrigation weirs (and bridges) must be set at the same (or lower) elevation as the adjacent streambed. If the water is flowing turbulently on the apron, provide some energy dissipation blocks that will allow the water to calm before leaving the apron.

Recommendation 17: PNDS should develop simple drawings of the irrigation channel control slot/wooden board solution for use at other sites.

8.6 Key Issues Update

The 2015 and 2016 technical audits provided a concise listing of the key issues that PNDS needed to focus on for improvements to its construction program. This 2017 audit has gathered similar data from each SP site. In the following table, the 2015/16 % is shown so that a comparison with the 2017 % is possible.

Table 28: Key Construction/Design Issues

2015	2016	2017	Remarks – All SP Types Unless Noted Otherwise
79%	56%	18%	Lack of construction details on drawings
45%	0	27%	Inaccurate drawings of connection details (Building and Bridge)
42%	7%	5%	Improper steel reinforcement design (Building, Bridge and Water Supply)
30%	24%	5%	Constructed dimensions differ from plan
87%	67%	55%	No elevations on plan (Water Supply)
60%	25%	17%	Drainage design and considerations (Road, Drainage, Retaining Wall)

Discussion

General improvement is again apparent for all of the Design Key Issues that were noted in the 2015 and 2016 audits. These improvements are likely due to the continued use of the TCS by Municipal engineers and TF.

9. Conclusions

The 2017 Technical Evaluation of Infrastructure for the National Program of Village Development has found that, generally, the rural infrastructure program of PNDS continues to provide adequate technical support to village communities.

The introduction and use of the Technical Construction Standards (TCS) has saved much time for the technical staff in the municipalities. All recent sub-projects have made use of these standards.

This audit has highlighted several areas where the TCS might be expanded or improved, to further aid the field staff in their duties to provide accurate and efficient assistance to village committees.

ANNEXES

Annex 1 – Summary of Recommendations

Note that this summary does not contain those technical recommendations contained in Annex 5 – Key Issues Summary

Technical Construction Standards

Recommendation 1: The TCS drawings and details should be used by all TF when developing designs. The standard TCS drawings should be revised to show the planned dimensions of the infrastructure in conformance with the Bill of Quantities.

Land Donation Certificate

Recommendation 2: PNDS should engage a lawyer, experienced in land and property transfer issues, to review the land donation forms and paperwork and advise accordingly. The lawyer should make recommendations regarding the legality of village elders signing on behalf of communities. The lawyer should also advise PNDS in regard to the granting of rights-of-way for such infrastructure as drainage channels or water piping in dense neighbourhoods.

Operation and Maintenance

Recommendation 3: PNDS should consider investing in actions specifically aimed at increasing the participation and activity of O&M Committee members.

Universal Accessibility

Recommendation 4: Building and tapstand ramps are an important part of these installations to guarantee easy and safe access for all users. Ramps should not be constructed steeper than 16% and should have rough/non-slip surfaces. Backfilling and compaction of granular materials should take place at the base of the ramp to join with adjacent pathways. TF and CF should ensure that the EIP do not neglect during the SP implementation.

Best Practices, Buildings

Recommendation 5: Calipers should be issued to all TF (or several pairs held at the office for use at all sites where RC activities are taking place.)

Recommendation 6: Revisions should be made to the drawings for more certainty in villagers understanding the need for attic accesses. Training of the TF should reinforce this requirement, as well as for the other components and practices detailed above: truss to ring beam connections; fine sands for final plastering; higher quality doors and windows; toilet and septic tank issues; ensuring proper drainage.

Best Practices, Bridges

Recommendations 7: Correct reinforced concrete practices must be followed at all sites using this methodology. TFs should review training materials before such SPs start construction. The appointment and training of a local Quality Control monitor for this part of the work might be a logical way for PNDS to ensure that these important practices are followed.

Recommendation 8: Bridge designs need to be thoroughly checked by senior personnel, with flood elevation and proper deck drainage in mind.

Recommendation 9: The bridges with shallow/exposed reinforcing should be closely examined. A protective coating of a high-quality sealant should be applied to the underside of the beams as soon as possible (seek information from a local concrete supplier for recommendations of appropriate locally-available products).

Recommendation 10: All TF should be re-informed about the importance of ensuring an adequate depth of cover for all reinforcement within concrete.

Recommendation 11: TF should schedule their time to ensure that their inspections of reinforced concrete coincide with the most important parts of the infrastructure.

Best Practices, Water Supply

Recommendation 12: National Standard Drawings should be altered to clearly show reservoirs with 5% sloped floors to a cleanout pipe installed in a sump lower than the floor. The pipe outside the reservoir should be equipped with a shut-off ball valve operated by wrench. Schematic designs of the system layout will be helpful to workers, with pipe layouts, connections, valves clearly labeled. The NSD for water tapstands needs to be altered to show the ramp edge meeting ground surface (rather than ending in a step).

Recommendation 13: PNDS should consider a requirement for all trenches to be excavated before delivery of the pipe is allowed to the SP site.

Recommendation 14: PNDS engineering department should provide adequate support and guidance to communities for pipe-bridge design and installation.

Best Practices, Roads

Recommendation 15: Revise the NSD set: 1) drainage channel drawing to clearly show the roadside wall level with the adjacent road. 2) Develop an isometric picture of a cross-section of a typical wall, showing the weep hole pipe installed correctly (with a piece of filter cloth wrapped around the inside end and packed in gravel). 3) Create a set of "spot improvement" drawings that will allow TFs to show the range of road improvement techniques that are available to villages. The normal road cross sectional drawing should be reserved for steep roads. 4) Create a NSD for causeways, showing appropriate downstream apron and energy dissipation blocks.

Best Practices, Irrigation

Recommendation 16: Downstream aprons of irrigation weirs (and bridges) must be set at the same (or lower) elevation as the adjacent streambed. If the water is flowing turbulently on the apron, provide some energy dissipation blocks that will allow the water to calm before leaving the apron.

Recommendation 17: PNDS should develop simple drawings of the irrigation channel control slot/wooden board solution for use at other sites.

Annex 2 – Technical Evaluation Checklists

Each sub-project type has a unique checklist. The sub-project types are as follows:

- Building
- Bridge
- Clean Water Supply
- Road, Drainage and Retaining Wall
- Irrigation

TECHNICAL EVALUATION CHECKLIST
BUILDINGS

Sub-Project location	Municipality		Sub-Project Completion Date:	
	Admin.Post		Sub-Project number	
	Suku		Remoteness	U NR R VR ExR
Sub-Project Name			New construction ☐	Rehabilitation ☐
Project phase			Inspection date:	Inspection by:

Components Evaluated	Evaluation Details: Inspection Result				
	Meets Spec.	Slightly Below Spec	Below Spec.	Not inspected	Not applicable
1. Foundation					
2. Ground beam (sloof)					
a. Reinforcement					
b. Dimension					
3. Wall					
a. Anchor					
b. Dimension					
4. Column					
a. Reinforcement					
b. Dimension					
5 Ring beam					
a. Reinforcement					
b. Dimension					
6 Truss assembly					
a. Structural assembly					
b. Connection to ring beam					
7 Roof structure					
a. Galvanized corrugated steel					
b. Connections to purlin, rafter					
8. Floor					
9. Plastering					
10. Ceiling					
11. Painting					
12. Doors and windows					
13. Toilet					
14. Septic tank					
15. Ramp and handrail for handicapped					
16 Service utilities					
a. Water					
b. Electrical installation					
c. Drainage					
17. Other structures					

Overall Sub-Project Assessment

The construction quality is : ☐ Excellent ☐ Good ☐ Poor

Comments: (Excellent or Poor needs a story)

Fitness for Purpose: ☐ Excellent ☐ Good ☐ Poor ☐ None (not finished)

Comments: (Excellent or Poor needs a story)

Environmental considerations
The sub-project quality is: ☐ Excellent ☐ Good ☐ Poor

Comments: (Excellent or Poor needs a story)

Community Sub-Project Proposal and Diary of Inspections

Frequency of Technical Facilitation and Supervision: _____ visits per week / month (circle one)

Sub-Project Construction Budget: _____ US$

Consultation with Line Ministry: ☐ Yes ☐ No (Old POM, Form 7; New POM, Form 6.1.1)
Who did they talk to? (Make note to BSR)_____

National Standard Engineering Drawings used? ☐ Yes ☐ No

As-built Drawings completed and filed? ☐ Yes, Sufficient ☐ Not Suff. ☐ No ☐ SP not finished

Land Donation required? ☐ Yes ☐ No
Land Donation Documentation completed and filed ☐ Yes ☐ No ☐ Not Applicable
(Look for TF 7.2.2)

Operation & Maintenance

Major repairs or rehabilitation performed			Yes		No
Major repairs or rehabilitation required			Yes		No
Nature of Defect - Environmental/Climate			problem areas		
- Design					
- Construction					
- Materials					
- O&M					
Repair costs or Estimate of repair costs	US$				
Routine maintenance (make notes in BSR)					
Roof repair			active areas		
Mechanical					
Plumbing					
Concrete repair					
Plaster repair					
Washing					
Painting					
Drainage					
Annual maintenance costs	US$				
O&M Committee Interview (make notes in BSR)					
In place and functioning			Yes		No
O&M user fee in place			Yes		No
User fee amount: US$_____/month? Year? Specific task? (circle one)					
Indirect beneficiary fees			Yes		No
Contributions from other sources (make note)			Yes		No
Current funds within O&M account	US$				
Affordibility of user fees - % of users who are able to easily pay			%		
Are there government inputs to maintenance activities?			Yes		No
Labour/material input - Community – labour-based			%		
- Community – contractor services			%		
- Government/Ministry			%		
O&M training received			Yes		No
Ongoing capacity development			Yes		No
- Is there a training budget?			Yes		No
- How much?	US$				

KEY ISSUES

Design

- [ ] Lack of construction details on drawings
- [ ] Inaccurate drawings of connection details
- [ ] Improper steel reinforcement design
- [ ] Constructed dimensions differ from plan

Roof/Truss

- [ ] Inadequate overlap of roof sheeting
- [ ] Improper connection of roof to truss (no cleat, etc.)
- [ ] Unreinforced splices in truss members
- [ ] Missing steel strapping
- [ ] Use of nails rather than bolts
- [ ] Undersized/missing truss members
- [ ] Improper conn. of truss to ring beam

Reinforcing

- [ ] Missing/short development length in steel reinforcing
- [ ] Improperly bent reinforcing cage tie bars
- [ ] Lack of tie bar wiring
- [ ] Missing anchors, foundation to sloof
- [ ] Missing anchors, column to wall

Concrete/Plaster

- [ ] Absence of concrete mix design
- [ ] Honeycombing in concrete
- [ ] Exposed/shallow reinforcing steel
- [ ] Poorly mixed concrete
- [ ] Undersized concrete column/beam
- [ ] Improper plastering technique
- [ ] Poor plastering and finishing

Sanitary Facilities

- [ ] Toilet building not provided
- [ ] No water connection to public system
- [ ] Poor drainage/ponding on floor
- [ ] Exposed plastic pipe
- [ ] No access lid to septic tank
- [ ] High watertable in septic tank

Electrical

- [ ] No junction box at wiring connections
- [ ] Low/unattached wiring in public area
- [ ] Broken switch
- [ ] Wiring installed but not energized

Miscellaneous

- [ ] Broken mechanical fixtures
- [ ] No handicap ramp/too steep
- [ ] Ponding on the floor
- [ ] Poor drainage around bldg.

Brief description
Sub-project description Issues

Key Photo Findings	**Comments and Recommendation**
[Sub-Project Signboard or Plaque, with Sub-Project Budget]	

TECHNICAL EVALUATION CHECKLIST
BRIDGE

Sub-Project location	Municipality		Sub-Project Completion Date:	
	Admin. Post		Sub-Project number	
	Suku		Remoteness	U NR R VR ExR
Sub-Project Name			New construction ☐	Rehabilitation ☐
Project phase			Inspection date:	Inspection by:

Components Evaluated	Inspection Result				
	Meets Spec.	Slightly Below Spec	Below Spec.	Not Inspected	Not Applicable
Evaluation Details					
1. Layout					
2. Foundation					
3. Erosion protection					
4. Abutments					
5. Pier/supports					
6. Construction materials					
a. Concrete					
b. Wood					
c. Steel					
7. Deck beams					
8. Deck					
9. Handrail					
10. Connections (nails, bolts)					
11. Apron / ramp					
12. Other structure					

ROAD and BRIDGE DATA 2-wheel ☐ 4-wheel ☐ Bus/Transport Truck ☐

Sub-Project Detail Information			
Sub-Project name		Sub-Project Number	

Overall Sub-Project Assessment

The construction quality is : ☐ Excellent ☐ Good ☐ Poor

Comments: (Excellent or Poor needs a story)

Fitness for Purpose: ☐ Excellent ☐ Good ☐ Poor ☐ None (not finished)

Comments: (Excellent or Poor needs a story)

Environmental considerations
The sub-project quality is: ☐ Excellent ☐ Good ☐ Poor

Comments: (Excellent or Poor needs a story)

Community Sub-Project Proposal and Diary of Inspections

Frequency of Technical Facilitation and Supervision: _____ visits per week / month (circle one)

Sub-Project Construction Budget: _____ US$

Consultation with Line Ministry: ☐ Yes ☐ No (Old POM, Form 7; New POM, Form 6.1.1)
Who did they talk to? (Make note to BSR)_____

National Standard Engineering Drawings used? ☐ Yes ☐ No

As-built Drawings completed and filed? ☐ Yes, Sufficient ☐ Not Suff. ☐ No ☐ SP not finished

Land Donation required? ☐ Yes ☐ No
Land Donation Documentation completed and filed ☐ Yes ☐ No ☐ Not Applicable
(Look for TF 7.2.2)

Operation & Maintenance

Major repairs or rehabilitation performed		Yes		No
Major repairs or rehabilitation required		Yes		No
Nature of Defect - Environmental/Climate		problem areas		
- Design				
- Construction				
- Materials				
- O&M				
- Over-use (vehicle too large)				
Repair costs or Estimate of repair costs	US$			
Routine maintenance (make notes in BSR)				
Cleaning		active areas		
Deck repair				
Concrete repair				
Drainage				
Apron and road repair				
Support structure				
Railings				
Erosion protection				
Annual maintenance costs	US$			
O&M Committee Interview (make notes in BSR)				
In place and functioning		Yes		No
O&M user fee in place		Yes		No
User fee amount: US$_____/month? Year? Specific task? (circle one)				
Indirect beneficiary fees		Yes		No
Contributions from other sources (make note)		Yes		No
Current funds within O&M account	US$			
Affordibility of user fees - % of users who are able to easily pay		%		
Are there government inputs to maintenance activities?		Yes		No
Labour/material input - Community – labour-based		%		
- Community – contractor services		%		
- Government/Ministry		%		
O&M training received		Yes		No
Ongoing capacity development		Yes		No
- Is there a training budget?		Yes		No
- How much?	US$			

KEY ISSUES

Design

- [ ] Lack of construction details on drawings
- [ ] Inaccurate drawings of connection details
- [ ] Improper steel reinforcement design
- [ ] Constructed dimensions differ from plan

Layout

- [ ] Poor site selection
- [ ] Inadequate erosion protection
- [ ] Inadequate depth of foundation
- [ ] Pier location subject to erosive forces
- [ ] Abutment and wingwall design

Reinforcing

- [ ] Missing/short development length in steel reinforcing
- [ ] Improperly bent reinforcing cage tie bars
- [ ] Lack of tie bar wiring

Concrete

- [ ] Absence of concrete mix design
- [ ] Honeycombing in concrete
- [ ] Exposed/shallow reinforcing steel
- [ ] Poorly mixed concrete
- [ ] Undersized concrete column/beam

Wood/Steel

- [ ] Inadequate structural design
- [ ] Bolted connections
- [ ] Deck and running boards

Miscellaneous

- [ ] Railings
- [ ] Apron and ramp
- [ ] Drainage considerations

Brief description
Sub-project description Issues

Key Photo Findings	**Comments and Recommendation**
[Sub-Project Signboard or Plaque, with Sub-Project Budget]	

TECHNICAL EVALUATION CHECKLIST
CLEAN WATER SUPPLY

Sub-Project location	Municipality	Emera	Sub-Project Completion Date :	
	Admin. Post	Atsabe	Sub-Project number	
	Suku		Remoteness	U NR R VR ExR
Sub-Project Name			New construction ☐	Rehabilitation ☐
Project phase			Inspection date:	Inspection by:

Components Evaluated	Evaluation Details: Inspection Result				
	Meets Spec.	Slightly Below Spec	Below Spec.	Not Inspected	Not Applicable
1. Water Source					
a. Smell, colour					
b. Watershed protection					
2. Water system design					
3. Pump system					
4. Reservoir					
a. Structural integrity					
b. Easy to clean					
5. Transmission and distribution pipe – proper installation					
6. Public taps					
a. Number and locations					
b. Fixtures					
c. Platform, accessible ramp					
d. Drainage					
e. Fencing/Protection					
7. Water pressure and quantity					
8. Other structures					

Sub-Project Detail Information		
Sub-Project name		Sub-Project Number

Overall Sub-Project Assessment

The construction quality is : ☐ Excellent ☐ Good ☐ Poor

Comments: (Excellent or Poor needs a story)

Fitness for Purpose: ☐ Excellent ☐ Good ☐ Poor ☐ None (not finished)

Comments: (Excellent or Poor needs a story)

Environmental considerations
The sub-project quality is: ☐ Excellent ☐ Good ☐ Poor

Comments: (Excellent or Poor needs a story)

Community Sub-Project Proposal and Diary of Inspections

Frequency of Technical Facilitation and Supervision: _____ visits per week / month (circle one)

Sub-Project Construction Budget: _____ US$

Consultation with Line Ministry: ☐ Yes ☐ No (Old POM, Form 7; New POM, Form 6.1.1)
Who did they talk to? (Make note to BSR)_____

National Standard Engineering Drawings used? ☐ Yes ☐ No

As-built Drawings completed and filed? ☐ Yes, Sufficient finished ☐ Not Suff. ☐ No ☐ SP not

Land Donation required? ☐ Yes ☐ No
Land Donation Documentation completed and filed ☐ Yes ☐ No ☐ Not Applicable
(Look for TF 7.2.2)

Operation & Maintenance

Major repairs or rehabilitation performed			Yes		No
Major repairs or rehabilitation required			Yes		No
Nature of Defect - Environmental/Climate			problem areas		
- Design					
- Construction					
- Materials					
- O&M					
Repair costs or Estimate of repair costs	US$				
Routine maintenance (make notes in BSR)					
Catchment facility and reservoir cleaning			active areas		
Pipe check and repair					
Pipe flushing					
Valve exercising					
Filter bed replacement					
Drainage					
Annual maintenance costs	US$				
O&M Committee Interview (make notes in BSR)					
In place and functioning			Yes		No
O&M user fee in place			Yes		No
User fee amount: US$_____/month? Year? Specific task? (Circle one)					
Indirect beneficiary fees			Yes		No
Contributions from other sources (make note)			Yes		No
Current funds within O&M account	US$				
Affordibility of user fees - % of users who are able to easily pay			%		
Are there government inputs to maintenance activities?			Yes		No
Labour/material input - Community – labour-based			%		
- Community – contractor services			%		
- Government/Ministry			%		
O&M training received			Yes		No
Ongoing capacity development			Yes		No
- Is there a training budget?			Yes		No
- How much?	US$				

KEY ISSUES

Design

- [ ] Lack of construction details on drawings
- [ ] Lack of accurate measurements in drawings
- [ ] Inaccurate drawings of pipe connection/network details
- [ ] Improper steel reinforcement design for reservoirs
- [ ] No elevations on plan
- [ ] Constructed dimensions differ from plan

Layout

- [ ] Poor site selection for infrastructure
- [ ] Erosion protection around catchment facilities
- [ ] Fence around catchment facilities
- [ ] Watershed protection

Reinforcing

- [ ] Missing/short development length in steel reinforcing
- [ ] Improperly bent reinforcing cage tie bars
- [ ] Lack of tie bar wiring

Concrete

- [ ] Absence of concrete mix design
- [ ] Honeycombing in concrete
- [ ] Exposed/shallow reinforcing steel
- [ ] Poorly mixed concrete

Reservoir

- [ ] No cleanout/overflow
- [ ] Improper lid/no lock
- [ ] Valve box issues
- [ ] Ease of maintenance (steel rungs, etc.)

Pipe Network

- [ ] Pipes are not buried
- [ ] Poor pipe connections
- [ ] Lack of/inappropriate pipe support

Tapstands/Miscellaneous

- [ ] Mechanical fixtures broken or leaking
- [ ] Tapstand floor not sloped
- [ ] Poor drainage around public areas
- [ ] Concrete floor poorly constructed/cracked

Miscellaneous

- [ ] Broken mechanical fixtures
- [ ] No handicap ramp/too steep
- [ ] Ponding on the floor
- [ ] Poor drainage around bldg.

Brief description
Sub-project description Issues

Key Photo Findings	**Comments and Recommendation**
[Sub-Project Signboard or Plaque, with Sub-Project Budget]	

TECHNICAL INSPECTION CHECKLIST
ROAD, DRAINAGE and RETAINING WALL

Sub-Project location	Municipality	Emera	Sub-Project Completion Date :	
	Admin. Post	Atsabe	Sub-Project number	
	Suku		Remoteness	U NR R VR ExR
Sub-Project Name			New construction ☐	Rehabilitation ☐
Project phase			Inspection date:	Inspection by:

Evaluation Details

Road Segment (Station Chainage) * Provide an estimate of % of Road Segment experiencing the problems noted. Missing Drainage Struc. – how many? Safety concerns – how many? What kind?	Problems Noted											
	1 * Cross Section (Crown/Camber) *	2 * Inadequate Roadside Ditches *	3 Missing Drainage Structure (1, 2, 3..)	4 * Improper Construction Materials *	5 * Steep and slippery when wet *	6 * Low and muddy during rain*	7 * Unstable slope above (too steep) *	8 * Unstable slope below (too steep) *	9 * Narrow width *	10 * Surface below standard *	11 * Pavement below standard *	12 Safety concerns (1, 2, 3,.. make
Start of road 0+000 to 0+100 meters												
0+100 to 0+200												
0+200 to 0+300												
0+300 to 0+400												
0+400 to 0+500												
0+500 to 0+600												
0+600 to 0+700												
0+700 to 0+800												
0+800 to 0+900												
0+900 to 1+000												
Use additional sheets as necessary												
Road and Bridge Vehicle Data:	Two-Wheel			☐	Four-Wheel			☐	Bus-Transport			☐

Technical Inspection Checklist Road, Drainage and Retaining Wall			
Sub-Project name		Sub-Project No.	

Inspection Details					
Spot Improvements Evaluated	Inspection Result				
	Meets Spec.	Slightly Below Spec	Below Spec.	Not inspected	Not applicable
1 Retaining Wall					
a. Structural integrity (batter, etc.)					
b. Weep holes					
c. Construction materials					
d. Erosion protection					
2 Culvert					
a. Layout					
b. Construction materials					
c. Construction techniques					
3 Small Bridge					
a. Layout					
b. Construction materials					
c. Construction techniques					
4 Steep Section Surfacing (Concrete, Asphalt)					
a. Construction materials					
b. Construction techniques					
5 Drainage channel					
a. Construction materials					
b. Construction techniques					

Overall Sub-Project Assessment

The construction quality is : ☐ Excellent ☐ Good ☐ Poor

Comments: (Excellent or Poor needs a story)

Fitness for Purpose: ☐ Excellent ☐ Good ☐ Poor ☐ None (not finished)

Comments: (Excellent or Poor needs a story)

Environmental considerations
The sub-project quality is: ☐ Excellent ☐ Good ☐ Poor

Comments: (Excellent or Poor needs a story)

Community Sub-Project Proposal and Diary of Inspections

Frequency of Technical Facilitation and Supervision: _____ visits per week / month (circle one)

Sub-Project Construction Budget: _____ US$

Consultation with Line Ministry: ☐ Yes ☐ No (Old POM, Form 7; New POM, Form 6.1.1)
Who did they talk to? (Make note to BSR)_____

National Standard Engineering Drawings used? ☐ Yes ☐ No

As-built Drawings completed and filed? ☐ Yes, Sufficient ☐ Not Suff. ☐ No ☐ SP not finished

Land Donation required? ☐ Yes ☐ No
Land Donation Documentation completed and filed ☐ Yes ☐ No ☐ Not Applicable
(Look for TF 7.2.2)

Operation & Maintenance - Road, Drainage and Retaining Wall

Major repairs or rehabilitation performed		Yes		No	
Major repairs or rehabilitation required		Yes		No	
Nature of Defect - Environmental/Climate		problem areas			
- Design					
- Construction					
- Materials					
- O&M					
- Over-use (vehicle too large)					
Repair costs or Estimate of repair costs	US$				
Routine maintenance (make notes in BSR)					
Pot hole/surface repair		active areas			
Erosion control of shoulders					
Erosion control of slopes					
Drainage					
Vegetation					
Signs					
Minor repair culverts/walls					
Regrading and re-gravelling					
Repair scour checks					
Annual maintenance costs	US$				
O&M Committee Interview (make notes in BSR)					
In place and functioning		Yes		No	
O&M user fee in place		Yes		No	
User fee amount: US$_____/month? Year? Specific task? (circle one)					
Indirect beneficiary fees		Yes		No	
Contributions from other sources (make note)		Yes		No	
Current funds within O&M account	US$				
Affordibility of user fees - % of users who are able to easily pay		%			
Are there government inputs to maintenance activities?		Yes		No	
Labour/material input - Community – labour-based		%			
- Community – contractor services		%			
- Government/Ministry		%			
O&M training received		Yes		No	
Ongoing capacity development		Yes		No	
- Is there a training budget?		Yes		No	
- How much?	US$				

KEY ISSUES - Road, Drainage and Retaining Wall

Design

- [ ] Lack of construction details on drawings
- [ ] Lack of accurate measurements in drawings
- [ ] Improper cross section
- [ ] Drainage considerations
- [ ] Constructed dimensions differ from plan

Layout

- [ ] Overly steep gradient
- [ ] Too narrow for vehicles

Construction

- [ ] Improper materials
- [ ] Lack of compaction

Pipe, Culvert and Channel

- [ ] Dimensions/layout
- [ ] Improperly buried
- [ ] Erosion protection

Steel Reinforcing

- [ ] Missing/short development length in steel reinforcing
- [ ] Reinforcing cage tie bars, wiring incorrect

Concrete

- [ ] Absence of concrete mix design
- [ ] Honeycombing in concrete
- [ ] Exposed/shallow reinforcing steel
- [ ] Poorly mixed concrete

Retaining Wall

- [ ] Foundation/structural integrity
- [ ] Batter
- [ ] Weep holes
- [ ] Poor drainage at foot of wall
- [ ] Finishing

Slopes

- [ ] Fill slope - 1:4 max
- [ ] Cut slope - 1:2 max

Brief description
Sub-project description Issues

Key Photo Findings	**Comments and Recommendation**
[Sub-Project Signboard or Plaque, with Sub-Project Budget]	

TECHNICAL EVALUATION CHECKLIST
IRRIGATION

Sub-Project location	Municipality		Sub-Project Completion Date :	
	Admin. Post		Sub-Project number	
	Suku		Remoteness	U NR R VR ExR
Sub-Project Name			New construction ☐	Rehabilitation ☐
Project phase			Inspection date:	Inspection by:

Components Evaluated	Inspection Result				
	Meets Spec.	Slightly Below Spec	Below Spec.	Not Inspected	Not Applicable
Evaluation Details					
1. System layout					
2. Reservoir design					
3. Weir					
4. Water level controls					
5. Ditches					
6. Culvert and pipes					
7. Embankments					
a. Fill slope – 1 vert.:4 horiz. maximum					
b. Cut slope – 1 vert.: 2 horiz. max.					
8. Irrigation channel					
a. Dimensions					
b. Field outlets					
9. Channel control structures					
10. Retaining Wall					
a. Structural integrity					
b. Erosion protection					

Sub-Project Detail Information			
Sub-Project name		Sub-Project no.	

Overall Sub-Project Assessment

The construction quality is : ☐ Excellent ☐ Good ☐ Poor

Comments: (Excellent or Poor needs a story)

Fitness for Purpose: ☐ Excellent ☐ Good ☐ Poor ☐ None (not finished)

Comments: (Excellent or Poor needs a story)

Environmental considerations
The sub-project quality is: ☐ Excellent ☐ Good ☐ Poor

Comments: (Excellent or Poor needs a story)

Community Sub-Project Proposal and Diary of Inspections

Frequency of Technical Facilitation and Supervision: _____ visits per week / month (circle one)

Sub-Project Construction Budget: _____ US$

Consultation with Line Ministry: ☐ Yes ☐ No (Old POM, Form 7; New POM, Form 6.1.1)
Who did they talk to? (Make note to BSR)_____

National Standard Engineering Drawings used? ☐ Yes ☐ No

As-built Drawings completed and filed? ☐ Yes, Sufficient ☐ Not Suff. ☐ No ☐ SP not finished

Land Donation required? ☐ Yes ☐ No
Land Donation Documentation completed and filed ☐ Yes ☐ No ☐ Not Applicable
(Look for TF 7.2.2)

Operation & Maintenance

Major repairs or rehabilitation performed			Yes		No
Major repairs or rehabilitation required			Yes		No
Nature of Defect - Environmental/Climate			problem areas		
- Design					
- Construction					
- Materials					
- O&M					
Repair costs or Estimate of repair costs	US$				
Routine maintenance (make notes in BSR)					
Vegetation removal (aquatic and land)			active areas		
Sediment removal					
Mechanical gates, outlets					
Canal repair					
Embankment erosion protection					
Fencing repair					
Annual maintenance costs	US$				
O&M Committee Interview (make notes in BSR)					
In place and functioning			Yes		No
O&M user fee in place			Yes		No
User fee amount: US$_____/month? Year? Specific task? (circle one)					
Indirect beneficiary fees			Yes		No
Contributions from other sources (make note)			Yes		No
Current funds within O&M account	US$				
Affordibility of user fees - % of users who are able to easily pay			%		
Are there government inputs to maintenance activities?			Yes		No
Labour/material input - Community – labour-based			%		
- Community – contractor services			%		
- Government/Ministry			%		
O&M training received			Yes		No
Ongoing capacity development			Yes		No
- Is there a training budget?			Yes		No
- How much?	US$				

Brief description
Sub-project description Issues

Key Photo Findings	**Comments and Recommendation**
[Sub-Project Signboard or Plaque, with Sub-Project Budget]	

Annex 3 – List of Sub-Projects Evaluated and Quality Ratings

Brief reports for the sub-projects marked with yellow background are provided in Annex 4.

No.	Municipality	Administrative Post	Village	Sub-Project	Overall Construction Quality	Fitness for Purpose	Environmental Considerations	No. of Technical Facilitation Visits per Month
1	Aileu	Remexio	Suco Liurai	Health post	Good	Good	Good	1/mth
2	Aileu	Remexio	Maumeta	Health post	Good	Good	Good	2/mth
3	Aileu	Aileu Vila	Seloi Craic	Concrete bridge	Good	Good	Good	4/mth
4	Aileu	Remexio	Faturasa	Gravity water supply	Good	Good	Good	1/mth
5	Aileu	Aileu Vila	Bandudato	Rural road	Good	Good	Good	4/mth
6	Aileu	Aileu Vila	Seloi Malere	Rural road	Poor	Good	Poor	4/mth
7	Aileu	Aileu Vila	Suco Liurai	Rural road	Poor	Good	Good	1/mth
8	Aileu	Aileu Vila	Hoholau	Rural road	Poor	Good	Poor	2/mth
9	Aileu	Laulara	Talitu	Rural road	Good	Good	Good	4/mth
10	Aileu	Laulara	Tohumeta	Rural road	Good	Good	Good	4/mth
11	Aileu	Remexio	Maumeta	Rural road	Good	Not finished	Good	2/mth
12	Aileu	Aileu Vila	Seloi Craic	Irrigation	Good	Good	Good	1/mth
13	Ainaro	Maubisse	Horai-Quic	Concrete bridge	Poor	Excellent	Good	4/mth
14	Ainaro	Hatu Builico	Mau Chiga	Gravity water supply	Good	Good	Good	
15	Ainaro	Maubisse	Maubisse	Gravity water supply	Good	Good	Good	4/mth
16	Ainaro	Maubisse	Maubisse	Gravity water supply	Good	Good	Good	4/mth
17	Ainaro	Hatu Udo	Foho-Ai-Lico	Retaining wall	Good	Good	Good	4/mth
18	Ainaro	Maubisse	Manelobas	Rural road	Good	Good	Good	4/mth
19	Ainaro	Maubisse	Aituto	Rural road	Good	Good	Good	4/mth
20	Dili	Cristo Rei	Meti-Aut	School – primary	Good	Good	Good	2/mth
21	Dili	Dom Aleixo	Comoro	Health post	Good	Good	Good	8/mth

No.	Municipality	Administrative Post	Village	Sub-Project	Overall Construction Quality	Fitness for Purpose	Environmental Considerations	No. of Technical Facilitation Visits per Month
22	Dili	Atauro	Maquili	School extension	Good	Not finished	Good	2/mth
23	Dili	Atauro	Macadade	School extension	Excellent	Excellent	Good	2/mth
24	Dili	Cristo Rei	Becora	Water supply – pump	Good	Good	Good	8/mth
25	Dili	Cristo Rei	Hera	Gravity water supply	Poor	Poor	Good	8/mth
26	Dili	Vera Cruz	Dare	Gravity water supply	Good	Poor	Good	8/mth
27	Dili	Nain Feto	Lahane Oriental	Gravity water supply	Good	Good	Good	8/mth
28	Dili	Dom Aleixo	Bairro Pite	Water supply	Good	Good	Good	8/mth
29	Dili	Dom Aleixo	Bairro Pite	Water supply	Good	Poor	Good	8/mth
30	Dili	Vera Cruz	Vila Verde	Drainage	Good	Good	Good	8/mth
31	Dili	Vera Cruz	Caicoli	Drainage	Good	Good	Good	8/mth
32	Dili	Dom Aleixo	Kampung Alor	Rural road	Good	Good	Good	8/mth
33	Dili	Vera Cruz	Colmera	Pipe culvert	Good	Good	Good	8/mth
34	Lautem	Iliomar	Fuat	School – primary	Good	Excellent	Good	2/mth
35	Lautem	Lospalos	Bauro	Water supply – well	Good	Good	Good	8/mth
36	Lautem	Luro	Lacawa	Gravity water supply	Good	Excellent	Good	2/mth
37	Lautem	Lospalos	Muapitine	MCK	Good	Good	Good	8/mth
38	Lautem	Lautem	Ililai	Water supply – pump	Poor	Poor	Good	8/mth
39	Lautem	Lautem	Maina II	Water supply – catchment dam	Good	Good	Good	8/mth
40	Lautem	Lautem	Pairara	Gravity water supply	Good	Good	Good	8/mth
41	Lautem	Lautem	Parlamento	Water supply – catchment dam	Good	Excellent	Good	8/mth
42	Lautem	Lautem	Serelau	Gravity water supply	Good	Excellent	Good	4/mth
43	Lautem	Tutuala	Tutuala	Retaining wall - gabion	Good	Good	Good	4/mth
44	Lautem	Lospalos	Muapitine	Drainage	Good	Good	Good	8/mth
45	Lautem	Lautem	Com	Drainage	Good	Good	Good	8/mth

No.	Municipality	Administrative Post	Village	Sub-Project	Overall Construction Quality	Fitness for Purpose	Environmental Considerations	No. of Technical Facilitation Visits per Month
46	Lautem	Iliomar	Aelebere	Irrigation	Excellent	Good	Good	4/mth
47	Manufahi	Turiscai	Mindelo	MCK	Good	Good	Good	4/mth
48	Manufahi	Turiscai	Foholau	MCK	Good	Good	Good	
49	Manufahi	Turiscai	Caimauc	Concrete bridge	Poor	Good	Good	8/mth
50	Manufahi	Turiscai	Manumera	Concrete bridge	Good	Good	Good	8/mth
51	Manufahi	Alas	Mahaquidan	Water Supply – pump	Good	Good	Good	2/mth
52	Manufahi	Same	Holarua	Gravity water supply	Good	Good	Good	
53	Manufahi	Fatuberliu	Clacuc	Water Supply – well	Good	Good	Good	8/mth
54	Manufahi	Same	Daisua	Rural road	Good	Good	Good	4/mth
55	Manufahi	Turiscai	Fatucalo	Rural road	Good	Good	Good	
56	Manufahi	Turiscai	Matorec	Rural road	Poor	Good	Good	
57	Manufahi	Turiscai	Orana	Rural road	Poor	Good	Poor	2/mth
58	Manufahi	Fatuberliu	Clacuc	Water supply	Excellent	Good	Good	4/mth
59	Oecusse	Pante Macassar	Cunha	School - primary	Good	Not finished	Good	4/mth
60	Oecusse	Nitibe	Lela-Ufe	Market	Good	Good	Good	8/mth
61	Oecusse	Nitibe	Lela-Ufe	Housing - teachers	Good	Excellent	Good	8/mth
62	Oecusse	Oesilo	Usi-Taqueno	Clinic - maternity	Good	Not finished	Good	8/mth
63	Oecusse	Pante Macassar	Costa	Concrete road	Good	Good	Excellent	4/mth
64	Oecusse	Passabe	Malelat	Concrete road	Excellent	Good	Good	8/mth
65	Oecusse	Nitibe	Usi-Taco	Irrigation	Excellent	Excellent	Good	8/mth

Annex 4 – Brief Sub-Project Reports

This annex contains quality reports for a sample of sub-projects visited by the technical evaluation teams. They include photos of notable good and bad works.

From the 65 sub-projects audited:

- **5** were rated as **excellent**
- **51** were rated as **good**, and
- **9** were rated as **poor**

The sample includes:

Municipality	Administrative Post	Suco	Sub-Project	**Overall Construction Quality**
Aileu	Remexio	Faturasa	Gravity water supply	Good
Aileu	Aileu Vila	Seloi Craic	Irrigation	Good
Ainaro	Maubisse	Horai-Quic	Concrete bridge	Poor
Ainaro	Maubisse	Aituto	Rural road	Good
Dili	Atauro	Macadade	School extension	Excellent
Dili	Cristo Rei	Hera	Gravity water supply	Poor
Lautem	Lautem	Ililai	Water supply – pump	Poor
Lautem	Iliomar	Aelebere	Irrigation	Excellent
Manufahi	Turiscai	Foholau	MCK	Good
Manufahi	Turiscai	Orana	Rural road	Poor
Oecusse	Nitibe	Lela-Ufe	Market	Good
Oecusse	Nitibe	Usi-Taco	Irrigation	Excellent

Technical Evaluation Brief Sub-Project Report
Gravity Water Supply

Sub-Project Location		Project Detail	
Municipality	Aileu	Sub-project completion date: February 2017	
Admin. Post	Remexio	Remoteness	Very remote
Suku	Faturasa - Faculau	New construction ☐	Rehabilitation ☒
Sub-Project Name	Gravity water supply	Inspection date: 2 May 2017	Inspection by: Su'udi Noor
Project phase	Phase 2 Cycle 2	Construction quality rating	Good

Brief description

The project consists of a long pipeline network of 3,155 meters, one reservoir tank, and six public taps. The total cost is US $ 9,455 USD.

The clean water sub-project has improved public health, and the estimated number of beneficiaries per public tap is 10 households. The total number of beneficiaries is estimated at 60 families. Further, the excess water is also utilized by some people to grow vegetables. Activities arising from this water supply meets family needs.

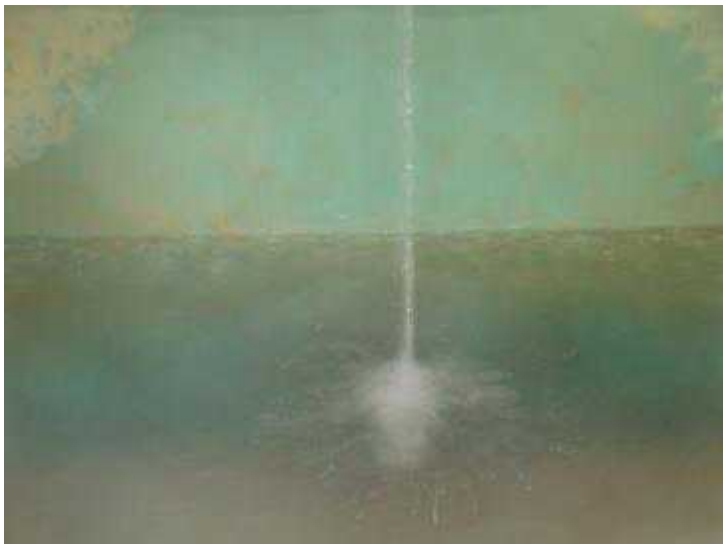
During the visit there was a meeting with the team from suku Futurasa, aldeia Faculau. Maintenance activities that have been carried out by the team include: cleaning up landslides, two times cleaning tanks/reservoir, and clearing trees and branches which fell on the pipeline.

At the time of the sub-project verification, the consultation with EVAS (the municipal Verification, Assessment and Supervision Team) was done with the administrative post engineer from the Directorate of Sanitation.

The construction quality is good and the public taps work well.

The field visit identified some important issues:

1. All public taps have a good flow of water, and the excess flow infiltrates well in the surrounding soil so that the environment looks clean.
2. There is no user fee charge for maintenance, but there have already been maintenance efforts by the public taps group.
3. There are water distribution pipes which are not buried.

Key Photo Findings	Comments and Recommendation
	The information board is still well displayed in the field. The presence of this information board, even though the sub-project has been completed, indicates that the transparency in Faturasa about this sub-project is quite good.
	The reservoir has fence protection fences in good condition and maintenance has been carried out by the public taps group.
	Flow of water into the reservoir tank. The water discharge needs to be monitored continuously. If the flow decreases, an immediate inspection should be done to look for the cause of flow disturbance, or for the damage that has occurred.

Key Photo Findings	Comments and Recommendation
	The queue of jerrycans at the water tap shows that the facility is actively used, and fulfills a need.
	The excess and spilled water from the public tap drains off for infiltration in the soil behind the tap slab.
	Another public water tapstand in the same water supply system. Also note the elevated washing slab to the side.

Key Photo Findings	Comments and Recommendation
	A woman has fenced off a small plot, and grows vegetables with water from a nearby public tap.

Technical Evaluation Brief Sub-Project Report
Irrigation

Sub-Project Location		Project Detail	
Municipality	Aileu	Sub-project completion date: February 2016	
Admin. Post	Aileu Vila	Remoteness	Remote
Suku	Seloi Craic	New construction ☐	Rehabilitation ☒
Sub-Project Name	Irrigation	Inspection date: 26 April 2017	Inspection by: Su'udi Noor
Project phase	1 cycle 2	Construction quality rating	Good

Brief description

The weir and irrigation channel project use the PNDS standard design. The project is located in the aldeia Lio. The size of the weir is 12 meter, and the irrigation channel measures 500 meter. The cost was US $ 21.142. The cross-section of the channel measured 0.8 m at the top, and 0.5 m at the bottom, with a height of 0.5 m.

The design of the irrigation channel foresees a water gate but that one is not yet installed. As part of the works, there is a concrete culvert which crosses under a village road.

The irrigation works serves two main objectives. First, to increase the capacity of the irrigation channel so that the water flow into the rice fields is steadier throughout the year; second, to increase the harvests of rice and vegetables.

The irrigation works has had a bigger impact than expected, because of the good water flow. They can now also irrigate "sleeping land" that wasn't cultivated before. In 2017, the community could plant rice again on another two hectares of land.

Thomas Martins, one of the vegetable farmers met, said that by April the irrigation water usually had dried up, but in April 2017 it was still running smooth[3]. This made the work also lighter, as they no longer had to use buckets to water the vegetables. They were also using a water pump, which was more time efficient and more productive.

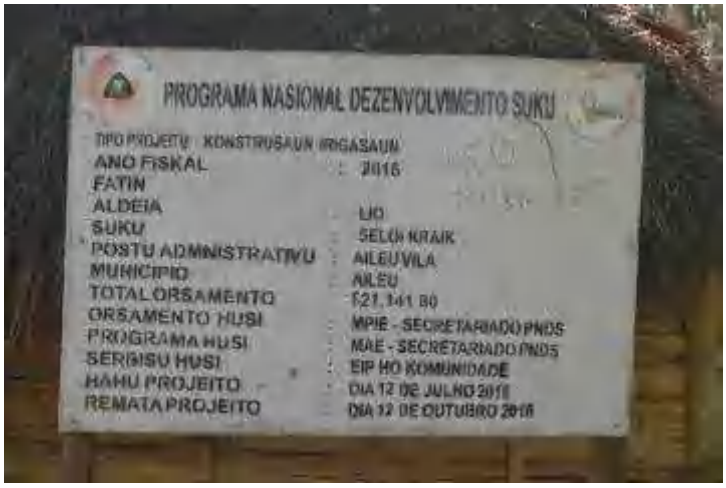
The overall construction quality is quite good, but there are some notes to improve construction of similar infrastructure in the future.

1. There was a change of location of the weir but no revision of the design was found.
2. There was no drawing of the layout of the weir.
3. The overflow of the weir was designed too small. During floods the flow rate is not properly controlled, and the flood water discharge isn't drained in a controlled manner.
4. Because of this, a gabion at the side of the overflow, which should help to dissipate the energy of the falling water, has partially collapsed to one side, due to the flood waters.

[3] The end of the rainy season in 2017 came also later than in previous years.

5. The size of the built irrigation channel is smaller than what is specified on the standard design drawing.

According to information from the President of the Planning and Accountability Commission (KPA), the maintenance team has been established but they were not present at the location, and so could not be interviewed. The inspection of the irrigation works shows that most of the construction has been completed, and that it is functioning, but there are still some 30 meters of channel to be built, and the water gate needs to be installed.

Key Photo Findings	Comments and Recommendation
	The sub-project's information board installed is still quite good. With the existence of this project board and the condition is still quite good indicating the existence of transparency process in Seloi Craic.
	The weir is functional and is used by the community, but the water gate, which serves to regulate the water elevation has not been installed. This even though the material for the water gate was available.

Key Photo Findings	Comments and Recommendation
	The soil under the gabion has been eroded by water, its stability is disrupted, and is has slightly overturned. The gabion needs to be opened up and repaired before the next rainy season. If possible, it should also be fortified with hard wood that doesn't rot under wet conditions.
	With a flat terrain, a circular culvert is not the recommended option, as this requires quite a lot of backfill on top of the culvert. Where water flows are small, a box culvert is more appropriate as it does not require any filling on top of the deck plate.
	The paddy fields receive more irrigation water than before the construction of the weir. A larger area of land can now be irrigated, and the water infiltrates deeper into the soil.

Key Photo Findings	Comments and Recommendation
	A vegetable farmer said that the irrigation channel has made it easier to develop his vegetable business. They can now water the plants with an electric pump, and grow vegetables much easier than before. Before they had to walk to get the water, which took a lot of time and energy. This vegetable grower has now become a regular supplier to Dili Mart, and they come periodically to the farm to buy his vegetables.
	Before the construction of the weir, this was 'sleeping land'. In 2017 farmers started to cultivate these fields again. They estimate that they have been able to take another 2 ha into cultivation.

Technical Evaluation Brief Sub-Project Report
Concrete bridge

Sub-Project Location		Project Detail	
Municipality	Ainaro	Sub-project completion date: Not finished	
Admin. Post	Maubisse	Remoteness	Remote
Suku	Hora Quic	New construction [x]	Rehabilitation [ ]
Sub-Project Name	Concrete bridge	Inspection date: 26 April 2017	Inspection by: Neil Neate
Project phase	3 cycle 1	Construction quality rating	Poor

Brief description

This reinforced concrete bridge replaces an old wooden bridge that existed here. The old bridge was at a much lower elevation and required much annual maintenance for the local villagers to keep it open and functioning.

The work generally seems to have been done very well, except for the placement of the steel reinforcement within the forms. The supporting beams' steel stirrups were allowed to rest on, or very close to, the formwork, with the result that "shadows" of the stirrups are plainly visible on the underside of the beams. The beams should be painted with a sealant coat as soon as possible so that moisture does not start to penetrate the thin veneer of concrete that coats the stirrups.

The design of the bridge has been done very well, with well-executed wing walls, bridge apron and railings.

Key Photo Findings	Comments and Recommendation
	Well-designed and (mostly) well executed bridge works.
	The inauguration plaque of the Mauleikeo bridge in suku Horai-Quic. The bridge was inaugurated on 22 February 2017 by the Municipal Administrator of Ainaro.

Key Photo Findings	Comments and Recommendation
	Stirrups are visible and starting to rust already. This concrete will start to crack and spall. The strength of the beam will be compromised.
	Stirrup positions are clearly visible on the underside of the beam. This means that they are very close to the outside of the concrete (probably less than 1mm). Water will penetrate the concrete and the steel will start to rust, causing cracking and spalling of the concrete. The underside of the affected areas should be painted with a sealant compound.

Technical Evaluation Brief Sub-Project Report
Rural road

Sub-Project Location		Project Detail	
Municipality	Ainaro	Sub-project completion date: December 2015	
Admin. Post	Maubisse	Remoteness	Remote
Suku	Aituto	New construction [x]	Rehabilitation [ ]
Sub-Project Name	Road improvements –Spot and Lengthy Areas	Inspection date: 27 April 2017	Inspection by: Neil Neate
Project phase	3 cycle 1	Construction quality rating	Good

Brief description

There were both some spot improvement works done on this road and some new road gravels added to lengthy areas.

The spot improvements made to this road are all in very good shape and will help the villagers move into the future.

The areas where gravel was applied to the road surface in an attempt to improve the road conditions have all largely returned to their former state because the underlying drainage problems had not been corrected at these areas.

Key Photo Findings	Comments and Recommendation
	This section of road had a new layer of gravel added. It has rapidly degraded again, with road rutting, corrugations and surface drainage problem evident.

Key Photo Findings	Comments and Recommendation
	This culvert was installed at a small stream crossing. It continues to provide good service in this respect. Road gravels have been shaped to allow rainfall to run off the road. The culvert was installed with adequate sidewalls to contain the road surface.
	Road gravels were added to this steep section. Stormwater runoff is already degrading this area, with drainage gullies forming. This section should have had some steep road works done on it that would serve many seasons with no damage.

Technical Evaluation Brief Sub-Project Report
Primary School

Sub-Project Location		Project Detail	
Municipality	Dili	Sub-project completion date: April 2017	
Admin. Post	Atauro	Remoteness	Very remote
Suku	Macadade	New construction [x]	Rehabilitation [ ]
Sub-Project Name	Primary School	Inspection date: 23 May 2017	Inspection by: Su'udi Noor
Project phase	1 cycle 2	Construction quality rating	Excellent

Brief description

The construction of the primary school in Macadade, built on the school's land, comprised of three classrooms of 7 x 7.8 m^2 and a 2 m wide terrace. The project is located in what used to be aldeia Amartuto but which has now become aldeia Bite. The total cost was US $ 48,500.

This sub-project proposal has been consulted with EVAS, i.e. with the Community Development Officer (CDO) from the administrative post, to check that there was not any overlap with other project financing.

At the time of the field visit there was a meeting with the Suku Secretary and with Mr. Jeremias Alves, the School Director. They stated that the goal of the development was to provide more appropriate classroom space for the primary school students. The three classrooms that were built through PNDS met an urgent need as the old school space was no longer adequate. The School Director said that previously the school borrowed a room in the church, and another room at a teacher's private home more than 1 km from the school. This also intervened with the teaching; if there was a church activity, the children were usually given one or two days off. What was even more worrisome was that there were no desks and benches, and the children had to sit on the floor. With the new classrooms, at the school itself, the children are very happy and they learn more focused than before.

The construction was 100% complete on April 9, 2017, and the classrooms were taken into use in May 2017, even before the official handover. The quality of the construction is quite good, but it needs some small repairs on the louvre windows ('*Naco*') so that they can easily be opened and closed.

The field visit identified several issues as follows:

1. The physical work was 100% complete on April 9, 2017, and the classes have been taken into use, but there has not yet been an official handover.
2. The terrace floor is more than 1 meter above the ground, which makes it quite dangerous for the children.
3. There is a vertical hair crack of more than one mm wide near the column and the window sill.

4. The diameter of the main reinforcement bars on the technical drawing was 10 mm, but in the bill of quantities 12 mm is specified, and 12 mm diameter bars is also what has been used. There is no written documentation of the change, no minutes of a meeting where it was discussed, or a revised drawing.
5. The design drawing foresees a ramp and hand rail to help disabled persons, but these have not been placed, and there is also no written documentation of the change.

Key Photo Findings	Comments and Recommendation
	The classes built by the PNDS project are situated to the left of a building constructed by a contractor. The school is in general in very good condition, and is being used for teaching, even though the official handover has not yet happened. The new classes were quickly taken into use because the replacement classes (at the church and in a teacher's house) are far away an inconvenient. The initiative of the school to take the classes already into operation can be understood. What is important is that the school takes on the responsibility for upkeep and maintenance.
	One of the classrooms in use. The floor is tiled, and there is an access panel in the ceiling. It is hoped that the school will be able to handle routine maintenance for the classes, and also maintain a clean environment around the school.

Key Photo Findings	Comments and Recommendation
	A well-executed roof truss. It would have been better if the connections between the beams had been reinforced with a steel plate and bolts. This would have been stronger than just using nails.
	The connection between the columns on the terrace and the wooden beams uses a steel profile, reinforced with steel bolts. This is very good practice, and can serve as an example for other buildings under construction or planned.
	There is a crack in the floor, which is caused by inadequate soil compaction, and shrinkage of the floor plaster. The cause of the crack should be addressed. The floor should be opened, the soil filled up and properly compacted, and then cemented again.

Key Photo Findings	Comments and Recommendation
	In the wall, there is a hairline crack with a small width less than 2 mm. The evolution of the crack should be monitored. If the crack does not become bigger, then it is most likely caused by a poor plastering technique, but this is a non-structural damage.

Possible reasons for the damage are:

- The mixture for the plaster did not have the right amounts of sand, cement and water.
- The sand used in the plaster had a high organic content, and may have been mixed with mud.
- The bricks of the wall, when placed, were either too dry or too wet when the plaster was put over it.
- Plastering was done in too hot weather.
- The paint used does not have good elasticity. A paint with good elasticity can help to cut down on the emergence of hair cracks.

To repair the wall, the following steps should be taken:

1. Remove the plaster from the cracked area, with a distance of about 5 cm on both sides of the crack.
2. Spray the surface of the wall with water. Spraying water on the wall with a hose is better than throwing water on it; the wall will better absorb water. Let the wall dry out a bit for a while.
3. Start patching up the wall with a fine mortar. Make sure that the thickness of the applied plaster is the same as the adjacent areas next to the crack, so that after the repair the wall will be flat.
4. Let the wall rest for two weeks. Then paint it again with the same colour as the surrounding wall.

If the crack becomes wider than 2 mm, then it points to a more serious problem, with structural damage to the wall.

Technical Evaluation Brief Sub-Project Report
Gravity water supply

Sub-Project Location		Project Detail	
Municipality	Dili	Sub-project completion date: October 2016	
Admin. Post	Cristo Rei	Remoteness	Not remote
Suku	Hera - Acanuno	New construction ☐	Rehabilitation ☒
Sub-Project Name	Water supply and sanitation	Inspection date: 4 May 2017	Inspection by: Su'udi Noor
Project phase	3 cycle1	Construction quality rating	Poor

Brief description

The Hera Water Supply Rehabilitation Project, located in aldeia Acanuno, according to the design should consist of: a gabion and stone structure to protect a water source, a polyester pipe to take the water out, a water storage and distribution tank (rehabilitation), two reservoir tanks and six 2" diameter pipes, a reservoir box of 3 m by 4 m which is 2 m high, and seven public taps. The total cost was US $ 18,212.

During the field visit, the evaluator did not meet the suku team, but according to the facilitator at the time of sub-project verification it was consulted with EVAS (the municipal Verification, Assessment and Supervision Team), in this case with the SAS engineer from the administrative post.

This project has not been completed as planned, especially for the public taps: only one was of the seven built is functioning. According to information obtained, the suku team (EIP, KPA, Chefe de Suku and Chefe de Aldeia) has written a letter requesting that the project be stopped. The current construction has already cost US $ 14,640.

Furthermore, the water only flows to the first reservoir, and only one of the distribution boxes, which was rehabilitated, is still functioning.

The overall quality of construction and the hoped-for benefits are less than expected, and it is to be feared that the infrastructure will quickly deteriorate because there are unresolved problems which were not addressed during the construction process.

Important issues identified during the field visit are:

1. Of the planned seven public taps, only one unit is functioning.
2. The water flow stops at the reservoir basin, and the water overflows because it is hardly used.
3. A length of 18 of the transmission pipe is not buried and simply lies on top of the river bed it crosses.
4. Only one unit of the rehabilitated distribution boxes is still functioning.
5. There is need for an in-depth study of suku Hera to identify the problems of this situation.

Key Photo Findings	Comments and Recommendation
	Gabions help to protect the water source. Under the gabions is a stone construction which steers and holds the water. The installed screen is very simple and it gets easily clogged by falling leaves. Because of this, the water source must be routinely inspected by members of the Water Users Group, or water users themselves, to prevent clogging of the water pipe.
	The transmission pipe is simply lying on the river bed. It is therefore very vulnerable to damages by a vehicle crossing the river bed, or even by water flows of the river when in flood during the rainy season. There is an immediate need to secure the pipe. A first low-cost alternative is to dig a trench and bury the pipe at a safe depth. A second, more expensive, alternative is to construct a “pipe bridge”.
	A view of the transmission pipe from the river. If there is flooding, the pipe will be damaged or break because of strong flood water currents.

Key Photo Findings	Comments and Recommendation
	The water reservoir is not well maintained. Water gets wasted because only one of the planned seven public taps is functioning.
	A public tap was built, but it is not operational. Instead, a distribution pipe brings water directly into the house.
	One public tap is still functioning and serves the community. The picture with the line of jerrycans shows that the people are still in desperate need of water. The problem in suku Hera should be studied more in-depth to find the root causes of the problem, so that it may get addressed and lead to a proper solution.

Technical Evaluation Brief Sub-Project Report
Water supply – Submersible pump

Sub-Project Location		Project Detail	
Municipality	Lautem	Sub-project completion date: August 2016	
Admin. Post	Lautem	Remoteness	Very remote
Suku	Ililai - Titilari	New construction [x]	Rehabilitation [ ]
Sub-Project Name	Water supply – Submersible pump	Inspection date: 8 May 2017	Inspection by: Su'udi Noor
Project phase	3 cycle 1	Construction quality rating	Poor

Brief description

The PNDS Water Supply project in suku Ililai is located in aldeia Titilari, and consists of: 1) drilling to a ground water source at 8 m depth; 2) one reservoir; 3) four public water taps), and; 5) distribution pipes along approximately 2 km.

The total cost of this project is US $ 15,728, and the project was declared 100% completed on August 2, 2016. Mr. Armindo Tavares, the Chief of the Project Implementation Team, stated that the clean water project serves about 50 families from aldeia Titilari. There is an O&M team, but it does not really function, and there has been no O&M. There is no PNDS or Government policy on what measures to take if an existing O&M team is not willing to perform its O&M tasks, and what should be done to ensure that O&M is handled properly.

At the time of the visit there was no water flowing from the public water taps, even though there were no problems at the pump, or from the pump to the reservoir. Community members stated that water stopped flowing from the public taps some six months before (i.e. around November 2016). It is unclear why neither the community, nor members of the O&M team, have not reported this to the administrative post.

It could be that there is a burst in the water pipe due to water pressure, and – as explained by the facilitator – there is a height difference of 70 m between the water reservoir and the public taps, which may be too high a pressure for the type of pipe used. With such a height difference, there is need for a pressure relief valve or a pressure relief reservoir. This matter will need PNDS' attention, and the project should be monitored at least every six months. Apart from knowing the condition of the infrastructure, such visits can also be used to give guidance to the community or to the O&M team.

At the time of project verification, the water supply project has been consulted with SAS and the administrative post Community Development Officer, in order to avoid overlapping financing with other projects.

The field visit has identified several issues as follows:

1. The O&M team exits on paper, but is not working.
2. The public taps are not working, and the community is waiting for help from PNDS and/or the government to get the public taps working again.

3. There is no pump house building.
4. There is no wash out pipe in the reservoir.

Key Photo Findings	Comments and Recommendation
	The submersible pump installation is very simple, but has no protection. A situation like this should not occur, because of risks of disturbance to pump operation, and/or attempts at destruction. Pump houses provide protection, and sustainability for water supply operations.
	The reservoir tank is made of zinc / corrugated iron, but it is not equipped with a wash out valve (to drain the tank), and no fence around the tank.

Key Photo Findings	Comments and Recommendation
	During the visit, the pump was still functioning and was capable of pumping water into the reservoir tank at a height of 70 meters. The water quality is sufficiently good and the water can be drunk.
	The outlet pipe is well attached to the reservoir, and the ball valve is still functioning normally.
	This is the first public standpipe after the reservoir. It does not disperse any water, and – according to water users living close by – in May it had been out of operation for six months. The construction of the standpipe is good, but it shows that the construction has not been used for a long time.

Key Photo Findings	Comments and Recommendation
	The second public standpipe was in the same condition as the first one. A review by the PNDS Team and/or the Municipal Engineer is necessary to find out what the problems are, and to find a solution.

Technical Evaluation Brief Sub-Project Report
Irrigation channel

Sub-Project Location		Project Detail	
Municipality	Lautem	Sub-project completion date: February 2017	
Admin. Post	Iliomar	Remoteness	Very remote
Suku	Aelebere - Lalumato	New construction [x]	Rehabilitation [ ]
Sub-Project Name	Irrigation channel	Inspection date: 9 May 2017	Inspection by: Su'udi Noor
Project phase	2 cycle 2	Construction quality rating	Excellent

Brief description

The irrigation channel project in suku Aelebere uses PNDS standard design principles, with some adaptations for the location. The project site is located in aldeia Lalumato. To reach the project location, it is approximately a one hour walk from the road, where the car was parked, and it includes a river crossing. The travel time by car from Lospalos is around three hours, due to poor road conditions along the way.

Field observations show that the irrigation channel is 655 m long, with a cross-section width at the top of 1.50 - 1.55 m, a bottom width of 1.20 to 1.25 m, and a height of 0.7 m. The total cost of construction was US $ 44,000.

The irrigation channel is not equipped with a sluice which would allow to control water levels at the entrance to the channel. Such a tool is useful to control the volume of water which enters the irrigation channel when the river floods. In the downstream part of the channel, there is a simple but quite effective and easy to maintain facility which allows to divert water to a branch channel.

There were two main objectives for the construction of the irrigation channel. First, to replace the earthen channel – a simple soil excavation – with a more permanent construction, made of stone and concrete. This also increases the volume of water that can be brought to the rice paddies, with a more stable volume throughout the growing season. Second, it results in a higher production of rice and vegetables, and allows to start cultivating again on plots that had been left idle for lack of water.

There are signs that the impact of the project exceeds the community expectations, due to the smooth flow of water, and the enthusiasm of the farmer groups to cultivate their paddies. Talking to the farmers' groups, they said that they wanted to start cultivating land they haven't been able to farm for a long time because of lack of water, and they work collectively as a farmers' group. During the visit, they met with the Chief of the EIP, the President of the KPA, the O&M Team and other team members, as well as local leaders and farmers. The community participation was very good, and there is an obvious sense of ownership of the irrigation channel they have built, and a willingness to maintain it.

At the time of sub-project verification, it has been checked with EVAS in this case through the sub-district agriculture office, with the intention to avoid overlapping financing with other projects.

The quality of the irrigation channel construction is generally very good and robust, and good quality sand from a nearby river was used for the construction. There are still some deficiencies, such as the lack of a water elevation control, but that may be due to lack of experience, and the problem can be addressed in the future.

The field visit encountered the following important issues:

1. It is still necessary to improve the water intake at the river, which has not yet been constructed for lack of funds. Also, a water control level needs to be installed, to control the amount of water that enters the irrigation channel.
2. For the time being, a simple water control level should be placed at the start of the irrigation channel.
3. A positive thing done by the local community is to stack rocks behind the channel walls, which strengthens the channel's position.
4. Community participation in the implementation of this sub-project is high, as could be seen by the local interest and enthusiasm at the time of technical audit visit.

Key Photo Findings	**Comments and Recommendation**
	The old water intake – parts of which still exist – was a small embankment of rocks and soil.

Key Photo Findings	Comments and Recommendation
	The old earthen embankment is still functional.
	The starting point of the irrigation channel. There is not yet a “water gate”, i.e. a water control level, to regulate the amount of water that enters the channel.
	Part of the irrigation canal where rocks have been piled behind the wall to strengthen the channel.

Key Photo Findings	Comments and Recommendation
	The irrigation channel is in very good condition, and the wooden crossing looks fairly tight and strong.
	A simple water divider in the middle of the channel.
	A wooden board, and an opening in the irrigation channel wall, functions as a gate to divert water into a field.

Key Photo Findings	Comments and Recommendation
	Slots have been constructed in the channel wall so that the water height can be regulated by inserting wooden slabs.
	At the end of the irrigation channel, the water flows in the old, excavated channel, and connects directly to paddy fields.
	Paddy fields are irrigated with water from this sub-project.

Key Photo Findings	Comments and Recommendation
	Even though the irrigation channel is located far from the suku center, there was a lot of interest of the local community to follow and observe the technical audit visit. It is a sign of a high sense of ownership and participation in the implementation of the PNDS sub-project.

Technical Evaluation Brief Sub-Project Report

MCK - Public bathing, washing, and toilet facilities

Sub-Project Location		Project Detail	
Municipality	Manufahi	Sub-project completion date: February 2016	
Admin. Post	Tuniscai	Remoteness	Remote
Suku	Foholau	New construction [x]	Rehabilitation [ ]
Sub-Project Name	MCK	Inspection date: 5 May 2017	Inspection by: Neil Neate
Project phase	3 cycle 1	Construction quality rating	Good

Brief description

This MCK sub-project has been constructed as an addition to the public building area of this village, in a central area and quite accessible to all villagers.

The mechanical and plumbing aspects of the building are already poor – the faucet for the outside laundry tub no longer works and the door knobs are broken. Even with these poor fixtures, the community uses the facility everyday to a great extent. We are told that the outside faucet has been replaced three times already – PNDS should find a way to specify and ensure that well-built ball valves are purchased by the building committee.

The floor in one of the toilets has been installed improperly and does not drain, creating a pooled unsanitary mess that must be unattractive for people to use. This is something that Technical Facilitators and Community Facilitators should be able to easily explain during the construction process. Simple drawings showing a highly sloped floor should be left behind so that villagers will not forget this important item as they prepare to pour the toilet floors.

Connections from the building posts to the roof rafters have not been done properly, endangering the building in a high wind situation.

The septic tank does not have a lid access portal.

Water is supplied to this building from a PNDS system that never runs dry.

Key Photo Findings	Comments and Recommendation
	The MCK is well situated in the village, and is well-used.
	The outside faucet has been replaced three times already since construction. Can PNDS find a better source of these plumbing fixtures and ensure that villages use them? Does the staining on the wall come from poor installation of the piping? PNDS should investigate this and change design or installation practices. The staining is unsightly and detracts from the beauty of the structure.
	Poorly connected roof rafters. The Standard Design should clearly show steel strapping and bolts for these important connections.

Technical Evaluation Brief Sub-Project Report
Rural road

Sub-Project Location		Project Detail	
Municipality	Manufahi	Sub-project completion date: February 2016	
Admin. Post	Tuniscai	Remoteness	Remote
Suku	Orana	New construction [x]	Rehabilitation [ ]
Sub-Project Name	Earth road opening	Inspection date: 3 May 2017	Inspection by: Neil Neate
Project phase	3 cycle 1	Construction quality rating	Poor

Brief description

An old 'horse trail' has been widened over some portions of this new road opening sub-project to enable four-wheeled vehicles to access the village. The intention is to enable agricultural buyers to visit the area during the harvest season.

Large parts of the newly opened road are now impassable by four-wheeled vehicles due to landslides along portions of the road that were deeply cut into slopes.

The National Standard Design set shows standard road cross sections that were not followed during the construction of this road opening. None of the new road has a proper cross section. 80% of the new road does not have a proper ditching system to catch and guide storm water flows away from the road. There are no drainage structures included in the design, nor have they been constructed. Some ad hoc scour checks (small diagonal berms across the road surface) have been formed by villagers in an attempt to lead destructive storm flows off of the road. No gravel has been applied to the surface of the road.

Steep slopes that have been created by road cuts are collapsing. Much of the new roadworks will be buried by landslides in the next rainy season.

A single excellent drainage culvert was included in the works. As a 'spot improvement' it will work fine, although the road to either side of it will be largely impassable. Some retaining wall was also constructed as part of the works and these are also good. The steep cut slopes need approximately 300 meters more wall of this kind to safeguard the road from landslides.

Key Photo Findings	Comments and Recommendation
	A typical landslide on the earthen road. When this soil is cleared away, the slope is all-the-steeper, with incipient failures to come. A retaining wall is needed here.
	Stormwater scouring along one toe-of-slope. The lack of a ditch and the continued erosion will make the slope unstable, and result in another landslide.

Key Photo Findings	Comments and Recommendation
	Another collapsed slope. A retaining wall will be the only way of preventing this slope from continuing to collapse.
	A properly constructed retaining wall along one section of this road. The National Standard Design show drainage channels, etc. along with the wall works, but these have not been included in the works.

Technical Evaluation Brief Sub-Project Report
Mini market

Sub-Project Location		Project Detail	
Municipality	Oecusse	Sub-project completion date: 100% complete but no handover yet	
Admin. Post	Nitibe	Remoteness	Remote
Suku	Lela-Ufe - Bebo	New construction [x]	Rehabilitation [ ]
Sub-Project Name	Mini Market	Inspection date: 16 May 2017	Inspection by: Su'udi Noor
Project phase	3 cycle 1	Construction quality rating	Good

Brief description

The mini market in suku Lela-Ufe is built on the land belonging to the Church, and consists of one open space with six tables for display, and one bathroom and toilet. The project site is located in aldeia Bebo. The total cost amounted to US $ 16,768.

The purpose of the project was to provide a more viable selling space for people who previously occupied simple huts. The 6 x 12 m^2 mini market will be used selling clothes, vegetables and groceries, and there are six tables to display merchandise.

This sub-project proposal has been consulted with EVAS, in this case with the Municipal Development Officer to avoid overlap with other project financing.

During the field visit there was a meeting with the EIP Chief, Joaquin Henrique, and the President of the KPA, Lorenzo Tail Sila. They said that the mini market is used on Sundays only, from 10 am to 5 pm. There are more traders than there is space in the mini market, and some traders conduct their business is simple huts outside the market. There is a $ 1-2 market fee those who trade inside the mini market, and of $ 0.25-0.50 for those trading outside. The management is done by the aldeia chief, and he also handles the maintenance.

The physical quality of the building is quite good, but there are some points that need attention and follow-up:

1. There are no ventilation holes in the bathroom and the toilet.
2. There are no control holes on the septic tank.
3. There is no piped water installation available for the bathroom and the toilet.
4. There are cracks in the floor of the mini market because the soil has not been properly compacted before pouring the floor.
5. The ring beam on top of the columns measures 20 cm x 15 cm, which is smaller than the 20 cm x 20 cm of the design drawing.
6. The connections of the wooden roof frame only use nails.
7. There is no ramp to enter the mini market, making it difficult for less mobile people to make use of it.

Key Photo Findings	Comments and Recommendation
	The mini market seen from the front. The building has a size of 6 x 12 square meters, and is used for selling clothes, vegetables and groceries. There are six fixed display tables to present the merchandise.
	Next to the mini market, there are still simple kiosks used by small traders to trade basic foods or vegetables.
	The bathroom and toilet are used on market day, usually once a week.

Key Photo Findings	Comments and Recommendation
	The septic tank with ventilation pipe, but there is no hole on top to access the septic tank.
	The bathroom and toilet are still in good condition, and are used only once a week. There is no piped water network available, so the water tank needs to be filled manually when the toilet will be used.
	The fixed tables and sitting ramps for merchants in the mini market.

Key Photo Findings	Comments and Recommendation
	The truss beams are tied to the columns with irons. This is not the best way to do it, as strong winds can still lift the roof. A better way to fix the roof trusses to the columns is with bolts and nuts to cast iron profiles fixed to the columns.
	The wooden truss is fixed with nails. It will be stronger if the connections are made with iron plates and nuts and bolts.

Technical Evaluation Brief Sub-Project Report
Secondary irrigation channel

Sub-Project Location		Project Detail	
Municipality	Oecusse	Sub-project completion date: July 2016	
Admin. Post	Nitibe	Remoteness	Very remote
Suku	Usi-Taco	New construction [x]	Rehabilitation [ ]
Sub-Project Name	Secondary irrigation channel	Inspection date: 16 May 2017	Inspection by: Su'udi Noor
Project phase	3 cycle 1	Construction quality rating	Excellent

Brief description

The irrigation channel project in suku Usi-Taco has not used the PNDS standard design. The project site is located in aldeia Cuantua. Field observations show that the irrigation channel is 1,518 m long and has three types of cross-sections: 1) one with a width of 0.8 m on top and 0.5 m at the bottom; 2) 0.5 m on top and 0.3 m at the bottom, and; 3) 1.0 m on top and 0.4 m at the bottom. The total cost of the project was US $ 44,250.

The irrigation channel has two water sources from different rivers. At the time of the field visit, one of these two no longer provided water, and according to information this had been so since March 2017. The second water source, which was also the larger one, was still flowing, but it was expected that as of late May or early June, there would also no longer be water from that source.

The sub-project had two main objectives. First, to replace the existing irrigation channel, which was a simple excavation in the soil, with a more permanent construction which would also increase the capacity of the irrigation channel. This would allow to discharge more water to the paddy fields, and to do so longer during the growing season. Second, to increase the production of paddy and vegetables, and to take old paddy field into use again. According to the technical facilitator, the irrigation channel serves 18 ha of paddy fields.

During the field visit they met with farmer Domingoes Ico, who was harvesting paddy, and he said that before the irrigation channel was built, part of the paddy fields was often flooded with mud, which damaged the crops. The water flow was also not stable because of many leaks. The paddy harvest at that time six large 50 kg sacks; the current harvest is expected to increase and reach ten large 50 kg sacks, which is an increase of 200 kg or a 66% increase on the previous harvest. If, after harvesting the paddy, the water still flows, they plan to plant vegetables.

From talking to the farmers during the field visit, the community is very happy with the irrigation channel they have built, and it looks quite well maintained. There are other paddy fields near the houses, which before could not be cultivated because of lack of water, and in 2017 these paddies have been planted and the harvest had just finished.

The quality of the irrigation channel construction is generally quite good, and was supported by the use of good quality sand coming from a nearby river which, according to local standards, is considered the best source for sand.

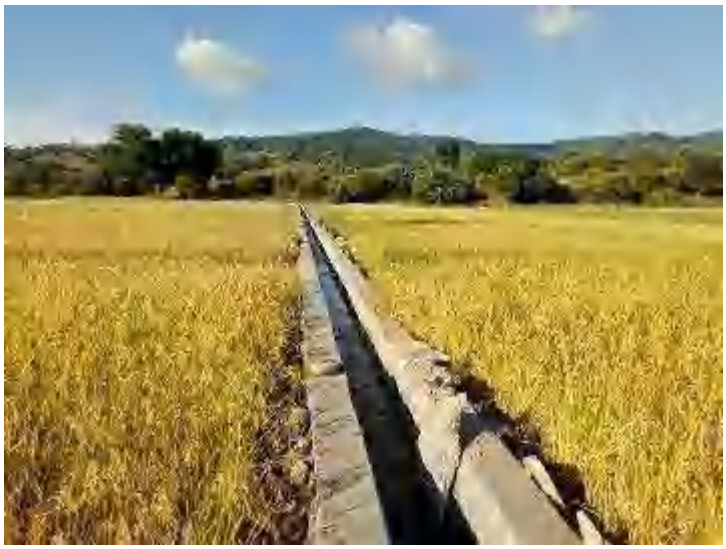
At the time of subproject verification, the consultation with EVAS was done with the municipal office of the Ministry of Agriculture, and there was no overlap of financing with other projects.

The important points of the field visit are:

1. The community has already been involved in maintenance.
2. There are two sources of water. The first source is a small river, but at the time of the visit it was already dry. The second source takes water from the old channel which is a water diversion from the big river, and at the time of the technical audit it was still flowing smoothly.
3. The harvests of crops increased, and there is opportunity to take 'sleeping land' into paddy production again.
4. There is no water divider where a side channel connects to the main channel.

Key Photo Findings	Comments and Recommendation
	Domingoes Ico, one of the family farmers was interviewed when harvesting. He expected that his paddy harvest would increase quite a lot. The previous year he harvested 6 sacks @ 50kg, and he expected that this harvest would reach 10 sacks, which means an increase of 4 sacks, or an increase of 60%.

Key Photo Findings	Comments and Recommendation
	This used to be 'sleeping land' as there was not enough water to irrigate. Now the irrigation water reaches the village, and these plots next to the houses can also be cultivated.
	This is the location of the water intake coming from the old channel (water from the big river). The water intake can be opened and closed in a simple manner.
	This is the starting point of the sub-project, some 50-75 m from the water intake, an existing construction.

Key Photo Findings	Comments and Recommendation
	Farmers harvesting paddy. They were happy with this irrigation sub-project as it brings more to their fields.
	The construction of the irrigation canal is still very good after 10 months. The water diversion is still done in the traditional way by placing stones in the channel to be blocked, so that it flows into the other one. For similar sub-projects in future, it is recommended to construct a small diversion reservoir, where gates can be opened or closed by placing wooden boards into slots in the walls, as is the case at the water intake.
	The irrigation channel is in excellent condition and well maintained.

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