## METHODOLOGY FOR THE SELECTION OF ROAD SUBPROJECTS

1. Following extensive data collection, a multi-criteria analysis (MCA) was used to make the final selection of the roads from the long list of roads to be the short list. Measures were used that reflected the likely impact of the roads on agricultural productivity, social and economic activity, the poor and on ethnic minorities. The primary objective remained the linking of productive districts to markets via NH14.

2. The data used were estimates based on district level data and the percentage of the district's roads the candidate roads represented and is outlined in Table 1 below. The scoring was based on the road's ranking - with 12 the best score and 1 the worst.

**Table 1: Road Subproject Screening**

| No | Theme | Description |
|---|---|---|
| 1 | Agricultural Productivity | Estimated crop tonnage available to the road, based on the tonnages of each expert crop produced by district and the percentage of the road length in the district represented by the candidate road. |
| 2 | Population served | Estimated population served by the candidate road based on populations of the districts served and the candidate road length as a percentage. |
| 3 | Rural population | Estimated rural population served by the candidate road based on populations of the districts served and the candidate road length. |
| 4 | Traffic count | 2015 traffic count on the candidate road. |
| 5 | Poor households | Estimate of the number of poor households served by the road (again based on district and road length data). |
| 6 | Ethnic minority population | Estimate of the number of poor households served by the road (again based on district and road length data). |
| 7 | Safeguards Compliance | All roads comply so this criteria does not discriminate. |
| 8 | Access to NH14 | All roads provide access to NH14 or equivalent. |

3. As all roads are expected to meet safeguard requirements, they were not ranked on this issue. The resulting scores are shown in Table 2. An overall score was calculated, weighting agricultural impact and traffic counts by a factor of two. The result confirmed a provisional list of roads given to provinces on the basis of agriculture data alone, and identifies the priorities for the selection of further roads on a competitive basis.

**Table 2: Selection of Five Roads based on Short Listing Criteria**

| | Kon Tum | Gia Lai | | | Dak Lak | | Dak Nong | | | Binh Phuoc | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Road no | 13 | 11 | 10 | 12 | 8 | 9 | 4 | 6 | 7 | 1 | 2 | 3 |
| Name | PR-675A | PR-665 | PR-670 | Chu Ty – Ia Nan Road | NR-29 | Cu Ne – Ea Sup | PR-685 | Road from NR-14 to Bu Prang | Le Thanh Tong Road | PR-756 | PR-756B&C | Dong Tam – LocThinh |
| Access to NH14 | 0 | 5 | 5 | 0 | 5 | 5 | 5 | 5 | 5 | 5 | 5 | 5 |
| Improved border access | 5 | 5 | 0 | 0 | 2 | 2 | 0 | 5 | 0 | 5 | 0 | 0 |
| Traffic count | 6 | 5 | 2 | 4 | 7 | 3 | 9 | 12 | 1 | 11 | 10 | 8 |
| Agricultural Impact | 9 | 12 | 11 | 3 | 6 | 8 | 2 | 10 | 5 | 7 | 4 | 1 |
| Population impacted | 6 | 8 | 11 | 1 | 9 | 4 | 3 | 5 | 10 | 12 | 7 | 2 |
| Rural population | 6 | 10 | 11 | 1 | 9 | 5 | 4 | 8 | 3 | 12 | 7 | 2 |
| Poor households | 12 | 9 | 11 | 6 | 8 | 7 | 4 | 10 | 3 | 5 | 1 | 2 |
| Ethnic minorities | 9 | 10 | 12 | 5 | 11 | 8 | 3 | 7 | 4 | 6 | 1 | 2 |
| Overall ranking | 7 | 10 | 9 | 1 | 8 | 6 | 4 | 12 | 3 | 10 | 5 | 2 |
| Selection | 1 | 1 | | | 1 | | | 1 | | 1 | | |

## A. ENGINEERING STUDY

### 1. Scope

4. Once the short list of Project roads was selected, surveys and investigation were carried out during project preparation for the preliminary design - upgrading and (re)construction. The scope of the project preparation technical assistance (PPTA) was limited to the preliminary design and a feasibility study of road and bridge upgrading, rehabilitation and construction.

5. The design for road upgrading and construction works was based on applicable Viet Nam road design standards TCVN 4054 - 2005. Bridges were designed following bridge design standards 22TCN 272-05 and other applicable standards.

6. Cost estimates were based on 2016 rates of the applicable province. The rate analysis followed cost norms.

7. The engineering appraisal included surveys of the existing road conditions. The appraisal included the study of alternative alignments where this might avoid built-up areas or market centres that would involve significant resettlement, or where realignment might improve road safety and performance.

### 2. Surveys and Investigation

8. Surveys and investigations were undertaken for engineering study and preparation of preliminary design for upgrading the project roads. The extent of the surveys was directed to ensuring consistent information for technical appraisal and assessment of treatment alternatives. Some of the surveys and investigations varied with the project roads, depending on the existing situation and thus the treatment requirements.

#### a. Topographic Surveys

8. Topographic surveys were undertaken to collect information and details that would enable the Consultant to design and provide cost estimates for each road section. Generally a corridor 15m on either side of the centre-line of the existing carriageway was surveyed. However, this was further extended where warranted due to site conditions by 5 – 10 m.

9. Full cross-sections were taken at regular intervals depending on the topography. Existing features such as roads/track, houses, trees, cultivated limits, utilities, water courses, relative heights and depth, depressions, earth embankment, bank and other features present within the project corridor were recorded. This information is also important for the social and environmental studies.

#### b. Hydrological Study

10. The hydrological study was carried out based on secondary hydro-meteorological data collected from relevant institutions, documents, guidelines and reports. The topography of the DTA region is quite diversified and there are distinct climatic subregions with different rainfall characteristics. There is a rainy season from May to October during which 80% or more of the annual rainfall occurs. The dry season lasts from November to April. Flooding usually occurs between July and November. Many project road sections cross watersheds and large streams. Large and medium span bridges are designed to a one percent probability of overtopping (100 year flood), while small span bridges, culverts and the roadbed is designed for a four percent probability.

#### c. Road condition Survey

11. A preliminary geological study was undertaken for each road and all culverts and bridges to assess the pavement, roadbed and construction material resources. The survey included

terrain, physical inspection of soils and rock, and a review of published material about the local geology.

### d. Geological Assessment

12. The scope of the investigation involved measuring and mapping of geological factors on the road up to 30m each side of the centreline. The main task of geological evaluation along the route was carried out on the basis of observing the natural and artificial outcrop determining the distribution of the rocks and the preliminary assessment of geological conditions in the area.

### e. Pavement Condition

13. Pavement conditions were assessed by direct observation based on the Design Process for flexible pavement - 22 TCN 211-06. Forms of damage were assessed and categorized based on descriptions and observations in the field. The degree of damage is assessed, mapped and recorded.

### f. Pavement Structure and Sub grade Soils

14. Pits were excavated at the edge of the road done at two kilometre intervals to determine the type and thickness of the existing pavement and subgrade. The locations of the pits were chosen to ensure they contains the most characteristics of the road surface for that route segment according to the instructions 22 TCN 263 – 2000.

15. Dynamic Cone Penetrometers (DCP) tests were conducted in accordance with the provisions of the DCP manual provided by Institute of Transport Science and Technology. DCP tests are conducted in the structured pit and test the upper layer.

## B. BORROW PITS AND CONSTRUCTION MATERIALS RESOURCES SURVEY

16. The survey identified locations for borrow pits (areas where material for building the road embankment and pavement sub-base could be sourced) and the likely ease of exploitation and distance material would need to be transported. Areas where surplus or unsuitable material could be dumped were also identified. Certificates were obtained from the required agencies to enable material to be extracted or dumped.

## C. GEOLOGICAL STUDY OF BRIDGE SITES

17. A geological study of bridge sites required on the project roads was undertaken. A technical study of the bridge sites along with bridge types was carried out at the outset which enabled design of the bridges. A part to this was assessment of existing bridges to determine the level of intervention (e.g. maintenance, rehabilitation), if any required. An engineering survey was carried out for all new bridge sites to prepare a preliminary design.

## D. AGREED LIST OF SUBPROJECTS

18. The following road subprojects were selected for inclusion in the Project.

**Table 3: Selected Road Subprojects**

| Province | Subproject |
|---|---|
| Binh Phuoc | 50.16 km of Provincial Road (PR) 756 in Loc Ninh, Chon Thang and Hon Quan |
| Dak Lak | 40 km of National Highway (NH) 29 in Cu M'Gar and Krong Buk districts; |
| Dak Nong | 37.5 km of PR 686 and PR 681 in Dak Song and Tuy Duc districts; |

| | |
|---|---|
| Gia Lai | 65.5 km of PR 665 in Chu Prong district; |
| Kon Tum | 70.2 km of PR 675 A in Ia H'Drai and Chu Prong districts. |

19. Table 4 shows the final roads subprojects' civil works contract packaging.

**Table 4: Road Subproject Contract Packaging**

| Out put 1 | NCB | | | Total subproject |
|---|---|---|---|---|
| | Package | Name | Value ( $ mil ) | |
| Kon Tum | 1 | Upgrade from Km22 to Km63 PR675A (include of 7 new bridges) | 8.91 | |
| | 2 | Upgrade from Km63 to Km81 PR675A; and Upgrade Km0 to Km14+200 PR675A (include of 3 new bridges) | 8.05 | **16.96** |
| Gia Lai | 1 | Upgrade from Km0 to Km38 PR665 | 6.99 | |
| | 2 | Upgrade from Km38 to Km65.5 RP665 | 7.78 | **14.77** |
| Dak Lak | 1 | Upgrade from Km186 to Km206 NR29 | 7.77 | |
| | 2 | Upgrade from Km206 to Km226 NR29 | 7.77 | **15.54** |
| Dak Nong | 1 | Upgrade from Km0 to Km14 (TL686) and 1 new bridge; and upgrade from Km31+500 to Km35+500 (PR681) | 8.34 | |
| | 2 | Upgrade from Km139 to Km158 (NR14C old) | 7.74 | **16.08** |
| Binh Phuoc | 1 | Upgrade from Km0 to Km31 PR756 | 7.52 | |
| | 2 | Upgrade from Km31 to Km50+200 PR756 | 7.12 | **14.64** |
| **TOTAL** | **10** | | **77.99** | **77.99** |

## E. PRELIMINARY DESIGN

### 1. General

20. Preliminary design involved the following activities:

- Improvement to road geometry;
- Vertical Design;
- Horizontal Design;
- Roadbed Design;
- Pavement Design;
- Junction and Crossroad Design;
- Bridge Design;
- Small Drainage Works;
- Protection Works;
- Traffic and Road Safety.

21. The proposed works will use similar materials to the existing road or bridge unless these are not adequate and reconstruction with improvement is required.

## 2. Design Approach

22. The project roads offer various situations requiring upgrading and improvement including:

- Bituminous surface requiring pavement strengthening, rehabilitation;
- Deteriorated pavement requiring partial/full reconstruction;
- Roads difficult for heavy vehicles because of geometric constraints;
- Road with seasonal/reduced serviceability due to missing or deteriorating bridges or other factors; and
- Road sections comprising right of way and basic formation only.

23. A needs based approach was considered more appropriate for the design of road upgrading and improvement works. The design was customized based on the existing situation and the expected future traffic and designs were chosen for their technical soundness and cost effectiveness.

## 3. Applicable Standards

24. The Consultants followed applicable design standards and criteria including:

- Rural roads grade B (according to TCVN 10380: 2014
- Grade V Standards of Mountainous Roads (TCVN 4054-2005)
- Grade IV Standards of Mountainous Roads (TCVN 4054-2005)
- Grade III Standards of Mountainous Roads (TCVN 4054-2005)

25. Attention was given to the use of standard designs of the MOT, MOC, DOT and other design standards, guidelines and best practices with relevance to the local conditions, where they address the requirements in more appropriate manner. Due consideration also has been given to the construction and maintenance practices prevalent in the provinces.

## 4. Pavement Design Standards:

26. Cement concrete pavement was designed according to "Decision 3230 / QD - BGTVT, dated 12/14/2012 on moderate scale of traffic levels.

27. Design class A2 pavement was designed according to the design process of flexible pavement 22 BC 211-06.

## 5. Bridge Design Standards:

28. Bridge construction with reinforced concrete DUL and concrete complying with standard 22TCN 272-05

- Design load: A load HL93, pedestrian loads 3x10-3 Mpa;
- Frequency of floods design:
    - Small Span Bridge Design P = 4%, not navigable, floating trees.
    - Midium Span Bridge Design P = 1%, not navigable, floating trees.
- Earthquake Level: Earthquake Region V (MSK-64 scale), ground acceleration coefficient a = 0.0200 and the earthquake zone IV (MSK-64 scale), a = 0.0438 ground acceleration.

29. Culverts were designed with the following criteria:

- Culvert aperture follows the existing culvert status quo and in accordance with the hydrological cacultation;
- Length of culvert comply with the roadbed width;
- Frequency of culvert design 4%; and
- Design load: HL93

30. The following considerations were taken into account to address potential effects related to climate change:

- Sufficiency of road formation/embankment height
- Adequacy of waterways, soffit level for bridges
- Lining of road side drainage especially along hills
- Improvement of drainage on valley side to reduce erosion effect.
- Management of slope drainage
- Enhancement of road surface drainage by paved shoulder (e.g. single lane road)
- Erosion control measures

## 6. Safeguards

31. Once the shortlist of project roads had been determined, safeguard surveys were undertaken on the roads by three sets of teams. The surveys covered social and poverty impact assessments including gender and ethnic minorities, land acquisition and resettlement surveys and environmental surveys. The methodology, conclusions and recommendations of the safeguard work are reported in the safeguard documents.