Technical Evaluation of Infrastructure
June 2016

National Program for Village Development (PNDS)

Final Report

Findings and Recommendations

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Technical Evaluation of Infrastructure, PNDS, 2016

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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 now fully encompasses the nation's 442 villages.

This technical evaluation was undertaken as a follow-up to the 2015 review, and has assessed the quality of a random sample of infrastructures that have been completed, as well as some that are currently under construction. The random sampling was based on sub-projects from Phases II and III, across 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 56 sub-projects were evaluated during this exercise**.

The technical evaluation was conducted by Neil Neate, P.Eng. and Suudi Noor, Civil Engineer, both of whom have extensive experience with Community Driven Development projects with 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 were very similar to those used in the 2015 PNDS audit. The field instruments were slightly expanded based on some recent technical evaluation feedback from Lao PDR and Myanmar, most especially in regards to the Road rating tool.

The technical field instruments separated sub-projects into components or aspects, each of which was 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 all Phase III sub-projects evaluated, it was found that 80% 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 matches the 2015 audit results (when community centres have been removed from the total). Bridge sub-project (SP) was found on the higher side of this – 86% of technical components were found meeting specification (only one bridge

SP was evaluated). Road and drainage SPs were noted to be failing in many more respects, with 82% of technical components observed to Meet Spec (14 SPs evaluated), with 18% of components considered to be Below Spec. Buildings and water supply SP components were found to meet specification 82% and 75% respectively, while displaying lesser number of components being Below Spec, 4% and 6% respectively.

The technical evaluation teams also rated other criteria. Members of the village implementation committee (EIP) were questioned regarding their community's use of and the ongoing functionality of the infrastructure; the Operation and Maintenance Team (EOM) were quizzed about their activities and whether or not user fees are being collected. The sub-projects were also examined and rated in regards to how well the designs and construction efforts met the program's environmental safeguards.

- **A total of 83% 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.
- **91% of the sub-projects evaluated were rated as being Good or Excellent in terms of the construction's environmental impact**. PNDS staff should take pride in this result and continue to ensure that sub-project impact upon the environment is minimal.

In a similar finding from 2015, the remoteness of villages was found to have no strong linkages to the technical quality of the sub-projects. This is a demonstration that technical facilitators are dividing their time amongst the villages in an appropriate fashion.

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 village sub-project sites during Phases II and III an average of at least once per week.**

This report provides a summary of the major problems and challenges associated with the PNDS construction program, along with recommendations for corrective measures and proper construction methodologies.

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 now fully encompasses the nation's 442 villages.

The Government is providing each village with an annual 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 'phases' 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. This audit evaluates a sample of phase II and phase III projects only. The total number of projects constructed during these two phases is 599.

The program menu features infrastructure from sixSectors: 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 were as follows:

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

- Design and budget 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
- 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)

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 Emera (Atsabe and Emera Administrative Posts), Aileu and Covalima Municipalities; the other team evaluated sub-projects in Emera (Letofoho and Railaco AP), Liquica and Viqueque Municipalities.

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. This technical evaluation of PNDS has drawn from resources developed for the 2015 technical audit of PNDS, with some alterations based on experiences from recent work in Lao PDR and Myanmar.

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.

4 Site Selection Procedure and Sampling Methodology

The survey focus for the 2016 technical audit is on Phase II and III sub-projects across 5 Sectors in 5 Municipalities (Aileu, Viqueque, Ermera, Covalima and Liquica), resulting in a total population of 229 projects. Using an online sample size calculator a sample of 52 was derived for 90% confidence level, 90% confidence interval and 10% margin of error. Given the small population of sub-projects in health, education and agriculture, two extra health, one extra agriculture, and one extra education sub-project were added to the sample. A final total of 56 sub-projects were visited and evaluated.

To ensure a representative and unbiased sample was chosen, and to ensure proportional and accurate results from the municipal population and sector population, a stratified random sampling methodology was used.

The population of projects was divided into categories using Municipality and Sector (stratification sectors). The following table provides the population and sample counts by these categories. The population counts in each category were used to stratify the sample across all the municipalities and stratification sectors.

Table 4.1: Representative Sample and Population size by stratification category

Municipality	Sector					TOTAL
	1 Health	2 Education	3 Road, bridge & flood control	4 Water & sanitation	5 Agriculture	
Aileu	**2** (2)	**1** (2)	**3** (17)	**4** (19)	0	40
Viqueque	**2** (4)	**1** (8)	**2** (10)	**4** (16)	**1** (1)	39
Ermera	**1** (2)	**1** (4)	**3** (12)	**10** (46)	**2** (3)	67
Covalima	0	0	**5** (21)	**6** (30)	**2** (4)	55
Liquica	0	**1** (4)	**2** (11)	**3** (13)	0	28
Total Sub-Projects						229
Total Sample	5	4	15	27	5	56

Note: Population counts in brackets

To identify the random sample in each of the 20 categories (the bold numbered cells in the table above), a randomization procedure in Excel was used. The process included:

a) Generating random numbers for the sub-projects in each category
b) Using the random numbers to sort the sub-projects in each category in ascending order

c) Selecting the random sample in each category by choosing the first sub-project, the last sub-project and then every fifth sub-project until the sample size was achieved.

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 report, 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 2016 evaluation will again use a coding system based on infrastructure 'type'.

The sampled sub-projects were therefore divided into six 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 5.1.1: PNDS Technical Evaluation 2015 Sub-project types

Type	Sub-Project Type Descriptor	Number of Sub-projects Evaluated	Sectors Represented Within This Sample
1	Building	12	1, 2, 4, 5
2	Bridge	1	3
3	Water Supply	26	4
4	Road, Drainage, Retaining Wall	14	3
5	Irrigation	3	5

The SP sampling stratification methodology, based on Sector, remains random and valid. The analysis within this report is, however, largely 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 bridges in Sector 2, to concrete reservoirs in Sector 3, to concrete road structures, drainage channels and retaining walls in Sector 4, etc. Similarly, a single retaining wall sub-project was evaluated during this audit, listed on the menu as under Sector 4, but such wall installations took place at numerous other sites as part of SPs in other Sectors (on building and bridge sites, for example). Thus this evaluation's findings for this SP type should be viewed and applied with equal interest across the PNDS sectors featuring such infrastructure.

5.2 Technical Evaluation Checklists

The technical evaluation (TE) teams used unique Technical Evaluation Checklists (TEC) for each SP type, using the field tools from the 2015 audit with a few small changes that reflect suggestions from subsequent evaluations in Lao PDR and Myanmar. The Road checklist was field tested at the first SP evaluated, road spot improvements in Suku Lausi, Administrative Post Aileu Vila, Aileu. 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 SP 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. A discussion of each of the components or aspects evaluated on the checklists is presented in Annex 3 - Description of Evaluation Details.

This instrument also collected other SP quality ratings (Overall Construction Quality, SP 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 the SP was rated as being one of five choices: Meets Spec. (Specification); Slightly Below Spec.; Below Spec.; 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 Township 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. Extreme degradation due to 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 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)

5.4.1 Excellent, good and poor are defined as follows:

Overall Quality Assessment

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 regards 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 radically over or under-designed for its intended purpose.

Environmental Considerations

Excellent – Sub-Project fully complies with or exceeds the PNDS POM Guiding Principles in regards 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 defined and 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 56 SPs evaluated is provided in Section 6 below, along with a complete summary of the technical evaluation's individual quality ratings in Annex 4.

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 5.

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 Phase, by location or by the rating evaluations under Construction Quality or Community Involvement. Sorting procedures can be used to reveal trends or to highlight problem areas.

Spreadsheets for each SP evaluated were created and saved to computer files using standard naming formats. The naming formats for each sub-project are based upon the PNDS MIS administrative numbers (Project Phase-Municipality-Administrative Post-Village) along with added codes for SP Type to enable this evaluation's sorting and correlation activities to take place.

The file naming system used for this technical evaluation is as follows, substituting numbers for each square-bracket item:

[Phase] - [Municipality] - [Admin. Post] - [Village] - [Sub-project Number] - [Sub-project Type], where the project phase is either 2 or 3 for this year's sampling; GoTL administrative numbers for Municipality, Admin. Post, Village; Sub-project Number is the last digit of the PNDS MIS code indicating the number of individual sub-projects within a village during each Phase; and Sub-project Type is 1 for Building; 2 for Bridge; 3 Water for Supply; 4 for Road, Drainage, Retaining Wall; and 5 for Irrigation.

5.6 Technical Construction Standards

The National Standard Drawing set has now been introduced to the Municipal PNDS offices. These sets of drawings are collected in the Technical Construction Standards (TCS) and feature standard drawings for nine types of infrastructure (bridge, building, culvert, drainage, irrigation, retaining wall, gabion basket walls, road, and water system) and one for testing and storage of materials.

It was found, for the Phase III SP evaluated, that 71% of the Community Proposals contained some or all of the Technical Construction Standard drawings for the subject infrastructure type.

It should be noted that PNDS Administrative Post Technical facilitators and Municipal Engineers received training in PNDS TCS just prior to the commencement of phase III implementation; therefore 71% of proposals utilizing the standards immediately after roll-out is a positive result. Some of the files examined contained the TCS title and secondary page or two, but were missing the complete set of TCS drawings, which include cross sections and details.

This percentage of Community Proposals containing the appropriate subject TCS infrastructure drawings (for Phase III SP) can also be examined by Municipality, as in the following table.

Table 5.6.1: Use of Technical Construction Standard Drawings by Municipality

	Aileu	Covalima	Ermera	Liquica	Viqueque
Use of TCS	100% (10 of 10)	50% (4 of 8)	73% (8 of 11)	60% (3 of 5)	75% (3 of 4)

Recommendation 1: All TF should use the TCS as SP Community Proposal plans are being developed. (Aileu engineers may be able to offer advice to their peers in these regards.)

6 Sub-Projects Evaluated

NO.	MUNICIPALITY	ADMINISTRATIVE POST	SUKU	STATUS	SUB-PROJECT
1	Aileu	Aileu Villa	Lausi	Remote	Rural Road (earth road)
2	Aileu	Laulara	Cotolau	Very Remote	Water System - Gravity
3	Aileu	Laulara	Cotolau	Very Remote	Maternity Clinic
4	Aileu	Laulara	Tohumeta	Remote	Rural Road (earth road)
5	Aileu	Liquidoe	Faturilau	Remote	Rural Road (earth road)
6	Aileu	Liquidoe	Asubilitoho	Not Remote	Health Post
7	Aileu	Remexio	Faisoi (Remexio)	Remote	School
8	Aileu	Remexio	Faisoi (Remexio)	Remote	Water System - Gravity
9	Aileu	Remexio	Acumau	Remote	Public Bathroom at Community Centre
10	Aileu	Remexio	Hautoho	Remote	Water System - Gravity
11	Viqueque	Uato Lari	Vesoru	Very Remote	Shallow Well
12	Viqueque	Uato Lari	Vesoru	Very Remote	Residence - Health Personnel
13	Viqueque	Uato Lari	Babulo	Very Remote	Water System - Gravity
14	Viqueque	Uato Lari	Afaloicai (Uatu Lari)	Very Remote	Water System - Gravity
15	Viqueque	Uato Lari	Afaloicai (Uatu Lari)	Very Remote	Residence - Health Personnel
16	Viqueque	Uato Lari	Uaitame	Very Remote	Rural Road
17	Viqueque	Viqueque Villa	Fatu Dere	Remote	Primary School
18	Viqueque	Viqueque Villa	Maluro	Remote	Mini Market
19	Viqueque	Viqueque Villa	Uma Uain kraik	Remote	Rural Road (gravel road)
20	Viqueque	Viqueque Villa	Uma Quic	Not Remote	Shallow Well

NO.	MUNICIPALITY	ADMINISTRATIVE POST	SUKU	STATUS	SUB-PROJECT
21	Ermera	Letefoho	Eraulo	Remote	Bridge - concrete
22	Ermera	Letefoho	Haupu	Remote	Water System - Gravity
23	Ermera	Letefoho	Goulolo	Remote	Water System - Gravity
24	Ermera	Letefoho	Catrai-Leten	Very Remote	Water System - Gravity
25	Ermera	Letefoho	Lauana	Very Remote	Water System - Gravity
26	Ermera	Letefoho	Haupu	Remote	Water System - Gravity
27	Ermera	Railaco	Matata	Remote	Water System - Gravity
28	Ermera	Railaco	Lihu	Remote	Water System - Gravity
29	Ermera	Atsabe	Baboe Leten	Very Remote	Residence - Teachers
30	Ermera	Atsabe	Laclo	Extremely Remote	Water Channel (secondary/distribution channel) - Stone Masonry
31	Ermera	Atsabe	Malabe	Extremely Remote	Box Culvert
32	Ermera	Atsabe	Leimea Leten	Extremely Remote	Water System - Gravity
33	Ermera	Atsabe	Malabe	Extremely Remote	Water System - Gravity
34	Ermera	Atsabe	Paramin	Extremely Remote	Drainage - stone masonry
35	Ermera	Atsabe	Tiarlelo	Extremely Remote	Water Channel (secondary/distribution channel) - Stone Masonry
36	Ermera	Ermera	Ponilala	Remote	Water System - Gravity
37	Ermera	Ermera	Ponilala	Remote	Health Post
38	Covalima	Maucatar	Ogues	Not Remote	Rural Road (gravel road)
39	Covalima	Maucatar	Ogues	Not Remote	Water System - Gravity
40	Covalima	Suai	Camenaca	Not Remote	Water System - Pump

NO.	MUNICIPALITY	ADMINISTRATIVE POST	SUKU	STATUS	SUB-PROJECT
41	Covalima	Suai	Debos	Not Remote	Shallow Well
42	Covalima	Maucatar	BeleCasac	Remote	Drainage - stone masonry
43	Covalima	Tilomar	Casabuac	Remote	Water System - Pump
44	Covalima	Tilomar	Lalawa	Remote	Water Channel - Stone Masonry
45	Covalima	Fohorem	Dato Rua	Very Remote	Drainage - stone masonry
46	Covalima	Fohorem	Fohorem	Very Remote	Water System - Gravity
47	Covalima	Fohorem	Lactos	Very Remote	Plat Deker (concrete slab)
48	Covalima	Fatumea	Fatumea	Very Remote	Water System - Gravity
49	Covalima	Fatumea	Fatumea	Very Remote	Rural Road
50	Covalima	Fatumea	Fatumea	Very Remote	Mini Market
51	Liquica	Bazartete	Tibar	Remote	Primary School
52	Liquica	Bazartete	Fahilebu	Remote	Rural Road (earth road)
53	Liquica	Bazartete	Maumeta	Not Remote	Water System - Gravity
54	Liquica	Bazartete	Fatumasi	Remote	Water System - Gravity
55	Liquica	Liquica	Hatuquesi	Remote	Water System - Gravity
56	Liquica	Liquica	Luculai	Remote	Rural Road (earth road)

7 Technical Findings

7.1 Technical Specifications vs. As-Constructed Infrastructure

The field tool allowed each component or aspect of the individual sub-project types to be rated as being one of five choices: Meets Spec. (Specification); Slightly Below Spec; Below Spec; Not Inspected; and Not Applicable. 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 Spec/Slightly Below Spec/Below Spec is analogous to Good/Fair/Poor.

The technical quality ratings can be viewed in detail for each component of each SP, to understand how well each particular piece of the infrastructure has been constructed. If one is examining the data collected for a composite wooden deck/concrete foundation bridge SP, for example, the individual technical quality ratings for 14 different components can be reviewed, from Layout and Foundation to Connections and Apron/Ramp. A detailed examination of the data from one bridge might reveal that the concrete foundation and reinforced column works were done poorly, while the upper wood assembly was done in a very good and proper fashion. This might show that local unskilled workers did not receive adequate direction while performing the underside concrete support works but grew in confidence when they were working with local timber and wood-joinery techniques. Notations to each individual SP data input sheet are often informative in regards to the particular circumstances at each site.

An examination of each individual SP's ratings, while interesting, is obviously time-consuming and of small worth if one is seeking to identify broad-based ideas that will improve PNDS' construction program. It is possible to aggregate the component ratings, so that one can identify general trends in the data gathered. In regards to water supply SPs, for example, the ratings recorded for each of 14 components/ aspects can be gathered and examined as a representation of the average quality rating of each component/aspect of water supply SPs as a whole. It can be argued that an aggregate of the ratings from representative samples (90% confidence level, 90% confidence interval and 10% margin of error) will provide insights into the whole group of SP types, and will point towards those parts of PNDS' construction methodologies that most require improvements. The following Table 7.1.1 presents the aggregate of ratings from 26 PNDS water supply SPs, displaying an abbreviated list of the water supply components/aspects. A full list of the components/aspects rated for each SP type is provided in Annex 3.

Table 7.1.1: Aggregated Sub-Project Ratings for Water Supply Components, % of SPs Evaluated - % (Number of SPs Evaluated)

	[Number of SP Evaluated]	Meets Spec.	Slightly Below Spec.	Below Spec.
1	Watershed Protection [15 SP]	60% (9)	33% (5)	7% (1)
2	Water System Design [22]	95% (21)	-	5% (1)
3	Transmission/Distribution Pipe [16]	44% (7)	56% (9)	-
4	Reservoir – Easy to Clean [21]	95% (20)	-	5% (1)
5	Public Tapstands – Drainage [22]	59% (13)	41% (9)	-
6	Water Pressure and Quantity [19]	53% (10)	32% (6)	16% (3)

Discussion:

The table above provides detailed data in regards to specific parts of typical water supply SPs. For example, in line 1, gravity-fed systems usually depend upon a watershed area for the supply of pure water. It is also important that boreholes are located at least 30 metres from a source of contamination. Having some form of protection for these areas is a sensible idea. This can take the form of fencing and making the watershed out-of-bounds or monitoring activities and ensuring that nothing deleterious is released. Of the 15 SPs that were assessed in this regard, 60% (9 SP) were considered to Meet Spec. A further 33% (5 SP) were rated Slightly Below – these may have been gravity systems where it was apparent that some uncontrolled activities might be taking place above a source or a borehole SP installed without proper fencing, toilets or pooled water nearby, etc. Only one SP (7% of the technical sampling) was considered to be Below Spec. The commentary recorded for this Phase II rehabilitated shallow well in Viqueque (Suku Vesoru, PA Uato Lar) indicates that at the time of the technical evaluation the water within the well was contaminated by surface waters that had penetrated the joints of the concrete rings that surround the well.

The other components of water systems can be examined in similar manner:
Line 2 – For the most part, designs are good (95% Meets Spec). The single SP that did not meet with the intent of the Community Proposal is a system where poor design of a flow splitting reservoir has resulted in dry tapstands and villagers cutting pipes to access the water (more fully described in a Brief SP Report for Suku Babulo, PA Uato Lari, Viqueque).
Line 3 – Transmission/Distribution Piping (Installation) appears to require some analysis and possible changes to the current methodologies (56% Slightly Below Spec), likely due to unburied or improperly supported pipes.
Line 4 – Reservoir designers have been successful, ensuring that 95% of SP reservoirs are equipped with properly located and capped drains to make them 'easy to clean'.
Line 5 – Public tapstands have not been formed correctly in alarming numbers (41% Slightly Below Specification), allowing water to pool and become a nuisance and potential disease vector breeding area.

Line 6 – Water pressure and quantity at just over half of SP sites (53% - 10 SP) was judged as suitable, with another 32% (6 SP) considered Slightly Below. A final 3 sites demonstrated such poor water service that they were rated Below Spec. Again, notes were likely made for all of these evaluations, with comments, suggestions, advice and recommendations. These will be recorded in the Brief SP Reports that are attached in Annex 5.

A thorough analysis of all relevant components/aspects for each SP type will be offered in Section 8, Best Practices and Recommendations.

In order to understand the technical quality of the full breadth of SP works, however, 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 13% rated Slightly Below** in terms of meeting the intent of the sub-project proposal. **Only 9% of technical ratings are rated Below Specification.** This compares to an aggregate from the 2015 audit of 83% Meets Spec/12% Slightly Below Spec/5% Below Specification.

While this appears to indicate that the technical quality of PNDS sub-projects has slightly declined, these two figures deserve a closer examination.

First, the aggregate of ratings for the current technical audit is based upon infrastructure constructed in both Phase II and III. It is logical to see if there has been any difference in the technical quality of infrastructures between these two cycles.

Table 7.1.2: Aggregate of 2016 Technical Ratings, by Construction Phase

	Meets Specification	Slightly Below Spec.	Below Spec.
Phase II	75%	21%	5%
Phase III	80%	8%	12%

Second, the aggregate from the 2015 audit included a large percentage of community centres (24 SP of 52 evaluated – 46%). The majority of these buildings had been very well constructed (or, at any rate, any telltale concrete/truss connection problems covered by plaster or hidden in an attic), so that one might expect their rating contribution to the aggregate of last year's SPs to have brought the total up. The first line in the following table was reported in the 2015 results.

Table 7.1.3: Aggregate Of 2015 Technical Ratings, With and Without Community Centres (CC)

	Meets Specification	Slightly Below Spec.	Below Spec.
All SP	83%	12%	6%
All SP less CC	80%	15%	4%

Discussion:

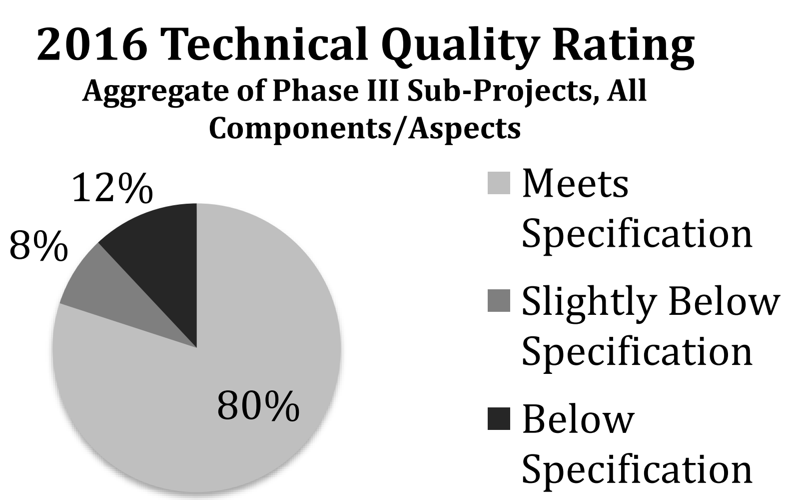
As can be seen in the second table above, the aggregate percentage of "Meets Spec" SPs in the 2015 audit does indeed come down from 83% to 80% when community centres are subtracted, reflecting the superior quality of these structures that populated the sample.

80% of the technical components were found to Meet Specification in both the 2015 and 2016 audits, which indicates that the technical quality of the representative sample of PNDS infrastructures evaluated in the two audits has not changed much in the course of one year.

More of concern, in fact, is the rise in the number of Below Spec components/aspects from Phase II to III, shown in the bottom line of Table 7.1.2 (rising from 5% in Phase II to 12% in Phase III). This worrisome phenomenon may be associated with certain SP types, and will be examined and further discussed in Table 7.1.3 below.

The following chart presents the 2016 finding using an aggregate of all of the technical components of the Phase III sub-projects evaluated (31 SPs)

Chart 7.1.1: Technical Quality Rating of Phase III Sub-Project Construction



A further analysis of technical quality versus Phase, including a comparison of those SP that were rated last year, will be offered in Section 7.3 Phase, below.

The following table presents separate totals for each of the SP types evaluated. It should be noted that there was only one bridge and three 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 7.1.4: Summary of Aggregate Technical Ratings by SP Type, All SPs

[Number of SP Evaluated]	Meets Spec.	Slightly Below Spec.	Below Spec.
Building [12 SP]	82%	14%	4%
Bridge [1 SP]	86%	14%	-
Water Supply [26 SP]	75%	19%	6%
Road, Drainage, Retaining Wall [14]	78%	4%	18%
Irrigation [3 SP]	82%	-	18%
Average over 56 sub-projects	80%	8%	12%

Discussion:

The aggregate percentages of Meets Spec components for SP types Building, Bridge and Irrigation are all above average and deemed reasonable for the third year of the PNDS rural construction program. The Slightly Below Spec totals can be added to the Meets Spec column to further demonstrate that PNDS Building and Bridge works are in a very favorable position, with very few instances where specific components are considered Below Spec.

The irrigation works shows a very much higher Below Spec percentage (18%), which could be worrisome. An examination of the details of these ratings, however, shows that this high percentage is based on the ratings of Below Spec for the components *Design* (1 SP) and *Water Level Controls* (2 SP). Each of these instances will be discussed in detail below (in Section 8, Best Practices) but it is clear that the actual construction of the irrigation systems presented few problems (14 of 17 technical components were rated Meets Spec), so that PNDS planners can be encouraged by the results of their promising irrigation program.

Water supply SPs show typical results for a construction program that is learning as each cycle is completed. A solid 75% of water supply components are considered to meet the specifications while an additional 19% are Slightly Below Spec. This should be a confidence boosting position for PNDS technical staff, in that it should be relatively easy to change the practices producing these Slightly Below ratings. It can be noted that the 2015 technical evaluation found the aggregate water supply Meet Spec/Slightly Below/Below Spec ratings to be 81%/18%/1%, so that the level of quality has been maintained throughout the past year.

The PNDS road improvement program seems to have improved since the 2015 audit. The Meet Spec/Slightly Below/Below Spec ratings were 52%/21%/28% last year, but based upon a sampling of only 5 sub-projects, some of which were lengthy road openings. The 2015 technical report recommended that PNDS should concentrate on local spot improvements for road SPs, and it appears as though this advice has been taken. A detailed examination of the components associated with the aggregate 18% of ratings that were Below Spec in this year's audit indicates that the majority of these instances are SPs where road opening or lengthy track widening had been attempted, with mixed to poor results. These circumstances will be examined in detail below (Section 8.4, Road, Drainage and Retaining Wall).

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

Spreadsheets were sorted to determine if a village's degree of remoteness played a significant part in the technical quality rating of a SP's components. A hypothesis might be that the technical quality of a SP will go down as the degree of remoteness goes up, due to a number of possible factors: increased difficulty for technical facilitators to visit the site; reduced number of skilled labourers being available; increased difficulty in securing proper construction materials; etc. In the 2015 audit, **this hypothesis was not found to be demonstrated** in the technical ratings returned from the field (several SP types actually had higher aggregate technical quality in more remote locations).

In the table below, the aggregate percentage of "Meets Spec." component ratings for each individual sub-project type are shown for each degree of remoteness, along with the aggregate sum of all sub-projects evaluated.

Table 7.2.1: Aggregate of "Meets Spec." components for Sub-project Types vs. Remoteness - % (Number of SP in each degree of remoteness)

[Number of SP Evaluated]	Not Remote	Remote	Very Remote	Extremely Remote
Building [12 sub-projects]	79% (1)	80% (6)	85% (5)	-
Bridge [1 SP]	-	86% (1)	-	-
Water Supply [26 SP]	74% (5)	78% (11)	69% (8)	88% (2)
Road, Drainage, Wall [14 SP]	100% (1)	72% (7)	89% (4)	100% (2)
Irrigation [3 SP]	-	100% (1)	-	73% (2)
All Sub-projects – [56]	78% (7)	77% (26)	80% (17)	85% (6)

Discussion:

Repeating the observations from 2015, the aggregate totals of SP quality ratings do not display a confirmation of the *Remoteness Hypothesis*. As can be seen from the last line of the table above, the aggregate percentages of infrastructure components meeting specification actually increases as the degree of remoteness becomes more extreme.

Only water supply SPs show some decline in technical quality between those SPs in Remote locations vs. Very Remote (with a large sample size of 19 SP), but this pattern is not shown elsewhere in a consistent way.

A conclusion that can be drawn from this result is that the quality of PNDS project execution (that being the SP socialization process, the design and implementation of the works, and the technical facilitation during construction) is sufficiently spread out amongst Timor Leste's villages to produce adequate results. The frequency of TF visits to SP sites will be examined in more detail in Section 7.10 of this report.

7.3 Phase

Spreadsheets were sorted to determine if there are any apparent trends in technical quality based upon when the SP was constructed. The main difference that might influence technical aspects of SPs according to phase 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 construction phase has already been examined, in Table 7.1.2 above, which showed that the number of infrastructure components meeting specification increased from Phase II SPs to Phase III SPs, from 75% to 80%.

The following table examines each SP type to see if this improvement trend is demonstrated in all infrastructure types.

Table 7.3.1: Aggregate of "Meets Spec." components for Sub-project Types by Phase - % (Number of SPs within each Phase)

[Number of SP Evaluated]	Phase II	Phase III
Building [12]	81% (5)	83% (7)
Water Supply [26 SP]	70% (14)	81% (12)
Road, Drainage, Wall [14 SP]	75% (2)	78% (12)
All Sub-projects above [52 SP]	74% (21)	80% (31)

Notes: The single bridge evaluated offers no comparison; all irrigation SPs took place in Phase III.

Discussion:

The observation of an improvement in the aggregate technical ratings of all SP components is seen for all infrastructure types where this comparison can be made.

Building, water supply and road improvement sub-projects have experienced an approximate 6% improvement in their technical quality from Phase II to Phase III.

The single bridge SP that was evaluated from Phase II cannot be compared to anything in Phase III. Its aggregate rating of 86% Meets Spec is sufficient to show that SPs of this nature are experiencing few problems.

Similarly, the three irrigation SPs evaluated were all constructed in Phase III. As discussed previously, the only ratings for these SPs that are below the Meets Spec criteria are for design and inappropriate channel control gate structures. These components of irrigation SPs are easily remediated with appropriate training, instructional guidelines and supervision from senior engineering personnel.

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.

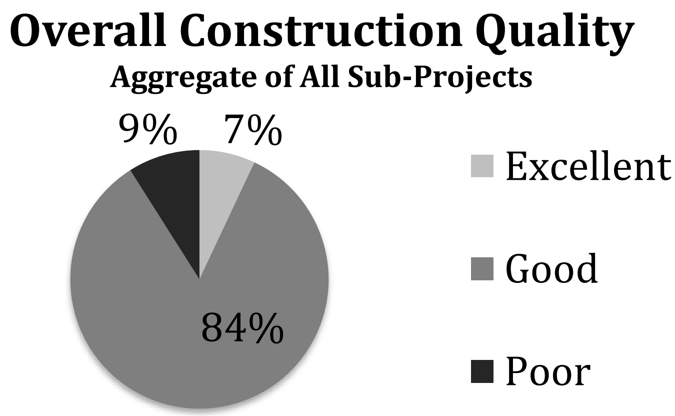
84% of the infrastructure examined during this evaluation was considered to be Good in its overall construction quality (47 of 56 sub-projects), with 7% (4 SP) rated Excellent. Only 5 SPs were rated Poor.

The rating system for Overall Quality was changed from the 2015 audit, which used the terms Good/Average/Poor to assess PNDS works. The 2015 results showed that 43% of the SPs were judged Good, 51% Average, and 6% Poor. (The change was spurred by respected advice that the term "Average" does not convey the same message as "Good", a semantic change but important nonetheless; our 2015 use of the two ratings Good /Average are approximately equal to the 2016 combined use of Excellent/Good, although one can see that the 'awarding' of Excellent is considerably less than the total of the previous year's Good.)

It cannot be ignored that there may be some subjectivity attached to this rating. The experience of the evaluator is key to the plausibility of the findings for this particular evaluation (perhaps more so than the relatively straight-forward judgment of infrastructure components meeting technical specification or not). The breadth of experience of the two evaluators that undertook this exercise (a combined total of more than 50 years working with rural infrastructure) should provide some credibility to any conclusions that might be drawn from this report section.

The chart below shows the 2016 ratings pictorially.

Chart 7.4.1: Overall Construction Quality



Discussion:

This subjective finding is based on the evaluator's overall, general impression of each of the PNDS infrastructures, based on many years of experience with rural infrastructures. It can be usefully compared to the aggregate of the technical quality ratings for the components/aspects of each piece of infrastructure, as reported above in Section 7.1, particularly Chart 7.1.1 which shows that 80% of the individual components/aspects of all infrastructures were found to Meet Specification.

The finding that 91% of PNDS works are of Good to Excellent construction quality indicates that the 'overall' infrastructures are as good (indeed slightly better) *than a sum of their parts.*

7.5 Fitness for Purpose

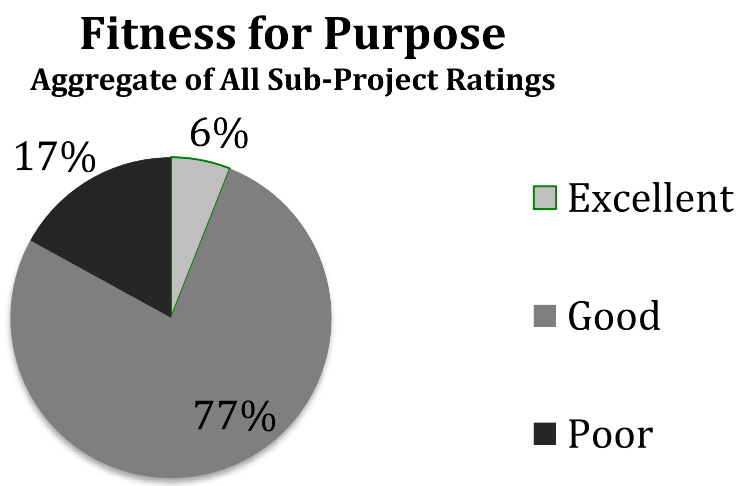
Fitness for purpose is defined as whether or not the infrastructure is still operating as originally planned or intended, and is neither over nor under-designed. If the infrastructure has fulfilled the requirements of the recipients and is neither over nor under-designed, then a rating of 'Good' would 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 PRF 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 radically over or under-designed for its intended purpose.

The following chart shows that:

83% of sub-projects have been judged to be of Good or Excellent Fitness for Purpose.

Chart 7.5.1: Fitness for Purpose, All Sub-Projects



The three sub-projects that were rated Excellent are as follows:

- An irrigation canal rehabilitation scheme in Suku Tiarlelo, Ermera that has used modern materials to replace several traditional irrigation diversion works that had been in use by the local farmers. Various spot improvements using reinforced concrete, mortared stone and gabion baskets have been skillfully designed and constructed to replace the indigenous wood/stone/soil installations that had served the farmers' fields for many years. Farmers have spent

much time every year working on these traditional systems, replacing wood, filling holes and piling stone for the diversion works. The new concrete/gabion installations have allowed the farmers to devote this time instead to their fields and market gardens, as well as the extension of irrigation to new lands.

Pictured above is an innovative irrigation canal bridge that allows agricultural flows to pass over a small intersecting watercourse. This is a very imaginative and well-designed structure.

- A water supply SP in Suku Haupu-Raepusa, Ermera where excess flows (from a river source) are being used for aquaculture in several ponds and to grow vegetables in many small kitchen-gardens. Additionally, each tapstand has been equipped with a fence to keep animals and small children away even though these were not shown in the design drawings.
- A small bridge and drainage network that has been constructed in Suku Eraulo, Ermera was deemed to have been a very good and well designed solution to this village's persistent problems with both excess water within their community and adjacent fields along with difficulties of transportation across an existing shallow watercourse. Some of the community's farmers have been able to expand their useful field areas in response to this new drainage work.

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

- An irrigation canal in Suku Laclo, Ermera has used more than twice as much reinforced concrete as it might have done with a smaller and more appropriate design. Wooden boards should be substituted for the designed mechanical gate.
- Two road SPs where heavy equipment has been used to facilitate large-scale new road openings, Suku Laulara and Faturilau in Aileu. Each of these new alignments are experiencing rapid erosion on a massive scale, to the point where motorcycles cannot travel these routes. Drainage considerations were given little, if any, attention during the excavations, resulting in uncontrolled and damaging new watercourses being formed on the steeply sloping cuts.

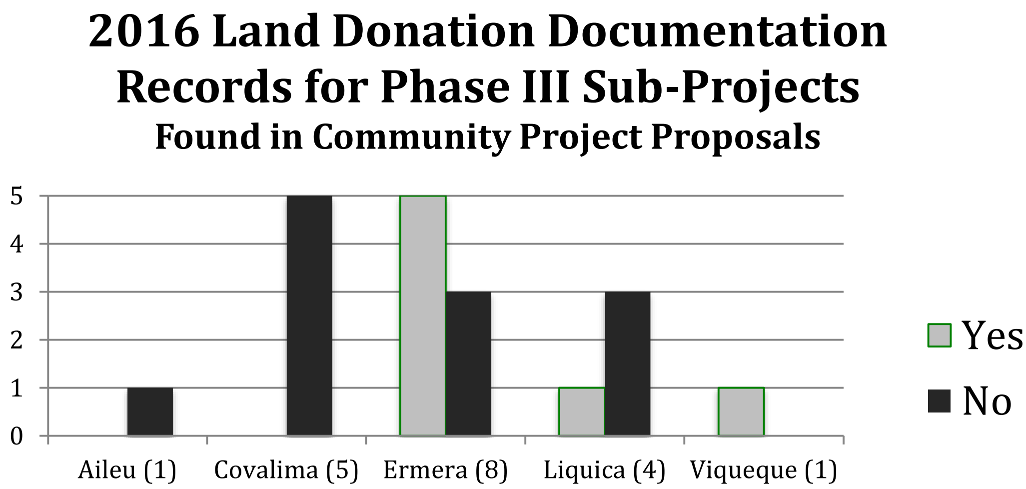
- A gabion basket installation in Suku Dato Rua, Covalima is displaying worrisome signs of movement in its lowest, foundational baskets. There is a danger that the entire eight-tier gabion basket assembly will begin to slip down the slope.
- Several water systems, in Suku Babulo, Viqueque; improper design has resulted in differing quantities of water being delivered to neighbourhoods in this village, causing resentment and instances of pipe-cutting and damage to the system.

7.6 Land Donation Certificate

Many PNDS sub-projects are wholly or partially constructed on private land that has been donated for that use. Examples include buildings that are often constructed in a central part of a village where existing community lands are not large enough to accommodate the structure or grounds. Many times water systems will have reservoirs sitting within agricultural plots and pipes crossing private property. Tapstands frequently occupy small plots of land at the front of individuals' property. Road sub-projects sometimes require a strip of land to be dedicated as public for widening purposes.

It is a requirement of PNDS that these lands are donated to the community for such communal uses. A form known as TF 7.2.2 is created as part of the land donation process, along with a requirement that the landowner writes a personal letter affirming their intentions. A copy of this documentation is filed in five locations: with the landowner; the aldeia chief; the village chief; the Municipal office of PNDS; and with GoTL National Directorate for Land and Property. Last year's technical evaluation made a recommendation that this form be attached to the Community Proposal, as a simple and effective way to ensure transparency in these important land transfers. The 2016 technical evaluation inquired into the status of the lands upon which SPs are situated, and searched the Community Proposals for 7.2.2 or other documentation re land donation.

Chart 7.6.1: Land Donation Documentation Records – Municipality (number of SP)



Note: Municipality Name (number of sub-projects requiring documentation)

The 2015 audit found no land donation documentation in Aileu files, over the 7 SPs evaluated; a single SP in Aileu has continued this trend. Ermera, however, has improved upon its record of last year, moving from 38% of 2015 Proposals containing the documentation to 63%, a fine showing with more work to be done to ensure that all Community Proposals meet the grade. Covalima and Liquica need to improve upon this aspect of community SP filing. The community files for a single water supply SP in Viqueque contained the form 7.2.2.

The disputed water source

The importance of ensuring that proper land donation documentation is completed for SP sites was demonstrated to the TE team in Suku Fohorem, AP Fohorem, Covalima. New gravity fed water supply works are underway in this village, with a catchment dam, reinforced concrete reservoir and several tapstands already complete. The landowner of the property containing the small spring, however, has withdrawn his permission for the works to carry on and be completed. The gentleman appeared during our visit, expressing very unhappy feelings about the project work and stating his objections to the PNDS works taking place on his property.

PNDS is aware of this situation and has located another groundwater source that is high enough to supply the already-constructed village reservoir. New design and extra works will be required to facilitate this change.

Several of the Community Project Proposals that the TE team viewed contain a copy of TF 7.2.2 and sometimes a copy of the donation letter. These documents are an important for new community infrastructure and copies should be contained in all Community Project Proposals. It is also important for PNDS field staff to understand that **all** lands upon which PNDS works take place require this land transfer to take place. Gravity fed waterworks that feature central village reservoirs and piped distribution systems to neighbourhood tapstands must have such paperwork for all components of the scheme, including narrow rear-yard strips of land where piping is laid. With this requirement in mind, PNDS designers and engineers should carefully examine the topography of SP villages during the design phase in order to locate transmission and distribution pipes on existing public lands where possible.

The Community Proposal for a gravity fed water system in Suku Leimea Leten, PA Atsabe, Ermera was noted to contain only a single 7.2.2 form, for a large aldeia and multi-faceted transmission, storage and distribution network. The form had been signed a local village elder on behalf of everyone in the village upon whose land the public works had taken place. A subsequent evaluation of another water system in this village, in another aldeia, displayed this same gentleman's name as the sole village signatory.

Catchment reservoir, Suku Leimea, Ermera

While it is laudable that Timor Leste villagers place a great amount of trust in elders to speak and represent them in public matters, PNDS facilitators must explain the importance and help in the creation of appropriate land donation documentation for each separate plot of land upon which SP works take place.

Recommendation 2: Copies of donation letters and TF 7.2.2 should be included in all Community Project Proposals. Senior PNDS personnel visiting SP sites should make periodic checks that all necessary and appropriately completed forms and documentation is in place.

7.7 Environmental Considerations

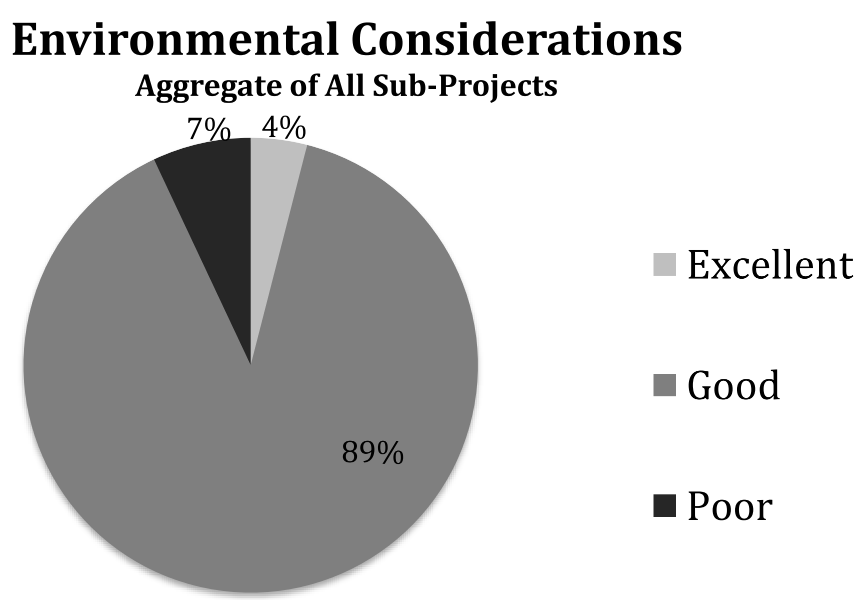
The Technical Evaluation Checklists for each sub-project type features an area on the second page where the quality of the infrastructure and its placement within the recipient village could be assessed in regards to environmental considerations. The POM cites the adherence to proper environmental safeguards as being one of PNDS' Guiding Principles and includes environmentally damaging activities on the Negative List. Cycle Step 6 stipulates that engineers and planners prepare and verify a proposed sub-project with due regard to environmental risks associated with it.

The results of this evaluation show that:

89% of the SPs evaluated were rated as Good, with 4% (2 SP) rated Excellent and 7% (4 SP) rated Poor.

As above, in 7.4, the rating system was changed from the 2015 audit, which used the terms Good/Average/Poor to assess PNDS works. The 2015 results showed that 94% of the SPs were judged Average and 6% Good, with no infrastructure rated Poor. The chart below shows the 2016 ratings pictorially.

Chart 7.7.1: Environmental Considerations, All Sub-projects



It is worthwhile to examine more closely those 2016 audit SPs rated Excellent and Poor to understand the circumstances and help PNDS and village implementation teams either replicate or avoid such situations in the future. The individual sub-projects and the TE rationale are as follows:

Sub-Projects Rated Excellent for Environmental Considerations:

- A water system in Suku Houpu-Duhoho, Ermera utilizes a river catchment facility that has been designed and constructed in a highly secure fashion (in contrast to other poorly designed installations that had been evaluated). The evaluator wished to bring attention to these good practices;
- The bridge and drainage network constructed in Suku Eraulo, Ermera (mentioned above in 7.6 Fitness for Purpose) has solved several problems for the village in a well designed, efficient and environmentally sensitive manner. The village and nearby fields had suffered with pooling water, which also was the cause of some local landslides. The new trench excavation has relieved these concerns and the bridge spanning this drainage channel has improved the transport of goods in the rainy season. Steep bank erosion has been reduced, as well as the danger of landslides.

Sub-Projects Rated Poor for Environmental Considerations:

- Two road opening SPs were rated Poor, due to concerns regarding large amounts of erosion taking place. The road works in Suku Tohumeta and Suku Faturilau, both in Aileu, were performed by heavy machinery, and have resulted in unsustainable excavated roadbeds and steep cut slopes. Erosive stormwater flows are creating deep gullies and channels along these alignments, which are already not able to support the travel of any vehicles.
- A gabion basket installation at Suku Dato Rua, Covalima shows indications that the lower-most tier of an eight-level gabion basket installation is moving outward. There appears to be the potential here for a large failure of this installation, resulting in continued erosion and degradation of the slope beneath this road. This situation should be frequently monitored through the next rainy season. If movement of the gabion baskets is observed, further emergency measures may need to take place.
- A shallow well improvement SP in Suku Vesoru, PA Uato Lar, Viqueque was rated Poor due to the evaluator's concerns about contaminated surface waters flowing into these village water sources. Local villagers are aware of this problem and have abandoned their use of the wells and are gathering their domestic water from a local river. The situation may be relieved by ditching around the well to guide surface waters away, along with maintenance work to clean and seal the cracks in the concrete well liner and floor. Some sealant products have been recommended in the Brief SP Report.

7.8 Operation and Maintenance

The field tool provided a section where the operation and maintenance of sub-projects was explored for all infrastructures evaluated. Members of the Operations and Maintenance Team (*Ekipa Operasaun no Manutensaun, EOM*) were sought for these interviews. Questions or data included the following, as a sample:

- Routine maintenance tasks

- Major repairs performed
- Major repairs required (nature of defect?)
- Formation of GMF (Water User Group, *Grupu Maneja Fasilidade*), for water systems
- 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 these interviews indicate that O&M Committees and Water User Groups (GMF) are generally not active and seem to lack interest or knowledge in the specific methods by which their particular village infrastructure should be maintained. The following table displays some of this information collected from Phase II SPs (many Phase III SPs were not finished or had not yet completed their final activities).

Table 7.8.1: O&M Information from EOM/GMF Members, Phase II Sub-Projects - % (Number of SPs Evaluated)

	[Number of SP Evaluated]	Yes	No
1	O&M Committee in place and functioning [19 SP]	21% (4)	79% (15)
2	Major repairs done [16 Phase II SP]		100%
3	Major repairs required [15 Phase II SP reporting]	53% (8 SP)	47% (7)
4	O&M User Fee being collected [21 SP]	5% (1)	95% (20)
5	Contributions from Other Sources [19 SP]		100%
6	O&M Training received [18 SP]	56% (10)	44% (8)

The EOM groups that cited the need for major repairs of their infrastructure, 8 of 15 SPs that provided information on this aspect, defined the cause of the problems as shown in the following table.

Table 7.8.2: Major Repair Defect Cause – No. of SPs Affected

	Environ./ Climate	Design	Materials	O&M
Building (2 SP reporting)	1		2	2
Bridge (1 SP)	1			
Water Supply (4 SP)	3	4	3	3
Road (1 SP)	1			

Discussion:

It can be seen from line 1, Table 7.8.1 above, that few villages have active O&M Committees – only 4 of 19 SPs reporting appeared to have individuals who took an active interest in their responsibilities. Many villages reported that EOM members lived in different *aldeia* than that in which the subject infrastructure was located. Only one village of 21 is collecting user fees (line 4) to help pay for maintenance activities.

Information about routine maintenance activities was sought from EOM members. Most of the people questioned were unaware of normal maintenance activities and required prompting or suggestions in regards to basic or routine tasks for specific types of infrastructure. Many EOM members confirmed that little is done in terms of regular or routine maintenance of the village infrastructures.

No major repairs have taken place on these systems, however more than half the committees reported that some repairs were required on their infrastructure. The inactivity of the EOM and lack of user fee collections put the opportunity for making these repairs in doubt. EOM members were asked to characterize the nature of the cause for these defects, the results of which is presented in Table 7.8.2 above. Environmental or climate problems have caused the majority of the breakage, with design issues, poor materials and lack of O&M also cited for many of these defects.

Recommendation 3: EOM Committee members will benefit from additional training and resources in regards to specific tasks, duties and schedule of activities that are required of them for each infrastructure type in the PNDS menu, or PNDS may want to re-think its need for the EOM and instead incorporate the role of O&M into the existing suku structure.

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.

Most of the infrastructure evaluated during this mission featured changes to the Technical Construction Standard designs that had been photocopied and attached to the Community Proposals, most often different dimensions but often the construction of a structure using quite dissimilar materials and methods. Road culvert proposals, for example, would typically contain the standard reinforced concrete box culvert TCS design. What was constructed, though, were often mortared stone walled culverts with a variety of top slab options.

No as-built drawings of completed infrastructures were found in the Community Proposals and village files (of 34 completed sub-projects evaluated).

Maintaining records of these changes is important from several viewpoints. The financial implications of changes to SP designs must be accounted, certified and accepted by the community and its KPA. As-built drawing records of changes are also important from the PNDS planning and engineering perspective. Accurate as-builts filed with the Municipality will allow sub-project designers to learn from past experiences and improve future designs.

Recommendation 4: As-builts of completed infrastructure should be created as part of Program Cycle Step 11, and should be included in the Completion Report and kept on file in the village and the Municipality.

7.10 Frequency of Technical Facilitation and Supervision

The frequency of technical facilitation and supervision to SP sites was examined to see whether the technical quality of the infrastructure can be linked to trends in these visits.

The project commenced over the period October 2013 to August 2014 in three phases:

Oct 2013 – Phase I 149 suku commenced
Mar 2014 – Phase II 91 suku commenced
Aug 2014 – Phase III 202 suku commenced

When Phase III started, PNDS was operating in all 442 villages of Timor Leste, with Phase I and II villages implementing their second cycle. Villages have been receiving grants on average every two years.

Table 7.10.1: Technical Staffing Ratio

	Phase I and Phase II	Phase III
Total Number of Sub-Projects	335 + 219	385
Number of Technical Facilitators	121	121
Staffing Ratio (SPs/Staff)	4.59	3.18

PNDS technical facilitators and Municipal Engineers visit SP sites during the planning and construction period to provide technical assistance to village building committees, to inspect the ongoing works, to provide advice and to monitor progress. The POM states that these visits should be "regular" and, in Program Cycle Step 9, indicates that "PNDS Administrative Post Facilitators [should] conduct supervision visits in each [village] at least once per month, though usually once per fortnight. "

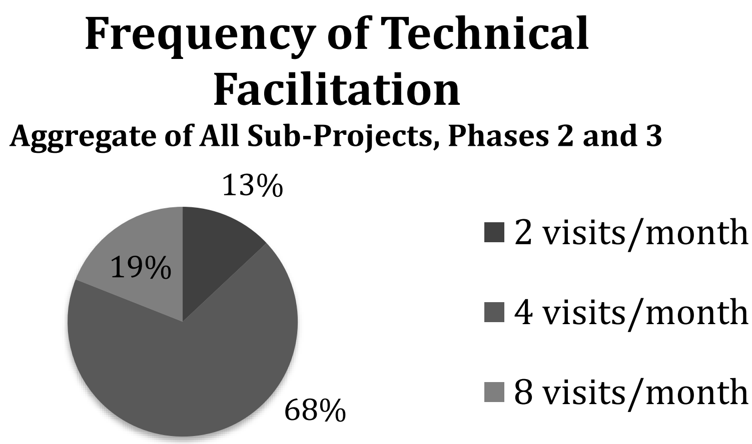
The technical evaluation questioned members of the SP building committee at each site regarding the frequency of PNDS technical facilitation visits, making note on the sub-project TEC and then transferring the data into the SEDIF. All frequency results were found to lie within the following choices:

- 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 (87%) are being visited by technical facilitators at a frequency of once/week or greater in Phase I/Phase II and Phase III.

Chart 7.10.1: Frequency of Technical Facilitation, All Sub-projects



The frequency of technical facilitation visits was obtained through speaking with members of the village sub-project implementation committee, where possible, or by referring to the Diary of Visits that is kept at the Xefe Suku's house or community center. Many villages did not have any records of these technical visits or maintained incomplete records, where TFs reported that they often attended the SP sites but did not leave behind any written notes or instructions.

This data was analyzed in regards to the Phase in which the sub-projects had taken place. This produced the following table:

Table 7.10.2: Technical Facilitation Frequency by Phase

	8 times/month	4 times/month	2 times/month
Phase II (20 SP)	20%	70%	10%
Phase III (27 SP)	19%	67%	14%

Discussion:

This data indicates that the frequency of technical facilitation has stayed approximately the same from Phase II to III, even though the staffing ratio increased the theoretical number of villages per staff member (from Table 7.10.1). This indicates that the technical field staff are efficiently planning their time and travel. It was noted at most of the villages receiving technical inspection visits at 8 times/month that the TF usually lived in or near the subject site and was thus able to visit more often.

This relatively similar amount of technical facilitation from Phase II to Phase III can be compared with the aggregate of the technical quality ratings for the two phases from Table 7.1.2 (Phase II = 75% Meets Spec. and Phase III = 80% Meets Spec.). It is noted that there has been a small increase in the aggregate technical quality of the SPs evaluated.

From the data gathered, it is evident that the frequency of technical facilitation to Phase II and Phase III SP sites has stayed approximately the same even as the project has expanded to include all villages in Timor Leste.

Recommendation 5: All sub-project inspection visits should be recorded in SP implementation diaries (*diario* or project site visitor log-book) that are maintained expressly for this purpose. Entries should make note of the date, visitor, purpose of visit, results of inspection, instructions for corrective measures required, summary of upcoming works, etc.

7.11 Universal Accessibility

The PNDS POM provides assurances 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.

Fully 100% of sub-project buildings evaluated feature proper ramps for handicapped, disabled and elderly users.

Water system tapstands are not as fortunate:

Table 7.11.1: Tapstand Universal Accessibility - % (Number of Sub-projects)

	Meets Spec.	Slightly Below Spec.	Below Spec.
Tapstand - Accessibility	62% (8 SP)	23% (3)	15% (2)

Discussion:

The TCS drawing for a public water system tapstand shows a concrete curbed platform with a wide, gently graded ramp for access. Universal accessibility guidelines are often focused on the elderly or handicapped citizens, but for tapstands the emphasis shifts to ease and safety of use. Properly located and formed ramps allow men, women and especially children a safe environment as they move around and off the concrete platform with heavy buckets of water or loads of laundry. The ratings assigned this aspect of water systems reflect the degree to which the design or installation presents a tripping hazard to users. A Slightly Below rating would normally be assigned a concrete platform that has been constructed with a ramp that has not been properly backfilled, creating a step at the end rather than a smooth transition to a soil pathway. Below Specification ratings are for those tapstands where no provision has been made for the ease of use or safety of the users.

Technical facilitators need to be made aware of the importance of this facet of water system infrastructure. If village implementation committee (EIP) move to delete these works, the TF should involve more senior levels of PNDS engineers.

This tapstand has been constructed high above the ground surrounding it, creating a big step for users to negotiate as they leave, a hazard as they carry heavy buckets of water. The village implementation team explains that they did not build the ramp as shown in the drawings because no disabled people live in this neighbourhood. The TF reported that the construction of this tapstand happened between her inspection visits.

Recommendation 6: 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 it with adjacent pathways. TF should ensure that the EIP do not remove them from the project design.

8 Best Practices and Recommendations

The technical ratings of SP components and aspects have been discussed at high levels in Section 7 of this report. The technical ratings data were aggregated, sorted and studied on a national level, according to SP, by remoteness, by construction Phase, by Fitness for Purpose, by frequency of technical facilitation, O&M, as-builts, and by Universal Accessibility.

The data can similarly be sorted and studied within each SP type. This section will look at each SP type in turn. A study of the ratings applied to each SP type's components and aspects will yield valuable insights to PNDS' construction methodologies and how they might be improved in future cycles.

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 (82% of building components Meet Spec) or were considered Slightly Below Spec (14%). Only 4% of the building components evaluated were rated Below Spec.

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 Spec or Below Spec are as shown in the following table. Not all building components and aspects are shown, for brevity.

Table 8.1.1 Building Components/Aspects Considered Slightly Below or Below Spec - % (No. of SP)

Building Component/Aspect [No. of SP Evaluated]	Percentage of SP Rated *Slightly Below Spec*	Percentage of SP Rated *Below Spec*
Wall – Dimension [9 sub-projects]	11% (1)	
Column – Dimension [12]	25% (3)	8% (1)
Ring Beam – Reinforcement [2]	50% (1)	
Ring Beam – Dimension [6]	17% (1)	
Truss – Structural Assembly [5]	20% (1)	
Truss – Connection to Ring Beam [4]	50% (2)	
Doors and windows [9]	33% (3)	11% (1)
Toilet [3]	33% (1)	

Discussion and Recommendations:

Walls were rated for two aspects: the presence of reinforcement anchors (extending from the ground beam and columns into the walls) and in regards to their dimensions. All of the buildings evaluated were complete, so that no inspection of the reinforcement could take place (a check mark in the Not Inspected column was entered for these aspects). Wall thicknesses can be checked adjacent to doors or windows. One SP was found to have numerous walls that were less than the thickness specified.

Columns were considered to be Slightly Below Specification if their dimensions do not match the designs or the building has been constructed with a column spacing wider than as shown on design drawings. A quarter of SPs (25%) were found lacking in this building component. One SP was found to have columns very much less than that specified, resulting in a Below Spec rating (maternity clinic, Suku Cotolau, PA Laulara, Aileu). The danger presented by narrow columns is that seismic events will cause the thin layer of concrete over the reinforcing bar to fracture, leading to column failure.

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 two of the ring beams could be inspected during their construction (the rest were complete) and one of these was found to have deficient reinforcement. Six completed ring beams were inspected and one of these was measured to be smaller than the drawing specifications.

Trusses were evaluated in regards to two aspects: structural assembly standards and conformance with drawings (1 SP Slightly Below Spec); and proper connections to a building's ring beam (2 SPs considered Slightly Below Spec). Many trusses are constructed by local woodworkers who fabricate the wooden trusses using traditional layout and joinery methods, ignoring design drawings. Connections and structural bracing are sometimes neglected. In other instances, design drawings were lacking sufficient detail, leaving the community to trust the skill of local builders.

These 2016 audit results for trusses can be compared to those from 2015. Structural assembly of the trusses has not gotten much better, although only four SPs were rated in the current evaluation (2016: 2 SP rated Meet Spec, 2 rated Slightly Below; 2015: 12 Meets Spec, 2 Slightly Below, and 4 Below Spec). Truss connections to ring beams continue to be problematic: (2016: 2 SP rated Meets Spec, 2 Slightly Below; 2015: 13 Meets Spec, 3 Slightly Below). There continues to be need for improvement in these regards.

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.

Doors and windows were frequently noted as being Slightly Below Spec (33% of SPs, 3 of 9). These ratings are directed at sagging and fractured panels that are perhaps a year old. Properly constructed doors and window panels, using high-grade wood, should last a decade before needing major repair or refurbishment. The use of lower-grade woods, inadequate millwright techniques and inexpensive hardware serve to cheapen a building for its users. The single Below Spec rating was directed at a school addition in Suku Fahisoi, PA Remexio, Aileu where a very low doorway had been installed, causing tall persons great injury if they enter unaware of the hazard.

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. The medical clinic toilet in Suku Vesoru, PA Uato Lari, Viqudue had a poorly draining tiled floor, which will greatly frustrate a doctor who stays there. TCS drawings should have a drawing attached showing clear details of how to build properly sloped tile floors.

It should be noted that **electrical systems** were not found to have any similar problems as had been observed in the 2015 technical audit. (Keep up the good work, EDTL workers.)

The PNDS building program has produced many fine schools, health clinics and other public structures. Building program engineers and technicians should carefully review the findings of this evaluation, as described in the building components above, and make improvements to future infrastructures in areas noted.

Recommendation 7 – PNDS Municipal engineers who are expert in building design and construction should continue their checks and verification of SP designs of this type. Site inspection visits before, during and after construction should continue. Line Ministry engineers should be taken to the field by PNDS technical staff for joint inspection at least once through the building season.

8. 2 Bridges

Foundation, abutment and wingwall design are fundamental to the integrity of a bridge structure and must be based on the actual conditions of each individual site. National PNDS expert engineers currently review all bridge designs that feature these components. The Technical Construction Standards contain generic drawings and specifications, but these must be carefully chosen and fitted to each individual site. Additional features such as wingwalls, ramp, slope protection, etc. should be added during the design stage based on the field survey. Foundation considerations are amongst the most crucial of decisions in bridge planning and design, carefully considering the nature of the underlying soils. Senior personnel should be consulted throughout the design process. Erosion protection measures must be selected, designed, installed, and maintained. Ministry sectors should continue to be consulted and involved with these sub-projects, particularly since use of public equipment might be requested in the future for maintenance and repair activities.

A single bridge SP was evaluated during this audit, near Suku Eraulo, PA Letefoho, Ermera. The technical evaluation of the structure found very few deficiencies with the work. The sole bridge element that was rated Slightly Below Spec is the transition apron from the deck to the approach road surface.

Table 8.2.1 Bridge Components/Aspects Considered Slightly Below - % (No. of SP)

Bridge Component/Aspect	Percentage of SP Rated *Slightly Below Spec*
Apron (1 sub-project)	100% (1 sub-project)

The design elevation of the bridge deck is 30 to 40 cm higher than the surrounding ground, with the result that the approaches to the bridge are steep. Gravel has been placed on both sides to facilitate vehicle travel across the bridge, however it is loose and susceptible to settlement and erosion. Frequent placement of additional material on the aprons will be necessary on both sides of the bridge to maintain reasonable access for motor vehicles. Designers should take note of this installation in order to avoid repeating such errors. Additional concrete can be placed on the aprons to ease the ongoing maintenance burden here.

8. 3 Water Supply Systems

Similar to bridge SPs above, water supply sub-projects frequently involve specialized knowledge and experience. The relatively high quality of water supply SPs shows that senior PNDS design/construction engineers have provided expert guidance, assistance and advice to project field personnel.

Table 8.3.1 Water Supply Component/Aspect Ratings - % (No. of SP)

Water Supply Component/ Aspect	Percentage of NCDDP SP Rated *Slightly Below Spec*	Percentage of NCDDP SP Rated *Below Spec*
Water System Design [22 evaluated]		5% (1)
Watershed Protection [15]	33% (5)	7% (1)
Reservoir – Structural Integrity [21]	5% (1)	
Reservoir – Ease of cleaning [21]		5% (1)
Transmission Pipe [16]	56% (9)	
Public Tap – Fixture/Platform [18]	28% (5)	11% (2)
Public Tap – Drainage [22]	41% (9)	
Public Tap – Fencing [18]		22% (4)
Water Pressure/Quantity [19]	32% (6)	16% (3)

Discussion:

The **water system design** for Suku Babulo, PA Uato Lari, Viqueque has contributed to feelings of animosity and resentment within the community when one reservoir and some tapstands are able to receive water when others do not. The community has had individuals cut pipes in order to access water when their own tapstand is dry. In cases where water supplies may be low at certain times of year, water system designers need to use reservoir configurations that guarantee equal distribution of water to systems where there is more than one tapstand connected to reservoirs.

Watershed protection has not been sufficiently addressed in 5 of 15 SPs evaluated. This can be fencing of upland areas for gravity-fed sources or the provision of proper separation distances and drainage within villages for shallow wells and boreholes from unsanitary conditions. The single *Below Spec* rating was for a shallow well with cracked rings and concrete platform where contaminated surface waters are leaking into a village well.

A single **reservoir** was considered *Slightly Below* in regards to its **Structural Integrity** and another was rated *Below Spec* for the **Ease of Cleaning** (Suku Babulo, Viqueque and Suku Cotolau, Aileu respectively). The Brief SP Reports for these installations provide more detail in regards to how such infrastructures can be improved.

Water transmission pipes (that transport water from the catchment reservoir/tank to the village) have been constructed Slightly Below Spec in 56% of the SPs evaluated (9 of 16). Substandard work in this case normally consists of inadequately supported pipe (improper pipe stands), lack of cover over pipe (especially PVC), or poor assembly of the piping.

Public tapstand fixtures, platforms, drainage and fencing have high percentages of *Slightly Below* and *Below Spec* ratings. Imperfections are generally associated with faulty faucets; poorly installed and leaking pipes; improperly graded concrete platforms that allow water to pool (a nuisance for users and potential breeding area of disease vectors); inadequate ditching to lead waste water away from public areas; and lack of fencing to prevent animals and small children from visiting the tapstand.

Water pressure and quantity was identified as problematic at roughly half of the SPs evaluated. There is sometimes little that can be done about this, due to constraints presented by elevations of sources, spring-fed volumes fluctuating during the year, and limited groundwater recharge. Engineers should be aware of this village concern and should work to ensure that installed systems are as leak-free as possible. Designers should make use of proper flow-splitting reservoirs in situations where several tapstands are supplied from a single location.

Recommendation 8: PNDS Municipal engineers who are experts in water supply design should continue their checks and verification of SP designs of this type. Site inspection visits before, during and after construction should continue. Line Ministry engineers should be taken to the field by PNDS technical staff for joint inspection at least once through the building season.

Recommendation 9: PNDS should provide a technical training course for water system engineers and senior technologists/technicians. The course should provide a comprehensive review of proper water system quantity requirements and calculations methods, survey prerequisites, construction techniques and technologies, and operation and maintenance practices.

8. 4 Road, Drainage and Retaining Wall

The majority of PNDS road works consists of spot improvements along existing road or track alignments. These spot improvements are generally aimed at formalizing drainage works beside or crossing the alignments, such as drainage channels or road culverts. Most of the spot improvements of this kind are quite well done.

Some road improvement SPs, however, feature the opening of new road alignments, using heavy machinery to make large excavations into slopes to create these roads. All of the SPs that featured this form of roadwork displayed worrisome signs of soil erosion from stormwater runoff.

Road works were rated in two different ways. Spot improvement works (components), such as retaining walls, culverts, drainage channels, etc. were rated using the audit's standard field tool and rating system, i.e. *Meets Spec*, *Slightly Below* and *Below Spec*.

Lengthy road works, however, 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 has been introduced 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.

The road components that received ratings of *Slightly Below* and *Below Spec* are as follows:

Table 8.4.1 Road Component/Aspect Ratings - % (No. of SP)

Road Component/Aspect [No. of SPs Evaluated]	Percentage of SP rated *Slightly Below Spec*	Percentage of SP Rated *Below Spec*
Retaining wall – struct'l integrity [5]	20% (1)	20% (1)
Retaining wall – weep holes [3]		67% (2)
Culvert – construct'n techniques [10]	10% (1)	30% (3)
Small bridge – construction tech. [7]	14% (1)	57% (4)

Discussion:

Retaining walls were judged to be *Slightly Below* or *Below Spec* in a large number of cases where the slope (batter) at which they were constructed was considered too vertical or where weep holes had not been installed as per the design.

Culverts also suffer from a lack of proper placement or the construction ignored the design. One of the rated culverts was rated *Slightly Below*, with a further 3 installations considered *Below Spec*. Poorly located culverts become nightmares for maintenance crews, as they rapidly fill with silt and debris. Conversely, well-designed and properly constructed infrastructure simplifies maintenance activities and strengthens a road.

Several **small bridges** have numerous construction problems in both Viqueque and Liquica (Suku Uma Uain Kraik and Fahilebu respectively). Concrete mixing has been done improperly; connections of the bridges to adjacent road approaches is steep and prone to erosion and scouring; portions of the bridge superstructure are starting to crack, perhaps due to poor foundation conditions; and the size of masonry channels has been reduced from the TCS and constructed with slopes toward the road rather than away from it.

There were four SPs where lengthy sections of road were constructed or improved. Two of these, in Aileu, included 'road opening' segments where heavy machinery was used to excavate slopes and form roadbeds.

Table 8.4.2 Road Upgrade SPs - % of Alignment Affected by Problem

		Tohumeta, Aileu	Luculai, Liquica	Uma Uain Kraik, Viqueque	Faturilau, Aileu
	Length of Road Improvements (metres)	700	3,000	400	300
1	Improper Cross Section (Crown or Camber) - %	100%	40%	5%	100%
2	Surface below standard - %	33%	44%		100%
3	Pavement below standard - %				
4	Improper construction materials - %	100%	42%	9%	100%
5	Narrow width - %		3%		
6	Inadequate roadside ditches - %	78%	100%		100%
7	Steep and slippery when wet - %		16%	4%	
8	Low and muddy during rain - %		3%		
9	Unstable slope above (too steep) - %	27%	3%		33%
10	Unstable slope below (too steep) - %	8%	5%		
11	Missing drainage structure – number count	2			1
12	Safety concerns – number count		2		

Discussion:

Road shape, crown and surface/pavement issues – the shape and crown of a road cross section is important to properly shed stormwater runoff. Poor cross sections were recorded for 100% of 2 of the 4 roads evaluated; a third road exhibited an improper shape over 40% of its length.

The surface of 2 roads was observed to be badly rutted (33% and 44% of two roads in LIquica and Aileu) and 100% of a third road in Aileu. This can often be caused by the failure to properly shape a roadbed before laying down surface gravels. Road sub-base soils must be excavated and shaped to form an adequate camber (providing a crown to the road surface), before placement of road gravels or pavements. Failure to do this will promote water pooling beneath the road, softening the underlying sub-base soils and leading to surface rutting and cracking. The PNDS roads evaluated during this assignment are not yet very old, only one to two years, so that more disruption of the road surfaces is likely to come where proper crowns have not been formed.

Improper construction materials were used for the new road openings in Aileu (it did not look as though any road gravels had been imported to form these new alignments). Roads must be constructed using layers of properly sized rock and gravel that is not rounded. Most native granular soils 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 7 and 8 in Table 8.4.2 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 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 in the two road openings evaluated in Aileu. These slopes will exhibit constant raveling of material as rainfall runs down the steep inclines. Large slope failures will also 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 instances on a 3 km road rehabilitation SP in Liquica. One circumstance was a slope below the alignment that is in active failure-mode, with a risk of a vehicle turning over and rolling down the slope. The second area is a slope above that appears unstable, along a narrow section of the road.

Recommendation 10: The PNDS Municipal engineers who are experts in road, drainage and retaining wall design should continue their checks and verification of SP designs of this type. Site inspection visits before, during and after construction should continue.

Recommendation 11: Public Works Ministry, Road sector should continue to be consulted and involved with these sub-projects, particularly since use of public equipment might be requested in the future for maintenance and repair activities. Because of the complexity of roads, PNDS may want to consider including an extra sign off at the municipal level of any new road SPs proposed.

8. 5 Irrigation

There were 3 PNDS irrigation SPs evaluated during this assignment.

Table 8.5.1 Irrigation Components/Aspects Ratings - % (No. of SP)

Irrigation Component/Aspect [No. of SPs reporting]	Percentage of SP rated **Slightly Below Spec**	Percentage of SP Rated **Below Spec**
System Layout [3 SP Evaluated]		33% (1)
Water Level Controls [3]		33% (1)
Channel Control Structures [3]	33% (1)	

Discussion:

One of the irrigation schemes was judged to have a **System Layout** or design that was *Below Spec*. It is important that senior engineers, who have experience with irrigation projects, are involved with all SPs of this nature. The irrigation SP in Suku Laclo, Ermera has used at least twice as much concrete as a smaller, more logical system might have done. Senior review of such plans and, more importantly, site visits to discuss and refine designs should be standard practice for all irrigation SPs.

The same SP in Laclo was judged to be deficient in its use of **Water Level Controls**. A mechanical gate has been designed at the downstream end of a channel to stop stream flows from entering an irrigation ditch that is directed toward agricultural fields. The gate seems to be misplaced (a gate would more effective at the entrance to the channel) but also will be prone to failure due to large amounts of stream-borne rocks and sand that will foul the mechanism. Mechanical gates should only be used in situations where clean, placidly flowing irrigation water is flowing.

In a similar situation, the mechanical gate designed as a **Channel Control Structure** for the irrigation works built at Suku Tiarlelo, Ermera will quickly become disabled when the stream flows reach high levels, inundating and sweeping rocks, wood and debris into the channel. Also at this site, some gabion baskets have been installed as an erosion prevention measure, in an attempt to protect the channel headworks from stream flows. The leading basket has already started to deform from a high water event in the recent past. It is apparent that when the stream reaches its highest level, submerging this area in approximately one metre of turbulent flows, the gabion baskets will likely continue to deform and probably 'roll' downstream in some way. It is suggested that the gabion baskets be removed and replaced with a thick layer of mass concrete to protect the channel works.

Recommendation 12: PNDS Municipal engineers who are experts in irrigation design should continue their checks and verification of SP designs of this type. Site inspection visits before, during and after construction should continue. Line Ministry engineers should be taken to the field by PNDS technical staff for joint inspection at least once through the building season.

8.6 2015 Key Issues Update

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

Table 8.6.1: Key Construction/Design Issues

Design – All SP Types Unless Noted Otherwise

2015	Remarks	2016
79%	Lack of construction details on drawings	56%
45%	Inaccurate drawings of connection details (Building and Bridge)	0
42%	Improper steel reinforcement design (Bldg, Bridge and Water Supply)	7%
30%	Constructed dimensions differ from plan	24%
87%	No elevations on plan (Water Supply)	67%
60%	Drainage design and considerations (Road, Drainage, Retaining Wall)	25%

Discussion:

General improvement can be seen with all of the Design Key Issues that were noted in the 2015 audit. Much of the credit for these improvements is due to the issuance of the TCS and their use by Municipal engineers and TF.

Additional updates to the Key Issues from 2015 are presented in Annex 6.

9 Conclusions

This Final Report of the 2016 Technical Evaluation of Infrastructure for the National Program of Village Development has found that the completion of sub-project works in the Municipalities evaluated to be largely in conformance with the Community Project Proposals and the specifications as set out by PNDS for the community-built infrastructure. The majority of the Phase III Community Proposals have made use of the Technical Construction Standards that were introduced since the 2015 audit.

Problems and key construction issues have been highlighted by the technical evaluation teams, with approximate percentages of sub-projects so affected being calculated and presented in this report and an annex. These findings can be used by PNDS to continue its efforts to improve the technical quality of the infrastructure developed by villagers.

In addition to this, separate ratings were made of the operation and maintenance, fitness for purpose, overall quality, and adherence to appropriate environmental safeguards. A study of these aggregated ratings also shows that the program is largely meeting its goals.

ANNEX 1 – SUMMARY OF RECOMMENDATIONS

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

5.6 Technical Construction Standards

Recommendation 1: All TF should use the TCS as SP Community Proposal plans are being developed. (Aileu engineers may be able to offer advice to their peers in these regards.)

7.6 Land Donation Certificate

Recommendation 2: Copies of donation letters and TF 7.2.2 should be included in all Community Project Proposals. Senior PNDS personnel visiting SP sites should make periodic checks that all necessary and appropriately completed forms and documentation is in place.

7.8 Operation and Maintenance

Recommendation 3: EOM Committee members will benefit from additional training and resources in regards to specific tasks, duties and schedule of activities that are required of them for each infrastructure type in the PNDS menu, or PNDS may want to re-think its need for the EOM and instead incorporate the role of O&M into the existing suku structure.

7.9 As-Built Drawings

Recommendation 4: As-builts of completed infrastructure should be created as part of Program Cycle Step 11, and should be included in the Completion Report and kept on file in the village and the Municipality.

7.10 Frequency of Technical Facilitation and Supervision

Recommendation 5: All sub-project inspection visits should be recorded in SP implementation diaries (*diario* or project site visitor log-book) that are maintained expressly for this purpose. Entries should make note of the date, visitor, purpose of visit, results of inspection, instructions for corrective measures required, summary of upcoming works, etc.

7.11 Universal Accessibility

Recommendation 6: 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 it with adjacent pathways. TF should ensure that the EIP do not remove them from the project design.

8.1 Best Practices, Buildings

Recommendation 7 – PNDS Municipal engineers who are expert in building design and construction should continue their checks and verification of SP designs of this type. Site inspection visits before, during and after construction should continue. Line Ministry engineers should be taken to the field by PNDS technical staff for joint inspection at least once through the building season.

8.3 Best Practices, Water Supply

Recommendation 8: PNDS Municipal engineers who are experts in water supply design should continue their checks and verification of SP designs of this type. Site inspection visits before, during and after construction should continue. Line Ministry engineers should be taken to the field by PNDS technical staff for joint inspection at least once through the building season.

Recommendation 9: PNDS should provide a technical training course for water system engineers and senior technologists/technicians. The course should provide a comprehensive review of proper water system quantity requirements and calculations methods, survey prerequisites, construction techniques and technologies, and operation and maintenance practices.

8.4 Best Practices, Roads

Recommendation 9: The PNDS Municipal engineers who are experts in road, drainage and retaining wall design should continue their checks and verification of SP designs of this type. Site inspection visits before, during and after construction should continue.

Recommendation 11: Public Works Ministry, Road sector should continue to be consulted and involved with these sub-projects, particularly since use of public equipment might be requested in the future for maintenance and repair activities. Because of the complexity of roads, PNDS may want to consider including an extra sign off at the municipal level of any new road SPs proposed.

8.5 Best Practices, Irrigation

Recommendation 12: PNDS Municipal engineers who are experts in irrigation design should continue their checks and verification of SP designs of this type. Site inspection visits before, during and after construction should continue. Line Ministry engineers should be taken to the field by PNDS technical staff for joint inspection at least once through the building season.

ANNEX 2 – TECHNICAL EVALUATION CHECKLISTS

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

Building

Bridge

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	NR R VR ExR
Sub-Project Name			New construction ☐	Rehabilitation ☐
Project phase			Inspection date:	Inspection by:

Evaluation Details					
Components Evaluated	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 : ☐ Excelle ☐ Good ☐ Poor

Comments: (Excellent or Poor needs a story)

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

Comments: (Excellent or Poor needs a story)

Environmental considerations
The sub-project quality is: ☐ Excelle ☐ 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
<u>Sub-project description</u>   <u>Issues</u>

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	NR R VR ExR
Sub-Project Name			New construction ☐	Rehabilitation ☐
Project phase			Inspection date:	Inspection by:

Evaluation Details					
Components Evaluated	Inspection Result				
	Meets Spec.	Slightly Below Spec	Below Spec.	Not Inspected	Not Applicable
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 : ☐ Excelle ☐ Good ☐ Poor

Comments: (Excellent or Poor needs a story)

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

Comments: (Excellent or Poor needs a story)

Environmental considerations
The sub-project quality is: ☐ Excelle ☐ 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	NR R VR ExR
Sub-Project Name			New construction ☐	Rehabilitation ☐
Project phase			Inspection date:	Inspection by:

Evaluation Details					
Components Evaluated	Inspection Result				
	Meets Spec.	Slightly Below Spec	Below Spec.	Not Inspected	Not Applicable
13. Water Source					
a. Smell, colour					
b. Watershed protection					
14. Water system design					
15. Pump system					
16. Reservoir					
a. Structural integrity					
b. Easy to clean					
17. Transmission and distribution pipe – proper installation					
18. Public taps					
a. Number and locations					
b. Fixtures					
c. Platform, accessible ramp					
d. Drainage					
e. Fencing/Protection					
19. Water pressure and quantity					
20. Other structures					

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

Overall Sub-Project Assessment

The construction quality is : ☐ Excelle ☐ Good ☐ Poor

Comments: (Excellent or Poor needs a story)

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

Comments: (Excellent or Poor needs a story)

Environmental considerations
The sub-project quality is: ☐ Excelle ☐ 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)				
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	NR R VR ExR
Sub-Project Name			New construction ☐	Rehabilitation ☐
Project phase			Inspection date:	Inspection by:

Evaluation Details												
	Problems Noted											
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?	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 : ☐ Excelle ☐ Good ☐ Poor

Comments: (Excellent or Poor needs a story)

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

Comments: (Excellent or Poor needs a story)

Environmental considerations
The sub-project quality is: ☐ Excelle ☐ 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
<u>Sub-project description</u>   <u>Issues</u>

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	NR R VR ExR
Sub-Project Name			New construction ☐	Rehabilitation ☐
Project phase			Inspection date:	Inspection by:

Evaluation Details					
Components Evaluated	Inspection Result				
	Meets Spec.	Slightly Below Spec	Below Spec.	Not Inspected	Not Applicable
21. System layout					
22. Reservoir design					
23. Weir					
24. Water level controls					
25. Ditches					
26. Culvert and pipes					
27. Embankments					
a. Fill slope – 1 vert.:4 horiz. maximum					
b. Cut slope – 1 vert.: 2 horiz. max.					
28. 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 : ☐ Excelle ☐ Good ☐ Poor

Comments: (Excellent or Poor needs a story)

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

Comments: (Excellent or Poor needs a story)

Environmental considerations
The sub-project quality is: ☐ Excelle ☐ 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$			
<u>Routine maintenance (make notes in BSR)</u>				
Vegetation removal (aquatic and land)		active areas		
Sediment removal				
Mechanical gates, outlets				
Canal repair				
Embankment erosion protection				
Fencing repair				
Annual maintenance costs	US$			
<u>O&M Committee Interview (make notes in BSR)</u>				
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 - DESCRIPTION OF INSPECTION DETAILS

The Technical Inspection Checklists (TIC) provided the technical evaluators with a concise breakdown of each sub-project type of infrastructure into its sub-components and, if appropriate, a component broken into technical aspects. Following is a summary of these components and aspects, together with brief outlines of how each item was assessed and evaluated.

Building

Construction Components	Aspects	Comments and Technical Notes
1 Foundation		Foundation elements are often buried and difficult to observe. Above ground portions of a foundation can be examined to give clues as to how wide underground portions are likely to be.
2 Ground beam (sloof)		Sloofs should have reinforcement projecting into the underlying foundation, at a spacing of approximately 2 m. This reinforcement is required to keep the building from slipping off its foundations during seismic events. This element is missing from almost all Community Project Proposals that were examined.
3 Wall	a. Anchor	Walls should be anchored to column via a horizontal piece of steel 40 cm in length. This element is missing from all CPP drawings.
	b. Dimension	The width of the wall is normally determined by the size of local bricks, plus the depth of two layers of mortar.
4 Column	a. Reinforcement	Inspection of reinforcement cages (stirrups) is desirable, to check on tie bars and wired intersections.
	b. Dimension	Plans and specifications call for certain concrete dimensions. One often finds substandard columns due to the application of thick layers of mortar.
5 Ring beam	a. Reinforcement	Inspection of reinforcement cages (stirrups) is desirable, to check on tie bars and wired intersections.
	b. Dimension	Plans and specifications call for certain concrete dimensions. One often finds substandard columns due to the application of thick layers of mortar.
6 Truss	a. Structural assembly	Trusses require careful attention to the details on the plans – timber or galvanized light steel. Often local skilled labourers will build truss as they always have done – incorrectly. Pay attention to steel strapping and the use of bolts.

Building
(continued)

Construction Components	Aspects	Comments and Technical Notes
6 Truss	b. Connection to beam	Truss connections to the building walls is almost invariably done wrong. Local practice is to extend column steel up and hook it around the top truss members. This reinforcing steel is often held tight with a series of short nails. CPP drawings rarely show correct connection details.
7 Roof structure	a. Galvanized corrugated steel	The use of galvanized corrugated steel is wide-spread and likely not subject to corruption. Discourage the use of painted steel, as it degrades rapidly.
	b. Connections to gording	The roof should be attached to the truss via the gording (purlin) and cleats.
8 Floor		The building floor should be flat, no ponding, smooth
9 Plastering		Walls should be smooth and flat. Coarse sand is sometimes used (from mountain creeks) which produces a rough surface that does not accept paint very well, and gets dirty much quicker. It is difficult to clean.
10 Ceiling		Suspended plywood ceilings are sometimes featured in community buildings. They should be straight, not undulating, painted with preservative (and coloured paint) and have no wide gaps.
11 Painting		Painted surfaces should be evenly coloured with a minimum of splatter on unpainted surfaces. Extreme care should be taken around wooden doors and window casings/frames.
12 Doors and windows		Woodwork should be clean, straight, no knot holes or gaps between panels. Hinges should be firmly screwed tight and doors should not run into the floor. Number of hinges should match weight of door (2 or 3 hinges). Mechanical fixtures should all operate without force being applied. Shutters should fit snugly into window frames. Locks should operate smoothly. Hook and eye fasteners mate easily.
13 Toilet		Water should run freely into basin. No leakage of basin to floor through cleanout pipe. Free draining floor to lidded central hole or pipe at side of room. Toilet should flush easily with one or two scoops.
14 Septic tank		Tank should be connected to toilet building via underground pipe. Tank should have lid that is too heavy for elementary school age child to remove. Ventilation pipe should be galvanized and secured to well-founded pole or side of building. Septic tank should be two-chamber with downstream chamber connected to soak-away pit situated on granular soil.
15 Ramp and handrail		Universal accessibility guidelines should be followed. Ramp should be no steeper than 16% with rough/non-slip surface and have a handrail.

Building
(continued)

Construction Components	Aspects	Comments and Technical Notes
16 Service utilities	a. Water	Community water systems, if available, should be connected to public building sanitary facilities.
16 Service utilities	b. Electrical installation	EDTL connection work should be monitored and, if found lacking in some way, EDTL should be contacted as soon as possible.
	c. Drainage	The control and disposal of storm water runoff around the public areas of a building is important. Pooled water can be a nuisance, can promote messy conditions in the facility and can provide breeding grounds for disease vectors.
17 Other structures		If public buildings require a retaining wall or other infrastructure, use appropriate Technical Inspection Checklist for specific technical parameters.

Bridge

Construction Component	Comments and Technical Notes
1 Layout	Proper bridge layout must be addressed during the survey, planning and design stages of the sub-project. Bridge locations must consist of stable soils or bedrock. If the bridge is crossing a water course, the alignment of the flows should be near perpendicular to the structure. Bridges should not be located on or directly beside a bend in a stream channel since a change in flow direction causes turbulence and detrimental erosive forces on banks and bridge components.
2 Foundation	Foundations must be set upon competent and undisturbed native soils, at a depth which will not be undermined.
3 Erosion protection	Numerous methods of slope and structure erosion protection exist – mortared stone slopes, gabion baskets, vegetation, etc. Methods appropriate to the site should be used, along with sensible placement of erosion protection infrastructure. Both stream flow and road drainage should be addressed.
4 Abutments	Abutments must sit on competent foundations and be designed to support both road fill soils and vehicle weight. Road drainage must be gathered and directed away from the abutment in order to prevent erosion channels developing along the edges of the abutment.
5 Pier/supports	Mid-span support positions must be carefully determined in the field. Soil conditions and hydraulic considerations will determine the number and location of support piers. A design should seek to increase the watercourse's cross-sectional area so as to ensure mid-span support columns do not impede water flow. Erosion protection measures should be taken upstream, downstream and beneath the bridge deck to ensure that mid-span supports cause ponding and flooding upstream, likely to cause undermining of the new works.
6 Concrete	Concrete should be smooth, non-porous and with no staining or indications of shallow reinforcement. Phosphorescence on the surface of concrete is indicative of poor concrete mixing and/or inadequate vibration at a cold joint. Pours should be no more than one metre high in columns to facilitate proper rodding; many excessively short pours are not desirable either. Concrete materials should be examined. Clean washed sand; properly sized coarse aggregate; dry properly stored cement bags. Proper steel reinforcement techniques and cage placement within forms.
7 Deck beams	Confirm size and placement of beams. Steel reinforcement check. Adequate bearing surfaces and opportunity for expansion/contraction on abutment and mid span supports.
8 Deck	Wood, steel, reinforced concrete as per plans.
9 Handrail	Wood, reinforced concrete posts and/or steel railings as per plans.
10 Connections (nails, bolts)	Connections between bridge components should be as per plans. Bolts should be specified rather than nails for as many connections as possible.
11 Apron / ramp	A bridge apron or ramp provides the connection between the structure and the approaching road. Structural integrity and drainage patterns are important facets of these bridge elements
12 Other structure	Retaining walls, drainage channels, etc. can be assessed using appropriate Technical Inspection Checklist for specific technical parameters.

Water Supply

Construction Components	Aspects	Comments and Technical Notes
1 Water Source	a Smell, colour	Assessment of colour and smell of water. Water should be clear and odourless
	b Chemical analysis	If the source is a new one, chemical analysis of water sample should be done to confirm source's potability. If sub-project is developing an existing source that has been used for a number of years, no chemical analysis is required.
	c Watershed protection	Community leaders should be aware of the activities that are taking place above the water source. Disposal of garbage or large sanitary facilities should be banned within the community watershed. Normal rural agricultural activities (ie not industrial agriculture) will not usually harm underground aquifers.
2 Water system design		System's technical design should respond to community requirements within constraints of the local topography. Reservoir and main distribution line(s) should be easy to access. Hydraulics of system should ensure constant, adequate flows to all users.
3 Pump system		Proper type of pump for groundwater depth and number of users; correct installation practices and sealing of casing (as necessary for particular pump); accessible locations.
4 Reservoir	a Structural integrity	Proper materials and methods of installation per plans and specifications.
	b Easy to clean	Rungs for access to top of tank; clean-out pipe and valves/valve box at base.
5 Transmission and distribution pipe		Specified materials and pipe diameters; proper pipe supports for above ground transmission lines; correct depth of bury for distribution pipes; valve boxes with locks
6 Public taps	a Number and locations	Locations of tap stands should be intermittently installed within village neighbourhoods and convenient for the users. Sufficient tap stands provided so that long wait times are avoided.
	b Drainage	Proper sloping of the apron should take excess water to a drain which will take excess water and discharge it away from the public area.
	c Protection	Fencing to restrict animals from accessing the tapstand.
7 Water pressure and quantity		System design should ensure that all tap stands receive uninterrupted flows with sufficient pressure to fill buckets within reasonable length of time.

Water Supply (continued)

Construction Components	Aspects	Comments and Technical Notes
8 Other structures		Buildings, retaining walls, drainage channels, etc. can be assessed using appropriate Technical Inspection Checklist for specific technical parameters.

Road, Drainage and Retaining Wall

Construction Components	Aspects	Comments and Technical Notes
1 Road layout		Generally for new roads: appropriate gradients, cut slopes, earthen fills, and response to drainage patterns.
2 Foundation		Excavations in preparation for road building need to reach undisturbed, granular, compact soils. Placement of road bed materials as per specification and shaped to drain properly.
3 Road surface	a. Slope/crown	Appropriate slopes to drain storm runoff from the road surface to ditches alongside.
	b. Width	Appropriate width of road for proposed traffic users.
	c. Compaction	Grading and compaction equipment as necessary.
4 Ditches		Concrete or earthen ditches of appropriate depth to handle runoff from road and adjacent catchment area. Sloped properly toward drainage diversion infrastructure.
5 Culvert		Formed box culvert or pre-fabricated pipe sections, properly installed with headwalls and inlet/outlet aprons/blocks/drop structures, etc. as necessary.
6 Embankments	a. Fill slope	1 vertical: 4 horizontal maximum unless surfaced with stone/mortar, etc.
	b. Cut slope	1 vertical: 2 horizontal maximum unless surfaced with some form of wall, erosion protection, etc.
7 Drainage channel	a. Dimensions	Concrete or earthen ditches of appropriate depth to handle runoff from road and adjacent catchment area. Sloped properly toward drainage diversion infrastructure.
	b. Depth of bury	Some drainage channels are too deep for the small amount of runoff reaching them. Shallower on steep grades, deeper on flat sections.
8 Retaining Wall	a. Structural integrity	Width of foundation, size of boulders, mortar or loose stone.
	b. Batter	Proper slope of wall face, leaning backward at a 1 horizontal: 10 vertical maximum
	c. Weep holes	Number, location and drainage considerations along the front of the wall.
	d. Erosion protection	Overland flows from above, as well as from road.
	e. Finishing	Aesthetic considerations for large public infrastructures.
9 Other structures		Bridges can be assessed using appropriate Technical Inspection Checklist for specific technical parameters.

ANNEX 4 - List of Sub-Projects Examined

NO.	MUNICIPALITY	ADMINISTRATIVE POST	VILLAGE	SUB-PROJECT	OVERALL CONSTRUCTION QUALITY			FITNESS FOR PURPOSE				ENVIRONMENTAL CONSIDERATIONS			FREQUENCY OF TECHNICAL FACILITATION (No. of Visits/Month) Information not always available			
					EXCELLENT	GOOD	POOR	EXCELLENT	GOOD	POOR	Not Finished	EXCELLENT	GOOD	POOR	8/Mth	4/Mth	2/Mth	1/mth
1	Aileu	Aileu Villa	Lausi	Rural Road (earth road)			✓		✓				✓					
2	Aileu	Laulara	Cotolau	Water System - Gravity		✓			✓				✓					
3	Aileu	Laulara	Cotolau	Maternity Clinic		✓			✓				✓					
4	Aileu	Laulara	Tohumeta	Rural Road (earth road)			✓			✓				✓				
5	Aileu	Liquidoe	Faturilau	Rural Road (earth road)		✓				✓				✓			✓	
6	Aileu	Liquidoe	Asubilitoho	Health Post		✓			✓				✓				✓	
7	Aileu	Remexio	Faisoi	School		✓			✓				✓					
8	Aileu	Remexio	Faisoi (Remexio)	Water System - Gravity		✓			✓				✓			✓		
9	Aileu	Remexio	Acumau	Public Bathroom at Community Centre		✓				✓			✓					
10	Aileu	Remexio	Hautoho	Water System - Gravity		✓			✓				✓				✓	
11	Viqueque	Uato Lari	Vesoru	Shallow Well		✓				✓				✓	✓			
12	Viqueque	Uato Lari	Vesoru	Residence - Health Personnel		✓			✓				✓			✓		
13	Viqueque	Uato Lari	Babulo	Water System - Gravity		✓				✓			✓			✓		
14	Viqueque	Uato Lari	Afaloicai (Uatu Lari)	Water System - Gravity		✓			✓				✓			✓		
15	Viqueque	Uato Lari	Afaloicai (Uatu Lari)	Residence - Health Personnel		✓			✓				✓			✓		
16	Viqueque	Uato Lari	Uaitame	Rural Road	✓				✓				✓			✓		
17	Viqueque	Viqueque Villa	Fatu Dere	Primary School		✓					✓		✓			✓		
18	Viqueque	Viqueque Villa	Maluro	Mini Market		✓					✓		✓			✓		
19	Viqueque	Viqueque Villa	Uma Uain kraik	Rural Road (gravel road)		✓			✓				✓			✓		
20	Viqueque	Viqueque Villa	Uma Quic	Shallow Well		✓			✓				✓		✓			
21	Ermera	Letefoho	Eraulo	Bridge - concrete		✓		✓				✓				✓		
22	Ermera	Letefoho	Haupu	Water System - Gravity	✓			✓					✓			✓		
23	Ermera	Letefoho	Goulolo	Water System - Gravity		✓				✓			✓			✓		
24	Ermera	Letefoho	Catrai-Leten	Water System - Gravity		✓			✓				✓			✓		
25	Ermera	Letefoho	Lauana	Water System - Gravity		✓			✓				✓			✓		
26	Ermera	Letefoho	Haupu	Water System - Gravity		✓			✓			✓				✓		
27	Ermera	Railaco	Matata	Water System - Gravity	✓						✓		✓			✓		
28	Ermera	Railaco	Lihu	Water System - Gravity		✓					✓		✓			✓		
29	Ermera	Atsabe	Baboe Leten	Residence - Teachers		✓			✓				✓		✓			
30	Ermera	Atsabe	Laclo	Water Channel (secondary/distribution channel) - Stone Masonry		✓				✓			✓			✓		
31	Ermera	Atsabe	Malabe	Box Culvert		✓			✓				✓			✓		
32	Ermera	Atsabe	Leimea Leten	Water System - Gravity		✓			✓				✓			✓		
33	Ermera	Atsabe	Malabe	Water System - Gravity		✓			✓				✓			✓		
34	Ermera	Atsabe	Paramin	Drainage - stone masonry		✓			✓				✓				✓	
35	Ermera	Atsabe	Tiarlelo	Water Channel (secondary/distribution channel) - Stone Masonry		✓		✓					✓			✓		
36	Ermera	Ermera	Ponilala	Water System - Gravity		✓			✓				✓			✓		
37	Ermera	Ermera	Ponilala	Health Post		✓			✓				✓				✓	
38	Covalima	Maucatar	Ogues	Rural Road (gravel road)		✓			✓				✓		✓			
39	Covalima	Maucatar	Ogues	Water System - Gravity		✓			✓				✓					
40	Covalima	Suai	Camenaca	Water System - Pump		✓			✓				✓			✓		
41	Covalima	Suai	Debos	Shallow Well		✓			✓				✓					
42	Covalima	Maucatar	BeleCasac	Drainage - stone masonry		✓			✓				✓					
43	Covalima	Tilomar	Casabuac	Water System - Pump		✓			✓				✓		✓			
44	Covalima	Tilomar	Lalawa	Water Channel - Stone Masonry	✓				✓				✓			✓		
45	Covalima	Fohorem	Dato Rua	Drainage - stone masonry			✓			✓				✓	✓			
46	Covalima	Fohorem	Fohorem	Water System - Gravity		✓			✓				✓				✓	
47	Covalima	Fohorem	Lactos	Plat Deker (concrete slab)		✓			✓				✓					
48	Covalima	Fatumea	Fatumea	Water System - Gravity		✓			✓				✓		✓			
49	Covalima	Fatumea	Fatumea	Rural Road			✓		✓				✓		✓			
50	Covalima	Fatumea	Fatumea	Mini Market		✓			✓				✓		✓			
51	Liquica	Bazartete	Tibar	Primary School		✓			✓				✓			✓		
52	Liquica	Bazartete	Fahilebu	Rural Road (earth road)		✓			✓				✓			✓		
53	Liquica	Bazartete	Maumeta	Water System - Gravity		✓			✓				✓			✓		
54	Liquica	Bazartete	Fatumasi	Water System - Gravity		✓			✓				✓			✓		
55	Liquica	Liquica	Hatuquesi	Water System - Gravity		✓				✓			✓			✓		
56	Liquica	Liquica	Luculai	Rural Road (earth road)			✓		✓				✓			✓		

ANNEX 5 – BRIEF SUB-PROJECT REPORTS

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

The sub-projects are presented in numerical order based on the Technical Evaluation's coding system, which is derived from the PNDS MIS.

(available upon request – please note: only some Sub Project Reports are available in English)

ANNEX 6 - KEY CONSTRUCTION ISSUES UPDATE

Following is a continuation of Section 8.6 of the 2016 Technical Evaluation Final Report. This is an update to Annex 6 of the 2015 report. On the left of the following tables are the percentages of 2015 SPs that contained the construction problems as listed in the middle column. The right hand side provides the 2016 update.

1 Steel Reinforcement and Concrete (all Sub-project Types unless noted otherwise.)

2015 %	Remarks	2016 %
100%	Missing/short development length in reinforcing (Building and Road)	-
100%	Missing anchors, foundation to ground beam/column to wall (Building)	-
100%	Improperly bent reinforcing cage tie bars (Building)	17%
56%	Exposed/shallow reinforcing steel (Building and Road)	5%
56%	Honeycombing in concrete	33%
29%	Poorly mixed concrete (Building, Water Supply and Road)	23%
75%	Undersized concrete column/beam (Building)	17%

2 Building

2015 sample: 29 SP
2016 sample: 12 SP

2.1 Roof/Truss

2015 %	Remarks	2016 %
14	Inadequate overlap of roof sheeting	-
31	Improper connection of roof to truss (no cleat, etc.)	17
14	Unreinforced splices in truss members	-
38	Missing steel strapping	17
31	Use of nails rather than bolts	17
10	Undersized/missing truss members	17
34	Improper connection of truss to ring beam	17

Many Community Project Proposals did not contain adequate drawings for the village implementation committee and their skilled/semi-skilled labourers to be able to produce proper trusses and roof structures. Many installations were seen to follow local building practices, most of which will not withstand major seismic events or cyclonic winds. Many sub-project buildings had ceilings installed which prevented thorough inspections of the upper structure. Some of the percentages above may be low for this reason.

Recommendation 12: The Technical Construction Standards (TCS) should be reviewed to ensure that the building construction methodologies to avoid these common deficiencies are shown in clear, concise drawings and details.

2.2 Sanitary Facilities

2015 %	Remarks	2016 %
28	No water connection to public system	-
17	Poor drainage/ponding on floor	33
13	Exposed plastic pipe	-
41	No access lid to septic tank	17
3	High water table in septic tank	-

There appears to be an improvement in many of the sanitary facilities areas.

2.3 Electrical

2015 %	Remarks	2016 %
10	No junction box at wiring connections	-
3	Low/unattached wiring in public area	-
7	Wiring installed but not energized	-

All electrical installations viewed in the 2016 audit had been installed properly.

2.4 Miscellaneous

2015 %	Remarks	2016 %
10	Broken mechanical fixtures	33
6	No handicap ramp/too steep	-
52	Poor drainage around bldg.	17

Two of six buildings were equipped with faulty faucets that were already leaking or broken. The floor in two toilets was poorly sloped.

Recommendation 13: PNDS should review the specifications for mechanical fixtures and compile a list of brands or manufacturers whose products consistently fail within short periods of time, putting them on a Non-Approved List.

3 **Bridge**

2015 sample 4 sub-projects
2016 sample 1 sub-project

3.1 Layout

2015 %	Remarks	2016 %
25	Inadequate depth of foundation	-
25	Abutment and wingwall design is lacking	-
50	Poor drainage around apron	100

Few firm conclusions can be drawn from a single bridge SP evaluated in 2016.

4 Water

2015 sample 15 sub-projects
2016 sample 26 sub-projects

4.1 Layout

2015 %	Remarks	2016 %
7	Poor site selection for infrastructure	7
20	Erosion protection around catchment facilities	20
33	Fence around catchment facilities	47
13	Watershed protection	40

4.2 Reservoir

2015 %	Remarks	2016 %
20	No cleanout/overflow	-
20	Improper lid/no lock	7
27	Valve box issues	-
47	Ease of maintenance (steel rungs, etc.)	40

4.3 Pipe Network

2015 %	Remarks	2016 %
53	Pipes are not buried	53
20	Poor pipe connections	27
47	Lack of/inappropriate pipe support	33

4.4 Tapstands/Miscellaneous

2015 %	Remarks	2016 %
7	Mechanical fixtures broken or leaking	7
7	Tapstand floor not sloped	7
80	Poor drainage around public areas	33
13	Concrete floor poorly constructed/cracked	13

Similar to bridges, water supply sub-projects frequently involve specialized knowledge and experience. Some of the parameters above show little change from last year; most of these design/construction issues can use some improvements. Senior design/construction engineer or technicians should be identified who can assume wide-spread responsibilities for the design and construction excellence of these systems. Sector agencies should be consulted and, where possible, involved in the sub-projects.

Recommendation 14: National PNDS engineers should continue to check and verify water supply designs. More frequent construction inspection visits should occur.

5 Road, Drainage and Retaining Wall

2015 sample 5 sub-projects
2016 sample 14 SP

5.1 Layout and Construction

2015 %	Remarks	2016 %
20	Overly steep gradient	13
20	Improper materials	13
20	Lack of compaction	13

5.2 Pipe, Culvert and Channel

2015 %	Remarks	2016 %
20	Dimensions/layout	13
20	Improperly buried	-
20	Erosion protection	-

5.3 Retaining Wall

2015 %	Remarks	2016 %
20	Problems - Foundation/structural integrity	-
20	Lack of /Improper Batter	-
20	Missing Weep holes	13
40	Poor drainage at foot of wall	13

Last year's technical audit made recommendations that PNDS should avoid lengthy road or track improvement SPs and, for the most part, this appears to have been followed. Most of the SPs in the 2016 technical audit featured spot improvement works that were well done.

Recommendation 15: National PNDS engineers should continue to check and verify road improvement designs. More frequent construction inspection visits should occur.