Inception Report
FINAL
Consulting Services for
Technical Assistance to Help Upgrade Road Maintenance Management System to Road Management System in the State of Himachal Pradesh

Prepared by
HIMS Ltd., New Zealand
in Joint venture with SATRA Infrastructure Management Services Pvt. Ltd., India

Prepared for
Himachal Pradesh Road and Other Infrastructure Development Corp. Ltd
Project: Himachal Pradesh State Roads Project Ln.4860-IN/8199-IN

AUGUST 2016
INCEPTION REPORT - FINAL

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Contract No. HPSRP (Loan 4860-IN & 8199-IN)

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Prepared For

Himachal Pradesh Road and Other Infrastructure Development Corporation Limited

June 2016
Consulting Services for Technical Assistance to Help Upgrade Road Maintenance Management System to Road Management System in the State of Himachal Pradesh

### Quality Assurance Statement

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<td>Balamurali Alapati, Rajshekhar Gotimukul</td>
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<tr>
<td>Inception Report</td>
<td>Raj Mallela, Ashik Hussain</td>
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<td>For HPRIDC: 4860-IN &amp; 8199-IN</td>
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<td>Raj Mallela</td>
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ABBREVIATIONS

AMP     Annual Maintenance Plans
BI      Bump Integrator
BIS     Bridge Information System
BOT     Build, Operate and Transfer
BOOT    Build, Own, Operate and Transfer
BOLT    Build, Operate, Lease and Transfer
COTS    Commercial Off the Shelf
CRN     Core Road Network
DCL     Data Collection Limited, New Zealand
EIC     Engineer-in-Chief
FWD     Falling Weight Deflectometer
FY      Financial Year (Fiscal Year)
GIS     Geographical Information System
GoHP    Government of Himachal Pradesh
GOI     Government of India
GPS     Global Positioning System
HDM-4   Highway Development & Management Model Software
HIMS    HIMS Ltd, New Zealand
HO      Head Office
HPPWD   Himachal Pradesh Public Works Department
HPRADMS Himachal Pradesh Road Accident Data Management System
HPRIDC  Himachal Pradesh Road and Other Infrastructure Development Corporation Limited
HPSRP   Himachal Pradesh State Roads Project
IBRD    International Bank for Reconstruction and Development
IR      Inception Report
IRI     International Roughness Index
IT      Information Technology
LAN     Local Area Network
LRMS  Location Reference Management System
MDR   Major District Roads
MORD  Ministry of Rural Development, Government of India
NH    National Highway
NRRDA National Rural Road Development Agency
PMGSY Pradhan Mantri Gram Sadak Yojana
PMS   Pavement Management System
PWD   Public Works Department
RFP   Request for Proposal
RIS   Road Information System
RMS   Road Management System
RMMS  Road Maintenance Management System
RO    Regional Office
ROW   Right of Way
ROMDAS Road Measurement Data Acquisition System
RWFIMS Right-of-Way Features Information Management System
SATRA SATRA Infrastructure Management Services Pvt Ltd, India
SH    State Highways
SNP   Modified Structural Number
TIS   Traffic Information System
TNA   Training Needs Assessment
TOR   Terms of Reference
VR    Village Roads
WBM   Water Bound Macadam

HIMS  SATRA
1. **Executive Summary**

1.1 **Introduction**

The State Government of Himachal Pradesh (GoHP) through Government of India (GOI) had received a loan from International Bank for Reconstruction and Development (IBRD) for implementation of Himachal Pradesh State Roads Project (HPSRP) and intends to apply a portion of this loan to finance consultancy services for Technical Assistance to help and establish Road Management System (RMS), so that the same could be used for all state core road network (CRN) in Himachal Pradesh.

Himachal Pradesh Road and Other Infrastructure Development Corporation Limited (HPRIDC) awarded the consultancy services contract entitled, Consulting Services for Technical Assistance to Upgrade Road Maintenance Management System to Road Management System in the State of Himachal Pradesh, with Contract No. 4860-IN & 8199-IN to HIMS Ltd, New Zealand in joint venture with SATRA Infrastructure Management Services Pvt Ltd, India. The project commenced on 25 May 2016 with an expected completion date of 24 May 2018.

1.2 **Background of the Project**

The construction and maintenance of the State Highways (1,504 km), Major District Roads (2,139 km) and Rural Roads (27,575 km) totalling to 31,218 km are being looked after by the Himachal Pradesh Public Works Department (HPPWD). While NHs, SHs and MDRs carry the bulk of the traffic and are the principal carrier of economic activities, the State Core Road Network (CRN) comprises of SHs, MDRs and Other roads connecting NHs in the State with the rural and other roads, totalling to 4,200 km.

HPPWD has developed a computerised Road Maintenance Management System (RMMS) for rural roads, SHs, MDRs and Other roads. The software was developed under the Pradhan Mantri Gram Sadak Yojana (PMGSY), Rural Roads Project in 2007. Using the RMMS, HPPWD prepares an annual core road network condition report for rural roads and State roads. On the basis of an indicative budget, annual maintenance plans (AMPs) focussing on prioritizing periodic and rehabilitation works are prepared. The program is produced to a timeframe that meets the government's budgeting cycle and is revised in an iterative process as more accurate forecasts of the next FY budget become known.

However, the RMMS has its own limitations, particularly in the following functional aspects:

- It lacks necessary data fields required to prioritise higher class road network using economic evaluation;
- It lacks interfacing facilities with generally accepted maintenance needs tools such as HDM-4;
- Current system for data collection on 16 forms is too complex for rural roads.

HPPWD/HPRIDC intends to upgrade RMMS to RMS to significantly improve and rationalize decision making in planning, programming, funding, and procurement in the allocation of resources in road sector, in order to make the best use of public funds in preserving the road networks at an acceptable level of serviceability. The proposed upgrade of RMMS will
improve technical capacities, skills and management capabilities of HPPWD/HPRIDC thus improving the ability of the State Government of Himachal Pradesh (GoHP) and its subordinate agencies to manage efficiently and cost-effectively road maintenance and improvement activities.

1.3 Objectives of the Project

The overall objective of the Consultancy Services is to improve the quality and delivery of the services of the HPPWD in planning and programming. The more specific objectives are:

- Review the existing MS-Access based Road Information System in use at HQ and Field Units;
- Creation of additional fields and other information in RIS for its use in latest version of Highway Development & Management Model (HDM-4) software;
- Carry out any changes in the MS Access software for compatibility of data for producing reports/outputs as per the needs of the Client including enhancing Querying/Reporting;
- Develop and establish a middleware for linking modified RIS with HDM for smooth transfer of data between the two, or linking will include data import and export facilitates between the RMS and other applications and between various applications and report generation modules. RMS shall be configured and customized to meet technical, functional and administrative requirements of the Client;
- Carry out compliance/pilot testing and validation of all various modules/every sub-program/sub-systems and entire upgraded system after full interface with HDM software;
- Transfer skills and procedures to adequate number of staff in the HPPWD/HPRIDC for hand-holding and training of trainers to sustain the use of HDM and RMS during as well as after the end of these services;
- Providing implementation, operation and maintenance support (intermittent) to HPPWD and HPRIDC for 24 months after all mandatory testing and validations and third party user acceptance test-Response time of not more than 24 hours and rectification time not more than 72 hours. That will include trouble shooting, resolving any problems faced by the HPPWD/HPRIDC, minor modifications and refinements required in the system to improve its effectiveness based on the feedback information collected from its use, and removing bugs from the Software.

Thus along with the development and implementation of tools, improvements to the operational context and capacity building will be vital to the success of the project. This project will assist HPPWD/HPRIDC in the whole maintenance planning, programming and implementation cycle. The system applications adopted will, together with organisational capacity development, be instrumental in improving the overall efficiency and sustainability of HPPWD.

1.4 Scope of Services

The broad scope of the Project is to upgrade RMMS to RMS. The specific tasks included the following, which are summarised from the broad scope mentioned in the TOR:
Consulting Services for Technical Assistance to Help Upgrade Road Maintenance Management System to Road Management System in the State of Himachal Pradesh

- Study existing Road Maintenance Management System, assess and identify the strengths and weaknesses of the current data format, processes, planning and for maintenance management practices, decision-making process, organisational structure, and technical and managerial capabilities of the HPPWD/HPRIDC and propose changes aimed at providing adequate support for the RMS and ensuring that upgraded system will be efficient, effective and sustainable;
- Establish and implement Road Management System based on the need analysis and gaps of the current system;
- To provide training to identified HPPWD/HPRIDC staff in the use and maintenance of the system;
- Upgrade RMS with following components, using Commercial Off the Shelf (COTS):
  - GIS linked Road Information System (RIS);
  - Bridge Information System (BIS);
  - Pavement Management System (PMS);
  - Road Maintenance Management System (RMM)
  - Right-of-Way Features Information Management System (RWFIMS);
  - Traffic Information System (TIS);
  - HDM Planning Tool for road investment maintenance prioritisation.
- RMS should be capable of interfacing with other Geographic Information System (GIS) applications of GOHP like revenue maps and forest maps to facilitate easy access to tabular data residing within the RMS in future;
- Undertake a Road and Bridge Condition survey and collect required inventory data for input into the Road Management System (as per the quantities mentioned);
- Define required human resources and organisation structure to manage Road Management System (RMS) and define plans for training programs required to use the upgraded system.

1.5 Major Deliverables

Following are the major deliverables expected from this Project:

- Road Management System (RMS);
- Data collection procedures;
- Baseline network data;
- Training and Institutionalisation.

1.6 Road Management System (RMS)

Road Management System (RMS) will have the following sub modules (components):

- GIS linked Road Information System (RIS): This is a database linking different road data items. It will be accessed either from a centrally linked server or as a distributed database, which is independent of any network. GIS will be used as the basic platform
Consulting Services for Technical Assistance to Help Upgrade Road Maintenance Management System to Road Management System in the State of Himachal Pradesh

for all spatial features for road assets. Furthermore, the components will be accessible via an Internet Browser for reporting purposes only.

- **Bridge Information System (BIS):** This is a database linking different bridge data items. The BIS database shall contain sufficient attributes to maintain the bridge diary besides some 3 to 4 critical attributes to determine investment and rehabilitation needs in bridges.

- **Pavement Management System (PMS):** This will cover preservation of the existing road network as well as expansion which may cover new links, multi-laning, or capacity increases. The PMS will be developed using HDM planning tool, which will include deterioration prediction model for bituminous pavements. The processes will include, but are not limited to:
  - network-level planning;
  - project-level planning;
  - multi-project programming and budgeting;
  - optimization of projects under budget constraints;
  - overall network performance monitoring and evaluation against projected targets.

- **Routine Maintenance Management System (RMMS):** This application will be created for determining routine maintenance investments for sections not receiving periodic maintenance or improvements in that year.

- **Right-of-Way Features Information Management System (RWFIMS):** This application will be created to maintain all features such as structures, utility services both below and above ground, trees etc., within the Right of Way (ROW) and to generate strip maps showing these features. The proposed system shall integrate with the simple Infrastructure maps of roads available with HPPWD.

- **Traffic Information System (TIS):** This will be linked to the RIS. This will have facilities for storing regular and special traffic counts as well as the outcome from specific studies.

### 1.7 Data Collection Procedures

We will review the existing data collection procedures and in light of the additional data needs arising from the development of the RMS and prepare recommendations on the incremental improvement in data collection procedures, procurement of equipment and scheduling of surveys. We will prepare a road data collection manual including revised standard forms for data collection.

We will also review the data requirements for Rural Roads. Current practice of 16 Forms will be thoroughly studied and will be simplified as appropriate.

### 1.8 Data Collection

This includes data collection by visual surveys, deflection tests viz; Falling Weight Deflectometer (FWD), International Roughness Index (IRI) etc. as mentioned in Table 4-4.

In case of bridges, the condition survey will be limited to visual observations only. The Core Road Network (CRN) included under this survey is 3,890 km of SHs and MDRs and 310 km of other category roads.
Table 1-1: Data Collection Details

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<th>Method /Equipment</th>
<th>Year 1</th>
<th>Year 2</th>
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<td>Consultant</td>
<td>HPPWD</td>
<td>Consultant</td>
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<td>GPS referencing</td>
<td>Consultant’s GPS Equipment</td>
<td>100% (5,995 km)</td>
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<td>Inventory of pavements</td>
<td>HPPWD ROMDAS Equipment</td>
<td>830 km</td>
<td>3,370 km</td>
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<td>Pavement composition</td>
<td>Consultant’s Test pit tools</td>
<td>200 locations over 830 km</td>
<td>As needed</td>
</tr>
<tr>
<td>Inventory of CD structures</td>
<td>Visual observations</td>
<td>5% cross check (200 km out of 830 km)</td>
<td>100%</td>
</tr>
<tr>
<td>Roughness</td>
<td>HPPWD ROMDAS Equipment</td>
<td>100% (4,200 km)</td>
<td>5% cross check (200 km of 830 km)</td>
</tr>
<tr>
<td>Surface distresses</td>
<td>Visual observations</td>
<td>830 km and 5% (200 km) cross check over remaining network</td>
<td>3,370 km</td>
</tr>
<tr>
<td>Pavement strength (FWD)</td>
<td>HPPWD FWD</td>
<td>830 km (800 points)</td>
<td>3,370 km</td>
</tr>
<tr>
<td>Bridge condition data</td>
<td>Visual observations</td>
<td>cross check of 25 bridges</td>
<td>100% (4,200 km)</td>
</tr>
<tr>
<td>Traffic counts</td>
<td>Manual counting</td>
<td>830 km (40 locations)</td>
<td></td>
</tr>
<tr>
<td>Axle load</td>
<td>HPPWD Weigh Pads</td>
<td>830 km (40 locations)</td>
<td></td>
</tr>
<tr>
<td>Road user costs</td>
<td>Manual</td>
<td>830 km (20 locations)</td>
<td></td>
</tr>
</tbody>
</table>

1.9 Training and Institutionalisation of RMS

A comprehensive training will be provided on the operation and maintenance of RMS and data collection processes.

At present HPPWD is not having good institutional set-up to sustain the present RMMS system. It is manned at HPPWD HQ by 1-2 junior level staff. We will study the present institutional system and recommend best institutional mechanism for full sustainability of the new RMS in HPPWD/HPRIDC.
1.10 **Conclusion**

The enhanced RMS will assist HPPWD/HPRIDC to effectively plan and prioritize their capital and maintenance works on its road network as well as report on its condition and make efficient use of the resources. The RMS will enhance the capabilities of the HPPWD/HPRIDC by providing a source of readily accessible, relevant and valid information on the road system as well as improved support for decision-making by providing analytical tools. The data collection procedures and institutional framework to be developed under this assignment are aimed at providing adequate sustainability to RMS.
2. Introduction

2.1 Introduction

The State Government of Himachal Pradesh (GoHP) through Government of India (GOI) had received a loan from International Bank for Reconstruction and Development (IBRD) for implementation of Himachal Pradesh State Roads Project (HPSRP) and intends to apply a portion of this loan to finance consultancy services for Technical Assistance to help and establish Road Management System (RMS), so that the same could be used for all state core road network (CRN) in Himachal Pradesh.

Himachal Pradesh Road and Other Infrastructure Development Corporation Limited (HPRIDC) awarded the consultancy services contract entitled, Consulting Services for Technical Assistance to Upgrade Road Maintenance Management System to Road Management System in the State of Himachal Pradesh, with Contract No. 4860-IN & 8199-IN to HIMS Ltd, New Zealand in joint venture with SATRA Infrastructure Management Services Pvt Ltd, India. The project commenced on 25 May 2016 with an expected completion date of 24 May 2018.

2.2 Outline of the Inception Report

This Inception Report (IR) details the methodology and work plan intended to adopt for completing the tasks detailed in the TOR, and highlights any changes from our original proposal.

The work plan has been updated to show actual or provisional dates for each of the milestones and the expected outcomes.

This inception report covers in detail the following:

- The background to the project;
- Objective and Scope of services;
- Mobilisation of the project staff;
- Our understanding of the project;
- Our methodology;
- The updated Work Plan and Staff schedule.

2.3 Background for the Project

The construction and maintenance of the State Highways (1,504 km), Major District Roads (2,139 km) and Rural Roads (27,575 km) totalling to 31,218 km are being looked after by Himachal Pradesh Public Works Department (HPPWD). While NHs, SHs and MDRs carry the bulk of the traffic and are the principal carrier of economic activities, the State Core Road Network (CRN) comprises of SHs, MDRs and Other roads connecting NHs in the State with the rural and other roads, totalling to 4,200 km.

HPPWD has developed a computerised Road Maintenance Management System (RMMS) for rural roads, SHs, MDRs and Other roads. The software was developed under the Pradhan
Mantri Gram Sadak Yojana (PMGSY), Rural Roads Project in 2007. Using the RMMS, HPPWD prepares an annual core road network condition report for rural roads and State roads. On the basis of an indicative budget, annual maintenance plans (AMPS) focusing on prioritizing periodic and rehabilitation works are prepared. The program is produced to a timeframe that meets the government’s budgeting cycle and is revised in an iterative process as more accurate forecasts of the next FY budget become known.

However, the RMMS has its own limitations, particularly in the following functional aspects:

- It lacks necessary data fields required to prioritise higher class road network using economic evaluation;
- It lacks interfacing facilities with generally accepted maintenance needs tools such as HDM-4;
- Current system for data collection on 16 forms is too complex for rural roads.

HPPWD/HPRIDC intends to upgrade RMMS to RMS to significantly improve and rationalize decision making in planning, programming, funding, and procurement in the allocation of resources in road sector in order to make the best use of public funds in preserving the road networks at an acceptable level of serviceability. The proposed upgrade of RMMS will improve technical capacities, skills and management capabilities of HPPWD/HPRIDC, thus improving the ability of the State Government of Himachal Pradesh (GoHP) and its subordinate agencies to manage efficiently and cost-effectively road maintenance and improvement activities.

2.4 Objectives of the Project

The overall objective of the Consultancy Services is to improve quality and delivery of the services of HPPWD in planning and programming. The more specific objectives are:

- Review the existing MS-Access based Road Information System in use at HQ and Field Units;
- Creation of additional fields and other information in RIS for its use in latest version of Highway Development & Management Model (HDM-4) software;
- Carry out any changes in the MS Access software for compatibility of data for producing reports/outputs as per need of the Client including enhancing Querying/Reporting;
- Develop and establish a middleware for linking modified RIS with HDM for smooth transfer of data between the two or linking will include data import and export facilitates between the RMS and other applications and between various applications and report generation modules. RMS shall be configured and customized to meet technical, functional and administrative requirements of the Client;
- Carry out compliance/pilot testing and validation of all various modules/every sub-program/sub-systems and entire upgraded system after full interface with HDM software;
- Transfer skills and procedures to an adequate number of staff in the HPPWD/HPRIDC for hand-holding and training of trainers to sustain the use of HDM and RMS during as well as after the end of these services;
- Providing implementation, operation and maintenance support (intermittent) to HPPWD and HPRIDC for 24 months after all mandatory testing and validations and
third party user acceptance test. Response time of not more than 24 hours and rectification time not more than 72 hours. That will include trouble shooting, resolving any problems faced by HPPWD/HPRIDC, minor modifications and refinements required in the system to improve its effectiveness based on the feedback information collected from its use, and removing bugs from the Software.

Thus along with the development and implementation of tools, improvements to the operational context and capacity building will be vital to the success of the project. This project will assist HPPWD/HPRIDC in the whole maintenance planning, programming and implementation cycle. The system applications adopted will, together with organisational capacity development, be instrumental in improving overall efficiency and sustainability of HPPWD.

2.5 Scope of Services

The broad scope of the Project is to upgrade RMMS to RMS. The specific tasks included the following, which are summarised from the broad scope mentioned in the TOR:

1. Study existing Road Maintenance Management System, assess and identify strengths and weaknesses of the current data format, processes, planning and for maintenance management practices, decision-making process, organisational structure, and technical and managerial capabilities of the HPPWD/HPRIDC and propose changes aimed at providing adequate support for the RMS and ensuring that upgraded system will be efficient, effective and sustainable;

2. Establish and implement Road Management System based on the need analysis and gaps of the current system;

3. To provide training to identified HPPWD/HPRIDC staff in the use and maintenance of the system;

4. Upgrade RMS with following components, using Commercial Off the Shelf (COTS):
   - GIS linked Road Information System (RIS);
   - Bridge Information System (BIS);
   - Pavement Management System (PMS);
   - Road Maintenance Management System (RMMS);
   - Right-of-Way Features Information Management System (RWFIMS);
   - Traffic Information System (TIS);
   - HDM Planning Tool for road investment maintenance prioritisation.

5. RMS should be capable of interfacing with other Geographic Information System (GIS) applications of GOHP like revenue maps and forest maps to facilitate easy access to tabular data residing within the RMS in future;

6. Undertake a Road and Bridge Condition survey and collect required inventory data for input into the Road Management System (as per the quantities mentioned);

7. Define required human resources and organisation structure to manage Road Management System (RMS) and define plans for training programs required to use the upgraded system.
3. Mobilisation

3.1 Project Office

The Project Office has been setup at Shimla and the contact details of this office are:

- SATRA Infrastructure Management Services Pvt Ltd
- 3rd Floor, Goma Niwas
- Lower Chakkar
- Shimla – 171 005
- Tel: +91 177 2633 267
- e-mail: hprms@satragroup.in

3.2 Project Staff

The project Team Leader, Deputy Team Leader and Data Acquisition Specialist arrived in Shimla on 21 June 2016. The project kick-off meeting was held on 22 June 2016 with Chief Engineer cum Project Director and other senior officials of HPRIDC.

Staff needed for the inception phase, project start-up, and preparation of the Inception Report have also been mobilised.

A full time Office Manager has also been recruited and has started working from 23 May 2016.

3.3 Stakeholders Consultation

As part of the inception phase, initial discussions were held with most of the internal stakeholders. The objective of the discussions was to capture:

- Existing practices;
- Current status of the systems;
- Expectations on the proposed Road Management System (RMS).

The summary of the meetings is given in Annex I.

3.4 Services/Facilities Provided by HPPWD/ HPRIDC

HPRIDC has either provided or facilitated to obtain most of the required information at this stage. The details of the documents or reports or information collected and/or referred to are given in Annex II.

As stated in the TOR, the Review Committee, to provide effective technical guidance and to review Project outputs of these services, comprises of the following staff (refer to Table 3-1).
**Table 3-1: Review Committee**

<table>
<thead>
<tr>
<th>Designation</th>
<th>Role</th>
<th>Staff</th>
</tr>
</thead>
<tbody>
<tr>
<td>Addl. Chief Secretary (Public Works) to the GoHP</td>
<td>Chairperson</td>
<td>Narinder Chauhan</td>
</tr>
<tr>
<td>Engineer-in-Chief, HPPWD</td>
<td>Member</td>
<td>Er. A K Kohli</td>
</tr>
<tr>
<td>Chief Engineer-cum-Project Director, SRP, HPRIDC</td>
<td>Member</td>
<td>Er. R K Verma</td>
</tr>
<tr>
<td>Chief Engineer (PMGSY), HPPWD</td>
<td>Member</td>
<td>Er. A K Abrol</td>
</tr>
<tr>
<td>Zonal Chief Engineers, HPPWD</td>
<td>Review team</td>
<td></td>
</tr>
</tbody>
</table>

In addition, HPPWD/ HPRIDC appointed the following counterpart staff from HPPWD/ HPRIDC (refer to Table 3-2) to guide, administer and to facilitate the Project on daily basis:

**Table 3-2: Counterpart Staff**

<table>
<thead>
<tr>
<th>Designation</th>
<th>Staff</th>
</tr>
</thead>
<tbody>
<tr>
<td>Chief Engineer, Shimla Zone, HPPWD</td>
<td>Er. A K Chauhan</td>
</tr>
<tr>
<td>Chief Engineer, Mandi Zone, HPPWD</td>
<td>Er. Kehar Singh Thakur</td>
</tr>
<tr>
<td>Chief Engineer, Hamirpur Zone, HPPWD</td>
<td>Er. B R Dhiman</td>
</tr>
<tr>
<td>Chief Engineer, Kangra Zone, HPPWD</td>
<td>Er. S K Ganju</td>
</tr>
<tr>
<td>Superintend Engineer, HPRIDC</td>
<td>Er. Pawan Sharma</td>
</tr>
<tr>
<td>Executive Engineer, HPRIDC</td>
<td>Er. Aravind Sharma</td>
</tr>
<tr>
<td>Assistant Engineer, HPRIDC</td>
<td>Er. Rakesh Sharma</td>
</tr>
</tbody>
</table>
4. Project Appreciation

4.1 Our Understanding of the Project

We understand that the HPPWD/HPRIDC place great importance on this project, a project which will play a key role in delivering their obligations. The proposed RMS when deployed will assist HPPWD/HPRIDC not only in earmarking the budgets for road network maintenance on the basis of current and future predicted condition but also make available the updated and current information to the internal and external stakeholders.

4.2 Himachal Pradesh Road Network

Himachal Pradesh has a road network of over 34,345 km comprising of National Highways, State Highways, Major District Roads and Rural Roads. The HPPWD looks after construction and maintenance of National Highways, State Highways, Major District Roads and Rural Roads.

Table 4-1: Road Network Under HPPWD

<table>
<thead>
<tr>
<th>Road Type</th>
<th>Length (km)</th>
</tr>
</thead>
<tbody>
<tr>
<td>National Highways (NHs)</td>
<td>2,002.7</td>
</tr>
<tr>
<td>State Highways (SHs)</td>
<td>1,466.3</td>
</tr>
<tr>
<td>Major District Roads (MDRs)</td>
<td>2,397.7</td>
</tr>
<tr>
<td>Rural Roads (RRs)</td>
<td>27,790</td>
</tr>
<tr>
<td>Border Roads (BRs)</td>
<td>689</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>34,345.7</strong></td>
</tr>
</tbody>
</table>

The construction and maintenance of State Highways (1,466 km), Major District Roads (2,397 km) and Rural Roads (27,790 km) totalling to 31,654 km are being looked after by the Himachal Pradesh Public Works Department (HPPWD). While NHs, SHs and MDRs carry the bulk of the traffic and are the principal carrier of economic activities, the State Core Road Network (CRN) comprises of SHs, MDRs and other roads connecting NHs in State with the rural and other roads, totalling to 4,174 km.

List of SHs and MDRs as sourced from HPRIDC is given in Annex III.

4.3 Organisation Structure

4.3.1 HPPWD

HPPWD is engaged in planning, construction and maintenance of roads, bridges, ropeways and buildings (both residential and non-residential of various government departments) in the State. HPPWD further executes engineering work on behalf of
Local Bodies, Public Undertakings, Boards and other Institutions under Himachal Pradesh Government as “Deposit works”.

HPPWD is headed by the Engineer-in-Chief (EIC) with Headquarters at Shimla. Works and matters regarding Codes, Specifications, Planning and Monitoring, Inter-State Connectivity for the entire State and also the entire establishments of PWD are controlled by the Engineer-in-Chief. The department is divided into four zones namely, Mandi Zone, Hamirpur Zone, Shimla Zone and Kangra Zone at Dharmshala. All four zones are headed by Chief Engineers. Chief Engineer (National Highways) with headquarters at Shimla controls the Planning and Execution of works of National Highways traversing through the State.

Engineer-in-Chief (Quality Control and Design) acts as State Level Quality Coordinator for achieving quality parameters of works in the State. Material Testing Laboratories at State level and Zonal Laboratories are under his control. He conducts quality control checks throughout the State. He is in-charge for quality assurance, finalisation of Technical Instructions, Manual of Order, Codes and Specifications, Schedule of Rates, Training Programs, Workshops and allied fields etc.

Chief Engineer (PMGSY) is entrusted with monitoring, planning and day-to-day interaction with Ministry of Rural Development, Government of India (MORD) for the works of PMGSY and PMGSY funded projects through National Rural Road Development Agency (NRRDA).

Superintending Engineer (Electrical) controls works related to electrical installation, central heating, air conditioning, lifts, fire-fighting, fire alarm system, L.T. Sub-Station, Public Address system and CCTV systems in all Government residential and non-residential buildings.

Chief Architect is heading Architectural Wing at Shimla. This wing deals with all Architectural planning for buildings undertaken by PWD under North, South and Central Zones. In addition, this wing also undertakes consultancy jobs for corporate bodies and institutions, such as Regional Engineering College Hamirpur and Railways etc.

Superintending Engineer Arbitration Circle Solan deals with the entire arbitration cases of the Department.

A snapshot of the total strength of the HPPWD is given in Table 4-2

<table>
<thead>
<tr>
<th>Position</th>
<th>Number</th>
</tr>
</thead>
<tbody>
<tr>
<td>Engineer-in-Chief</td>
<td>1</td>
</tr>
<tr>
<td>Engineer-in-Chief (QC &amp; D)</td>
<td>1</td>
</tr>
<tr>
<td>Chief Architect</td>
<td>1</td>
</tr>
<tr>
<td>Chief Engineers</td>
<td>7</td>
</tr>
<tr>
<td>Superintending Engineers</td>
<td>35</td>
</tr>
<tr>
<td>Senior Architect</td>
<td>4</td>
</tr>
<tr>
<td>Executive Engineers</td>
<td>108</td>
</tr>
</tbody>
</table>
The organisation structure of HPPWD is given in Annex IV.

It is understood that currently HPPWD is operating RMMS with one or two staff.

4.3.2 **HPRIDC**

Himachal Pradesh Road & Other Infrastructure Development Corporation Limited (HPRIDC), a wholly owned Company of Government of Himachal Pradesh was incorporated in 1999 under the Companies Act, 1956, with the main objective of developing Roads, Bridges and other infrastructure in the State of Himachal Pradesh. HPRIDC is an apex organisation in Himachal Pradesh engaged in fostering the growth of infrastructure development in the State. The main objectives of the HPRIDC are:

- To construct, erect, build, re-model, execute, repair, develop, improve, administer, manage, control, maintain, demolish, grade, curve, pave, macadamize, cement, Highways, Expressways, Roads, Paths, Streets, Bridges, Sideways, Bypasses, Tunnels, Pavements, Reclamation, Improvements, Road over Bridges, Road under Bridges, Underground Road, or any other structural or architectural work and also to do other similar construction, levelling or paving work at present being a part of the activity of the Himachal Pradesh Public Works Department on Build Operate and Transfer (BOT) or Build Own Operate and Transfer (BOOT) or Build Operate Lease and Transfer (BOLT) basis/ or any other schemes in a manner which facilitate to undertake the above mentioned works;

- To facilitate and or undertake to construct, erect, build, renovate, develop, improve, manage, control maintain other infrastructure projects including those related to Power, Telecom, Information and Technology, Transmission of Electricity, Water Supply Projects, Irrigation Projects, Sanitation and Sewerage System, Housing, Building, Education, Hospitals, Tourism, Transport, Aviation, Ropeways, Rail System, Mining etc. or any other notified public facilities of similar nature on Build Operate and Transfer (BOT), Build Own Operate Transfer (BOOT), Build Operate Lease and Transfer (BOLT) basis / or any other scheme in a manner which will facilitate to undertake the above mentioned works in the State of Himachal Pradesh and other places;

- To act as a special purpose vehicle for resource mobilisation on behalf of the State Government for all infrastructure projects and also discharge obligations on this account on behalf of the State Government from revenue and other receipts accruing to the State Government from such projects.

<table>
<thead>
<tr>
<th>Architect</th>
<th>8</th>
</tr>
</thead>
<tbody>
<tr>
<td>Assistant Engineers</td>
<td>374</td>
</tr>
<tr>
<td>Assistant Architect</td>
<td>13</td>
</tr>
<tr>
<td>Junior Engineers</td>
<td>1,342</td>
</tr>
<tr>
<td><strong>Total Number of Staff</strong></td>
<td><strong>1,894</strong></td>
</tr>
</tbody>
</table>
4.4 Existing Practices and Data

A road classification is necessary to maximise allocation of funding in the most cost effective manner, particularly under funding constraints, and to assist in management and decision making for maintenance and upkeep of the network. HPPWD has also adopted road classification, as any other similar organisation in India.

4.4.1 Road Definitions

The definitions of roads and tracks, for the purposes of managing maintenance and upkeep of road network in Himachal Pradesh, are:

- A **paved road** is a formed cutting or embankment having a pavement with Bituminous (BT) surfacing.
- An **unpaved road** is a formed cutting or embankment with an earthen, katcha or WBM surface.
- A **track**, whether unformed or formed, has no pavement. A track is not a road.

4.4.2 Road Classification

The current functional classification for roads in Himachal Pradesh is:

- National Highways;
- State Highways;
- Primary Coverage Network - Major District Roads;
- Rural Roads (as included in the Core Network);
- Non-Core Network Roads.

4.4.3 Sub-Dividing the Road Network

Roads under the control of the PWD are both long (SH & MDR) and short (Village). It was suggested that for ease of management, these should be divided into shorter rather than longer road sections. For Panchayats roads are generally short and did not require further sectioning. Therefore, no matter who the responsible authority is, when sub-dividing and naming the road network, following criteria was suggested to take into account:

- A road is a portion of the network used for management and reporting purposes;
- The road name should clearly define the road from its start (origin) point to its end point;
- A road should have the same number throughout its full length (irrespective of whether it passes through villages or crosses block, district, division or sub-division boundaries);
- The road name should be in the direction of the road with the start at the first part of the name;
- Roads should start at road junctions with higher classification roads;
- Roads must be continuous and not duplicated or form part of or be included in any other road;
• The road name and number is to be unique within the State or each district; and
• The road is to have the same classification throughout its full length.

4.4.4 Road Names/Numbers

Road numbers are primarily for database records and need to be unique to interface with GIS. They allow connection of different data sets relating to a single road or section of road, in the same or different databases. Road numbers should be as simple as possible, be easy to use and unique to each road throughout the State. Roads should have the same classification and number for its full length, no matter if it crosses block, district, division or sub-division boundaries. Since blocks are an artificial boundary used for development of RMMS program and GIS, and do not relate to administrative centres of the PWD blocks, should not have any reference in the road numbering process.

Generally SH and MDR are long and may cross district and division boundaries, whereas, Rural Roads are generally short and confined to district or division areas. Therefore, road numbers should make reference to the district and division in which it is located.

For ease of management and reporting and particularly for the reallocation of rural roads to Panchayats, the road classification was followed as follows:

• National Highways;
• State Highways;
• Primary Core Network - Major District Roads (MDR);
• Secondary Core Network (Rural Roads);
• Other District Roads - PWD responsibility (ODR);
• Village Road - Panchayat responsibility (VR);
• Non-core network - Panchayat responsibility (PR).

The following road numbering was followed:

• State Highways SHxx
• Main District Roads MDRxx
• Other District Roads ODRxx
• Village Roads VRxxx
• Non-Core Network Roads PRxxx

xx and xxx = a unique number assigned for each road classification with no particular significance and continuous throughout the State for core network and district-wise for non-core network.

The typical road numbering is shown in Figure 4-1.
4.4.5 Link Numbering

To enable easy controllable management of data for each road, roads need to be subdivided into shorter manageable lengths called “Links”. Link lengths should generally be about 5 to 10 km in length and have their start and ends points at permanent easily definable locatable postings or defined boundaries.

Road links should start at permanent easily defined locations such as:

- road junctions;
- district boundaries;
- division boundaries;
- sub-division boundaries;
- bridge abutments;
- change in Responsible Authority;
- monuments/historic markers etc; or
- religious buildings, like temples/mosques.
For Core Road Network purposes, the road and link numbers are:

- State Highways \( \text{SHxx.zddsdyy} \)
- Main District Roads \( \text{MDRx.zddsdyy} \)
- Other District Roads \( \text{ODRx.zddsdyy} \)
- Village Roads \( \text{VRxxx.zddsdyy} \)
- Non-Core network Roads \( \text{PRxxx.zddsdyy} \)

Where:

- \( xx \) and \( xxx \) = a unique number in each road assigned uniquely with no particular significance for the whole State;
- \( z \) = designates the Responsible Authority for each link;
- \( dd \) = allotted Division number for each district;
- \( sd \) = allotted Sub-division number for each district;
- \( yy \) = the link number (consecutive number for each link along a road commencing from the origin).

For short roads, less than 5 km, splitting road into links is not really necessary. However, for standardisation of road numbering, links are to be included as they contain details of the Responsible Authority, Division and Sub-division through which the road passes.

### 4.4.6 Existing Data

HPPWD currently collects required data for RMMS, as follows:

**Road Inventory:**
- road name, hierarchy and location;
- road sections and sub-sections (links);
- road dimensions;
- pavement and surface types;
- pavement structure and treatment history;

**Road Condition**
- pavement surface condition;
- cross drainage condition;
- roadside condition;
- traffic by number and type; and
- pavement surface roughness.

The details of the standard formats for road data collection used are given in Annex V.
The one set of ROMDAS equipment being used consists of following components as mentioned in Table 4-3.

<table>
<thead>
<tr>
<th>Component</th>
<th>Purpose</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>Power Distribution Box</td>
<td>For supplying power to different hardware components and laptop</td>
<td></td>
</tr>
<tr>
<td>Hardware Interface</td>
<td>Core of the ROMDAS system integrating all hardware components</td>
<td></td>
</tr>
<tr>
<td>Software (ROMDAS)</td>
<td>To capture data from hardware interface and other directly connected components</td>
<td></td>
</tr>
<tr>
<td>Laptop</td>
<td>For holding ROMDAS software and provide communication ports to some components</td>
<td></td>
</tr>
<tr>
<td>Bump Integrator</td>
<td>For measuring roughness on rough roads</td>
<td></td>
</tr>
<tr>
<td>Programmable keyboards</td>
<td>For recording inventory and condition attributes</td>
<td>20 keys keyboard</td>
</tr>
<tr>
<td>GPS Receiver</td>
<td>For recording GPS coordinates of road centre lines</td>
<td></td>
</tr>
</tbody>
</table>

**4.5 Routine Maintenance Management System**

The Himachal Pradesh Public Works Department (HPPWD) is already using the existing Road Maintenance Management System (RMMS) for rural roads, SHs, MDRs & other roads. The software was developed under Pradhan Mantri Gram Sadak Yojana (PMGSY), Rural Roads Project in the State of Himachal Pradesh.

A Road Maintenance Management System (RMMS), also known as Road Information System (RIS), is information based computer package which facilitates maintenance management-planning tool, based on objective data, providing a systematic and uniform approach to Planning, Programming, and Budget. A brief description of the RMMS is given below based on our preliminary review. We understand RMMS was developed in Visual Basic as frontend and MS Access as backend Database with Crystal Reports as Reporting tool, with following objectives:

- Integrate all PWD road management activities from inventory to generation of reports;
- Help PWD in decision making process and ensure that road maintenance remains regular and timely;
- Assist PWD in Planning, Programming, Budgeting, Monitoring and Implementation of their Annual Maintenance Plan for their entire road network;
• Improve the present database in terms of integration of data with other data, security and accuracy of data by designing uniform database;
• Provide up to date information for senior management personnel for making effective decisions;
• Flexibility to accommodate changes for future enhancements from the current database to any Relation Database Management System with or without much changes to the existing database design;
• Operate under computer systems and software compatible with the existing systems being used by PWD.
• To have a uniform and user friendly interface for accessing.

Its main elements are:
• Basic Road Data;
• Pavement condition or performance model;
• Selection of intervention levels;
• Listing of priorities for maintenance (renewal and overlay)

HPPWD is currently preparing periodic and other maintenance using RMMS. The categories of road maintenance include:
• Routine Maintenance;
• Emergency Works;
• Periodic Maintenance; and
• Rehabilitation.

A schematic representation of the RMMS operations is given in Figure 4-2.
Figure 4-2: Maintenance Management System Operations

Once the data is entered into the system, based on a simple rating analysis, the maintenance needs are determined as shown below. The Road Priority Index (RPI) will be determined to assign the maintenance priority in case of budget constraints.
Consulting Services for Technical Assistance to Help Upgrade Road Maintenance Management System to Road Management System in the State of Himachal Pradesh

Figure 4-3: Criteria for Maintenance Needs in Existing RMMS

Some of the major shortcomings of the RMMS, derived from our initial quick review are:

- Most of the functionality including validation rules are hardcoded. Hence, editing of the source code is required in case of any changes even in data fields;
- Location reference management (editing, splitting or merging of links and roads) and history network changes are not maintained;
- Data entry is tedious (no bulk import facility provided);
- Interfacing with maintenance needs tools, such as HDM-4 is not provided for higher order roads;
- Linkage to GIS is either not developed or it is not functioning;
- Interfacing with other legacy systems, such as Project Management Information System (PMIS) is not provided (requires source code changes);
Facilities for recording actual maintenance performed or exclusion of committed projects sections from analysis are not provided;

The system architecture is old and obsolete in the current context;

The application development framework (Visual Basic) is obsolete and no support is available for Microsoft;

Other components, MS Access and Crystal Reports require major upgrade or possibly replacement.

- MS access is not suitable for multi user access; hence it is proposed to replace with latest RDBMS systems like SQL Server or Oracle.
- Upgrade of Crystal report version to the current version.

4.6 Major Deliverables

Following are the major deliverables expected from this Project:

- Road Management System (RMS);
- Data collection procedures;
- Baseline network data;
- Training and Institutionalisation.

4.7 Road Management System (RMS)

Road Management System (RMS) will have the following sub modules (components):

- GIS linked Road Information System (RIS): This is a database linking different road data items. It will be accessed either from a centrally linked server or as a distributed database, which is independent of any network. GIS will be used as the basic platform for all spatial features for road assets. Furthermore, the components will be accessible via an Internet Browser for reporting purposes only.

- Bridge Information System (BIS): This is a database linking different bridge data items. The BIS database shall contain sufficient attributes to maintain the bridge diary besides some 3 to 4 critical attributes to determine investment and rehabilitation needs in bridges.

- Pavement Management System (PMS): This will cover preservation of the existing road network as well as expansion which may cover new links, multi-laning, or capacity increases. The PMS will be developed using HDM planning tool, which will include deterioration prediction model for bituminous pavements. The processes will include, but are not limited to:
  - network-level planning;
  - project-level planning;
  - multi-project programming and budgeting;
  - optimization of projects under budget constraints;
  - overall network performance monitoring and evaluation against projected targets.
• Routine Maintenance Management System (RMMS): This application will be created for determining routine maintenance investments for sections not receiving periodic maintenance or improvements in that year.

• Right-of-Way Features Information Management System (RWFIMS): This application will be created to maintain all features such as structures, utility services both below and above ground, trees etc., within the Right of Way (ROW) and to generate strip maps showing these features. The proposed system shall integrate with the simple Infrastructure maps of roads available with HPPWD.

• Traffic Information System (TIS): This will be linked to the RIS. This will have facilities for storing regular and special traffic counts as well as the outcome from specific studies and also to interface with RADMS to access the road accidents data.

4.8 Data Collection Procedures

We will review the existing data collection procedures and in light of the additional data needs arising from the development of RMS and prepare recommendations on the incremental improvement in data collection procedures, procurement of equipment and scheduling of surveys. We will prepare a road data collection manual including revised standard forms for data collection.

We will also review the data requirements for Rural Roads. Current practice of 16 Forms will be thoroughly studied and will be simplified as appropriate.

Presently the existing RMMS is catering for rural roads, SH and MDRs. However, the maintenance requirements of SH and Rural roads are different. Rural roads may not require such large number of data items.

Hence, it is proposed to have separate data collection mechanism for State roads and Rural roads. A detailed mechanical means to collect the data is proposed for SH and MDRs and simplified manual data collection procedures for rural roads with minimal data attributes. The details of the simplified data collection items for rural roads will be detailed in Needs Analysis and System Architecture Report.

4.9 Data Collection

This includes data collection by visual surveys, deflection tests viz; Falling Weight Deflectometer (FWD), International Roughness Index (IRI) etc. as mentioned in Table 4-4. In case of bridges, the condition survey will be limited to visual observations only. The Core Road Network (CRN) included under this survey is 3,890 km of SHs and MDRs and 310 km of other category roads.

<table>
<thead>
<tr>
<th>Data</th>
<th>Method /Equipment</th>
<th>Year 1</th>
<th>Year 2</th>
</tr>
</thead>
<tbody>
<tr>
<td>GPS referencing</td>
<td>Consultant’s GPS Equipment</td>
<td>Consultant 100%</td>
<td>Consultant 100%</td>
</tr>
<tr>
<td></td>
<td>(5,995 km)</td>
<td>HPPWD</td>
<td>HPPWD</td>
</tr>
</tbody>
</table>
| Inventory of pavements        | HPPWD ROMDAS               | 830 km          | 3,370 km        | 100%
### Consulting Services for Technical Assistance to Help Upgrade Road Maintenance Management System to Road Management System in the State of Himachal Pradesh

#### 4.10 Training and Institutionalisation of RMS

A comprehensive training will be provided on the operation and maintenance of RMS and data collection processes. The detailed training plan with training schedule will be prepared as part of the subsequent deliverable Training Needs Assessment Plan Report.

At present HPPWD is not having good institutional set-up to sustain the present RMMS system. It is manned at HPPWD HQ by 1-2 junior level staff. We will study the present institutional system and recommend best institutional mechanism for full sustainability of the new RMS in HPPWD/HPRIDC.

---

#### Data | Method /Equipment | Year 1 Consultant | Year 2 Consultant | Year 1 HPPWD | Year 2 HPPWD
---|---|---|---|---|---
Equipment | | | (4,200 km) | | |
Pavement composition | Consultant’s Test pit tools | 200 locations over 830 km | As needed | As needed | |
Inventory of CD structures | Visual observations | 5% cross check (200 km out of 830 km) | 100% | 5% cross check (200 km out of 830 km) | 100%
Roughness | HPPWD ROMDAS Equipment | 100% (4,200 km) | 5% cross check (200 km of 830 km) | 100% (4,200 km)
Surface distresses | Visual observations | 830 km and 5% (200 km) cross check over remaining network | 3,370 km | 5% cross check (200 km) | 100% (4,200 km)
Pavement strength (FWD) | HPPWD FWD | 830 km (800 points) | 3,370 km | cross check at 20 locations | 100% (4,200 km)
Bridge condition data | Visual observations | cross check of 25 bridges | 100% (4,200 km) | | 100% (4,200 km)
Traffic counts | Manual counting | 830 km (40 locations) | | | 100% (4,200 km)
Axle load | HPPWD Weigh Pads | 830 km (40 locations) | | | 100% (4,200 km)
Road user costs | Manual | 830 km (20 locations) | | | |

The indicative list of 830 and 3,370 km as per the TOR is given in Annex VI.
5. Our Proposed Methodology

5.1 Methodology

Our proposed methodology has been reconsidered in light of our understanding through the discussions held and information collected from various stakeholders. The below described methodology elaborates each task to accomplish the scope of the work.

- Task Group 1: Assessment of current road maintenance management system;
- Task Group 2: Improvement in data collection and road information system;
- Task Group 3: Development of planning tools;
- Task Group 4: Preparation of annual road condition reports and rolling maintenance plans;
- Task Group 5: Road classification;
- Task Group 6: Transfer of skills to HPPWD/HPRIDC staff;
- Task Group 7: Ongoing Support;
- Task Group 8: Manuals, Technical Guidelines, and Completion Report;
- Task Group 9: Assess additional need for data collection equipment;
- Task Group 10: Institutional Set-Up in HPPWD;
- Task Group 11: Result Monitoring.

5.2 Task Group 1: Assessment of Current RMMS

5.2.1 Task 1.1: Mobilisation and Interactions with HPPWD/HPRIDC

The Project team has been mobilised for initiation of the assignment and familiarisation with the Project. The primary task included mobilisation of the Team Leader, Deputy Team Leader cum System Specialist and Road Data Acquisition and Data Interpretation Specialist along with required support staff.

The key focus of the task is to introduce the project team; including introduction and key outputs of previous and ongoing assignments related to the subject to the team. This task helps us in developing revised work plan for the project duration. This will then form the basis for making required changes in the overall plan based on the discussion and suggestions to be received from the stakeholders during the course of the Project.

5.2.2 Task 1.2: Comprehension of Existing Practices and Data

The existing practices and available data will be collected from various sources. The use of these data will be identified from the perspective of Planning, Budgeting and Programming. This task will also focus on methods used for data collection, collation, storage, validation, quality assurance and programme preparation.
5.2.3  **Task 1.3:  Appreciation of HPPWD Organisational Framework**

Our team would hold discussions with all implementing agencies and bodies of HPPWD, and collect baseline information regarding the present organisation, working procedure, delegation of powers and responsibilities and status of capability to implement RMS, and improve the project efficiency. This will help in appreciation of the present status of various aspects of the HPPWD organisational framework and institutional arrangement available for existing systems.

5.2.4  **Task 1.4:  Comprehension of Policy, Procedures and Planning**

Under this task all available policy, procedures, planning process and implementation work flow in the form of reports, documents and information etc will be identified, collected and studied. Integrated work flow of overall RMS will be discussed and analysed. Institutional framework to ensure successful policy development and implementation will be discussed along with implementation framework. This will be extended to understanding of organisational skills in road maintenance planning including implementation and monitoring.

5.2.5  **Task 1.5:  Submission of Inception Report**

Subsequent to collection of the existing practices and expectations from the RMS, data and processes as described above, realistic requirements to meet the project objectives and expected outcomes will be defined. The necessary changes to be derived from our understanding of actual field conditions and suggestions received from HPPWD and other relevant stakeholders, will be incorporated into our approach, methodology and work plan. We will then submit the Inception Report containing the revised methodology (if any) and work plan.

The report will become the basis for the remainder of the assignment.

5.2.6  **Task 1.6:  Comprehension of RMMS**

Our team will undertake a detailed desktop review of the existing RMMS. The current functionality of the RMMS against expectations of the HPPWD, gathered through various consultations as described above, will be compared to identify the shortcomings in the functionality of the RMMS. The current use of the system within HPPWD will be reviewed. The extent of implementation of maintenance programmes generated by RMMS in the past will be assessed. The outcome of this task will form the basis and will supplement system functionality stipulated in the TOR.

5.2.7  **Task 1.7:  Finalise the RMS System Architecture**

We propose to finalise RMS architecture, both system and deployment, based on the findings from the proposed discussions and reviews. A comprehensive “needs analysis” will be prepared and discussed. However, we have presented an indicative architecture of overall RMS, which will be discussed with HPPWD and required changes will be crafted to meet needs of HPPWD.
RMS High Level Software Architecture

Likely high level software architecture is presented below. This architecture will be mapped with current architecture and requirements, prior to finalisation:

![High Level Software Architecture Diagram]

**Figure 5-1: High Level Software Architecture**

The software architecture will consider the intention of HPPWD to share some information, particularly road network details and roadside amenities with wider stakeholders and road users.

**RMS Deployment Architecture**

Deployment architecture is conceptualised to meet wide spread presence of its offices of HPPWD. RMS will be designed to provide access to remote users through internet, whereas HO users can access through Local Area Network (LAN). Any necessary changes in the architecture will be performed considering the requirements of HPPWD.
Figure 5-2: Proposed RMS Deployment Architecture

We will consider providing for disaster recovery centre. The authentic utilisation of this server and possibility of recovery of data will be reviewed prior to finalising the disaster recovery framework.

However, the system architecture will be ensured to be in line with the overall IT and MIS policy of the State and the HPPWD.

Based on the discussions, it is understood that the entire IT infrastructure related to existing web based systems (like HP RADMS) is hosted outside HPPWD/HPRIDC offices at Government IT department. It is proposed to host the RMS also at the same location. Details of infrastructure required will be documented as part of RMS system Architecture Report.

5.2.8 **Task 1.8: Review Location Referencing System**

The CRN comprises of SHs, MDRs and other roads. We propose to review thoroughly the characteristics of the CRN prior to finalising the location referencing system.

The location referencing is an important part of RMS, as it allows HPPWD to manage data spatially and with respect to time. This is an important and meaningful analysis, which generally requires multi-year condition data of the same pavement segments to determine pavement deterioration trends and provide optimum preservation strategies. In addition, accurate referencing also allows overlaying condition indicators and other relevant parameters to identify sections in need of work, select appropriate interventions for those sections, and design specific treatments. Therefore, the quality of location referencing data is paramount for efficient RMS. Quality management practices include checks for the location data. Location referencing problems may make
it difficult to overlap different pavement indicators (e.g. roughness and cracking), develop time-series for performance prediction, link condition with traffic, etc.

A location referencing method refers to a technique used in the field or in the office to identify the specific location of an asset. Commonly used location referencing methods can be grouped in linear and geodetic (or spatial) reference methods. A location referencing system constitutes a set of procedures for determining and retaining a record of specific points in a transportation network. This system includes one or more location referencing methods, as well as procedures for storing, maintaining, and retrieving information about points and segments on the network. State-of-the-art referencing systems can handle more than one referencing method and datum.

Linear Referencing: The prevalent location referencing used in RMS applications is linear referencing. Linear referencing method consists of procedures for specifying a location as a distance, or offset, along a linear feature (road network), form a point with known location. Common linear location referencing methods include road/km stone, link-node, reference point / offset and road address.

Spatial Referencing: Use of spatial location referencing based on GPS is becoming more relevant as the technology becomes more affordable and accurate. Use of GPS to mark the location of distressed areas prevents some of the errors encountered by using km stone methods. Because the location is known in terms of coordinates, the relocation of a km stone or road realignment will not affect the true location of the distressed area. This mitigates the problem of losing historical data when a new segmenting system is implemented and aids with inter-agency data sharing because coordinates can be converted for use in other referencing schemes. The use of GPS also provides for easier data integration, allowing for the possibility of a more comprehensive and universal
location referencing system. Use of spatial/geodetic location referencing facilitates standardisation of data usage.

The location referencing system adopted in the earlier RMMS and currently practiced by HPPWD will be reviewed in greater detail. The review will be focused on system, terminology and approach being followed for location referencing. Any shortfall identified will be discussed with HPPWD and a suitable solution to mitigate the concerns will be provided by our experienced team. Extra care will be taken not to replace the existing practices but the focus will be to address the shortcomings in the existing practice of location referencing.

5.3 **Task Group 2: Improvement in Data Collection and RIS**

5.3.1 **Task 2.1: Data Review**

We propose to review existing data collection forms thoroughly and suggest the following:

- Simple formats for Rural roads;
- Detailed or improved formats for SHs, MDRs and NHs.

We will consider not only improvements to the data collection methods but also to the equipment and their calibration for hill roads.

5.3.2 **Task 2.2: Procurement / Upgrade of Data Collection Equipment**

We understand that HPPWD has been using ROMDAS equipment for collecting the inventory and condition data to populate and operate RMMS since 2008. Essentially, HPPWD has the following equipment (modules) of ROMDAS:

- Bump Integrator;
- GPS;
- Rating keyboards for inventory and condition data.

As per Clause 3.13 of TOR, following equipment will be made available by HPPWD/HPRIDC for this Project.

- ROMDAS Equipment for conducting inventory and roughness survey;
- Falling Weight Deflectometer (FWD) for conducting pavement strength survey;
- Portable Axle Weigh Pads for conducting traffic axle load survey.

It is, therefore, requested to make these equipment available within 5 months (i.e. by October 2016) from the commencement, as the Year 1 surveys will have to be completed by 9th month (February 2017).

The existing available equipment at HPPWD/HPRIDC was studied and analysed to check and validate its usability on the proposed data collection scope. The current status of the existing ROMDAS equipment and reasons for upgradation are explained below:
Consulting Services for Technical Assistance to Help Upgrade Road Maintenance Management System to Road Management System in the State of Himachal Pradesh

<table>
<thead>
<tr>
<th>S.No</th>
<th>Equipment</th>
<th>Purpose</th>
<th>Status</th>
<th>Remarks</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Existing ROMDAS Equipment</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>Bump Integrator (BI)</td>
<td>To Collect the Road Roughness data</td>
<td>BI is operational but not calibrated since very long as Z250 calibration profiler is not working.</td>
<td>Upgrade with latest version of bump integrator</td>
</tr>
<tr>
<td>2</td>
<td>GPS Pathfinder Pro XRS Receiver</td>
<td>To collect the GPS data of road assets and centreline</td>
<td>operational</td>
<td>Upgrade with the advanced version, as this may have compatibility issues with other upgrades</td>
</tr>
<tr>
<td>3</td>
<td>Proximity Sensor</td>
<td>Distance measurement instrument to record road chainage</td>
<td>operational</td>
<td>Upgrade with advanced version</td>
</tr>
<tr>
<td>4</td>
<td>Z250</td>
<td>To calibrate Bump Integrator</td>
<td>non-functional</td>
<td>Replace with new one</td>
</tr>
<tr>
<td>5</td>
<td>20 keys Keyboard</td>
<td>To record point and linear asset, and visual condition</td>
<td>Operational but not adequate to collect proposed data items in the current Project</td>
<td>Upgrade to 58 keys keyboard to collect required data items</td>
</tr>
<tr>
<td>6</td>
<td>ROMDAS System</td>
<td>A central system required to power, control and record data from all ‘add-on’ modules.</td>
<td>Obsolete and no support is provided</td>
<td>Upgrade to current version</td>
</tr>
<tr>
<td>7</td>
<td>Laptop with Operating System</td>
<td>To view and control survey activities</td>
<td>Obsolete and no support is provided</td>
<td>Upgrade to current version</td>
</tr>
</tbody>
</table>

**Additional Equipment Proposed**

<table>
<thead>
<tr>
<th>S.No</th>
<th>Equipment</th>
<th>Purpose</th>
<th>Status</th>
<th>Remarks</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Geometry</td>
<td>To capture road geometry characteristics like gradient, radius of curvature, cross-fall and other road geometry characteristics while surveying.</td>
<td>Not available</td>
<td>Availability of data items would enhance outputs from RMS</td>
</tr>
</tbody>
</table>

The Road Geometry data can be referenced with GPS coordinates for easy integration with GIS mapping software and Pavement Management System (PMS) module of.
Consulting Services for Technical Assistance to Help Upgrade Road Maintenance Management System to Road Management System in the State of Himachal Pradesh

<p>| | | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>proposed RMS.</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>ROW Video Camera</td>
<td>The ROW Video Camera is proposed to capture ROW video images of the road network. The date and time stamped videos will help HPPWD to review condition of the road network, missing road markings/signage’s and if any encroachments within the ROW etc.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Not Available</td>
</tr>
<tr>
<td>3</td>
<td>360° Video Camera (Optional)</td>
<td>ROW Images can be later reviewed using advanced mobile mapping software which allows users to take measurements (like road width, shoulder width, bridge spans, height of lamp post etc.) and GPS coordinates of assets (like Road, Median, Shoulder, Bridge, Culverts etc.) and events. The Measurements captured can be automatically added directly to GIS map layers and then exportable (e.g. export shape files for using in ArcGIS). This makes GIS mapping of visible infrastructure over a network very accurate and extremely efficient</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Additional benefits envisaged (Optional). To be decided by HPPWD/ HPRIDC</td>
</tr>
</tbody>
</table>

Hence, based on the above mentioned data requirement, the following upgrade options are suggested:

**Option-I: Full Upgrade with Complete Set**

- ROW Video Camera;
- Bump Integrator v2;
- High Resolution DMI;

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**hims SATRA**
- Trimble SPS461 GPS with GA810 Antenna;
- Industrial Mount Computer System;
- 58 Keys Rating Keyboard (USB);
- Geometry Unit;
- Z-250 (for calibration of BI);
- ROW or 360° Video Camera.
- Laptop

**Option-II: Partial Upgrade with Purchase of Essential Components**

- 58 Keys Rating Keyboard (USB);
- Geometry Unit;
- ROW Video Camera;
- Hardware Interface (replace existing Hardware Interface in order to connect additional equipment);
- Z-250 (as existing one is not working).

Following were the key considerations on the basis of which a decision may be taken by HPRIDC/HPPWD.

<table>
<thead>
<tr>
<th>Feature</th>
<th>Option-1 (Full upgrade)</th>
<th>Option-2 Upgrade</th>
<th>(Partial)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Technology</td>
<td>✓ ✓</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td></td>
<td>Latest versions available</td>
<td>Existing items are very old and support seldom available</td>
<td></td>
</tr>
<tr>
<td>Compatibility issues</td>
<td>✓ ✓</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td></td>
<td>No Issues</td>
<td>Possible issues</td>
<td></td>
</tr>
<tr>
<td>Record Road Asset Measurements</td>
<td>✓ ✓</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td></td>
<td>Possible</td>
<td>Not possible</td>
<td></td>
</tr>
<tr>
<td>Data Processing Software</td>
<td>✓ ✓</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td></td>
<td>Available</td>
<td>Available</td>
<td></td>
</tr>
<tr>
<td>1+2 year warranty</td>
<td>✓ ✓</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td></td>
<td>Available</td>
<td>Available</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Not available for obsolete items</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Hence, based on the above comparison it is proposed to go for Option-1 full upgrade.
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Considering the road network, terrain of the Himachal Pradesh State, it is proposed to have two (2) units/sets of ROMDAS equipment one (1) Unit per two (2) Zones, so that each Zone can share equipment in a year and collect annual inventory and condition data for loading into proposed Road Management System (RMS) for generation of Annual Maintenance Plan.

We propose to upgrade the existing ROMDAS equipment from Data Collection Limited, New Zealand (DCL), due to the following factors:

- To minimise cost of equipment (upgrade may always prove to be economical);
- Continue to employ the expertise created among HPPWD staff over the years in using ROMDAS.

We will assist HPPWD in procuring a Falling Weight Deflectometer (FWD) and Portable Axle Weigh Pads by preparing DRAFT Terms of Reference (TOR) for procurement of the FWD and Weigh pads. We will ensure that the technology developed by IITs/reputed manufacturers and tested on Indian roads be considered in case of FWD.

The preliminary specifications for the equipment to be procured are attached in Annex-VII.

5.3.3 Task 2.3: Selection of COTS

The proposed RMS will be used by HPPWD to improve quality and delivery of HPPWD services in the development and management of the State road network. RMS will enhance the capabilities of HPPWD by providing a source of readily accessible, relevant and valid information on the road network as well as improved support for decision making by providing various modern analytical tools.

The shortcoming of the RMMS through our preliminary review and the functional requirements of the proposed RMS are studied in detail. Considering these, the COTS which has been very carefully selected not only meet the needs of the HPPWD but also inject the much needed sustainability.

RMS will be a simple, direct and user friendly application aiming to sustain. TOR very clearly identified technical and functional requirements of the proposed COTS based RMS. Based on the given requirements, we have selected HIMS Asset Management System as the COTS for this Project. The proposed RMS will be developed by configuration and customisation of the popular, HIMS Asset Management System.

One web license with unlimited users along with 5 years annual maintenance will be supplied to HPPWD. The license will be registered in the name of HPPWD or HPRIDC. The upgrade patches and bug fixes will be supplied during the five year annual maintenance period at no additional cost to HPRIDC/HPPWD.

5.3.4 Task 2.4: Configuration of HIMS

HIMS is a sector leading Road Asset Management System and a “commercially-off-the-shelf” (COTS) product. Its solutions range from managing pavements, bridges and road furniture to traffic, social, environment and accident information. HIMS is an integrated solution with state-of-the-art-technology. Technology of HIMS is flexible, scalable and manageable with limited resources that a typical road agency could afford.
The HIMS in-built functions will be configured to meet the needs of HPPWD.

5.3.5 **Task 2.5: Location Reference Management System (LRMS)**

Location Reference Management System (LRMS) will be developed to maintain centralised location referencing for RMS. The LRMS forms the core of the RMS, a system that defines and enforces proper referencing conventions of the roads and associated assets. RMS will include facilities for linear and geo-referencing ( spatial) features.

The primary functions proposed for Location Reference Management (LRM) are:

- to enter, validate and store location referencing data (Road, Link, Node, LRP etc.);
- to manage location referencing data for all modules of RMS;
- to merge, break, retire links / sections;
- to modify location referencing data and trigger relevant changes in other modules of RMS;
- to detect inconsistencies in the location reference system and generate inconsistent reports;
- to maintain historical changes in the road network.

Process and data flow of LRMS is presented in Figure 5-4.
Location reference management is one of the most critical tasks of RMS. It is recommended that the maintenance of location referencing only be undertaken by an advanced user such as the Administrator. It is important to understand the road network definition and its linkages with other attribute data, such as, inventory and condition data, prior to defining or updating location reference data. The sequence of operations for both defining and updating location reference data is critical. Any undue change of the location reference data may break the critical link with attribute information thus making data inaccessible and in the end RMS non-functional. It is recommended to exercise utmost care when working with location reference data. A sample layout of the advanced options of LRMS is depicted in Figure 5-5.
Task 2.6: Road Information System (RIS)

Road Information System (RIS) or Asset Register (AR) will be developed to store assets inventory, condition and other relevant information. RIS will provide information to other sub systems (modules) within RMS.

Detailed inventory and condition data of Bridges will be stored in Bridge Information System (BIS).

RIS will have the following key functions:

- Enter and store inventory data;
- Enter and store spatial data;
- Enter and store condition data;
- Enter and store pavement condition data;
- Enter and store pavement strength data;
- Manage historical data;
- Identify most recent data;

Figure 5-5: Sample LRMS Options
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- Provide facilities for adhoc and statistical queries;
- Provide GIS platform to view network and other attribute data;
- Provide summarised (and current) attribute data to other modules such as PMS, BIS, AIS etc;
- Generate thematic maps, tabular reports and charts;
- To interface GIS data with other Geographic Information System (GIS) applications of GOHP like revenue maps and forest maps in future.

The process flow of RIS is presented in Figure 5-6.

![Figure 5-6: Process Flow of Road Information System](image)

5.3.7 **Task 2.7: Bridge Information System (BIS)**

The main purpose of the Bridge Information System (BIS) will be to identify and plan bridge repairs and improvements in a systematic way, enabling early identification of deficiencies and applying preventive maintenance. BIS will store bridge inventory and condition data and source other requisite data from other sub systems, i.e. road inventory data and traffic data etc. The Decision Tree analysis approach will enable HPPWD to assess maintenance and rehabilitation needs including preventive maintenance.

The preliminary process flow of Bridge Information System is given in Figure 5-7.
5.3.8 Task 2.8: Traffic Information System (TIS)

The Traffic Information System will store traffic volume data, as well as data from axle load surveys. This is intended to produce a range of different kinds of analysis/results, including assignment of traffic on the network, estimation of AADT and traffic growth forecasts.

TIS will provide following data to other modules of RMS internally and automatically once invoked by them:

- Average Annual Daily Traffic (AADT);
- Traffic Composition;
- Vehicular Growth Rates;
- Vehicle Damage Factor (VDF) etc.

TIS will store the following data:

- continuous counts from permanent traffic count stations;
- 7-day classified traffic counts;
- short-term (< 3 day) classified traffic counts;
- traffic growth rates;
- vehicle fleet characteristics;
- sample hourly flow data;
- processed weigh-in-motion or axle load survey data (i.e. aggregated statistics as opposed to measurements of each vehicle), if available.

### Figure 5-8: Typical Traffic Information System Process Flow

#### 5.3.9 Task 2.9: Prepare Data Collection Manual

We will review the existing data collection procedures and in light of the additional data needs arising from the development of the RMS. We propose to prepare recommendations on the incremental improvement in data collection procedures, procurement of equipment and scheduling of surveys. We will then prepare a road data collection manual including revised standard forms for data collection.

#### 5.3.10 Task 2.10: Data Migration

We propose to study the existing RMMS of HPPWD and the data available in it on CRN. We will undertake small sample check in field for studying the quality of existing data in RMMS. The network for the field validation will be limited to a maximum of 5%. The objective of the field validation is to decide the merits of the available data in RMMS.
and their relevance in the current context. Once the data to be migrated to be identified based on their relevance, we will explore the quickest way to extract data and load into the RMS. The method will also include extracting data from backed database.

5.3.11 Task 2.11: Data Collection

We will collect data over CRN in first year. The ROMDAS equipment will be used for this purpose. Wherever possible, we will propose the improvement to the current practice of data collection. These improvements will be discussed and agreed with HPPWD prior to embarking on the field data collection.

We will collect all other data on the CRN while the GPS road centreline data will be collected on the CRN and NHs. This data will be used to develop the GIS map of the State road network. The data collection will be conducted as per the details mentioned in Section 4.9.

The fully working equipment in good condition will be provided by HPPWD as mentioned in the TOR. We will bear all other costs related to the field data collection, maintenance and operation of equipment, repairs and any third party accidental claims incurred during the custody of the equipment HPPWD/HPRIDC being the owner of the equipment supplied, the insurances need to be taken by HPPWD/HPRIDC on their name and insurance charges will be shared on pro-rata basis for duration of our control.

GPS and Location Referencing (Linear and Spatial) Data

Establishment of Control Points

Nodes: Start and end points of each road link, this is normally the location of permanent features of the road, for example, major intersections.

Location Reference Points: These are reference points established in between nodes, to serve as check points for survey vehicles to reconcile distance measurements, minimizing cumulative errors due to variance of actual travel path. Normally km posts observed along the survey route are used for this purpose. Where km posts are not available, other permanent objects, such as, bridges, major culverts, police stations, school building, hospital building or similar prominent structures will be used as LRPs. These are generally spaced at 1 km with no more than 5 km.

Other Control Points – these includes bridges, start and end of bypasses, administrative boundaries or any other prominent features.

Establishment of Highway Centreline

Upon setting up of the Control Points, other surveys will be initiated along the pre-designated route to collect the chainage measurement and GPS coordinates of the notional centreline. The survey vehicle will collect the coordinates and distance measurements while travelling closest to the centreline (i.e. on the fast or innermost lane, next to the road median). The coordinates will be recorded continuously at no less than every 25 meters (or 5 meters) interval in both bounds, if relevant. The true centreline will be determined from the notional centreline measured using GPS receiver. We propose to use the real time differential GPS correction or correction through post process method. We propose to use Trimble ProXRT with GLONAAS or
equivalent option, which uses both US and Russian satellites. This ensures very rare loss of GPS signals. Alternatively, we will use the equipment to be provided by HPPWD/HPRIDC.

At each node and LRP, the offset must be reset to 0.

**Correction of data anomalies**

Quite often, lengths vary between the planned path distance and actually travelled distance due to survey vehicle deviating from the planned path to avoid oncoming traffic and other traffic manoeuvring (overtaking) including driving behaviour. The variance increases over travel distance if the distance gets accumulated. In order to minimise this cumulative error, the DMI will be reset back to the actual chainage as it encounters the successive Control Point.

Another anomaly is the loss of GPS signal. We propose to repeat the survey in case of substantial loss of GPS signals. Otherwise, we propose to interpolate from the known locations (good points).

**Precision of Measurements**

- Distance measurement – in line with TOR, distance will be measured by a HRDMI with an accuracy of 0.1 m per 100 m (0.1%);
- Differentially corrected GPS data of 95% ±1.0 meter horizontal and vertical accuracy (subject to using DGPS);
- Geo-coordinates of centreline of no more than 5 meter interval.

**Road Inventory Data**

TOR is silent on the specific items to be collected. We have however proposed to collect the following data items subject to approval of the HPPWD. The overriding factor will be the requirements of proposed RMS.

<table>
<thead>
<tr>
<th>Inventory Feature</th>
<th>Details of Measurement / Recording</th>
</tr>
</thead>
<tbody>
<tr>
<td>Right of way</td>
<td>Mostly through secondary sources such as design standards. Through visual observations in the field, wherever the boundary is visible.</td>
</tr>
<tr>
<td>Road type</td>
<td>Visual observations in the following categories:</td>
</tr>
<tr>
<td></td>
<td>• Single lane;</td>
</tr>
<tr>
<td></td>
<td>• Intermediate lane;</td>
</tr>
<tr>
<td></td>
<td>• Two lane;</td>
</tr>
<tr>
<td></td>
<td>• Two lane with paved shoulders;</td>
</tr>
<tr>
<td></td>
<td>• Four lane without divided carriageway;</td>
</tr>
<tr>
<td></td>
<td>• Four lane with divided carriageway;</td>
</tr>
<tr>
<td></td>
<td>• Multi-lane without divided carriage way; and,</td>
</tr>
<tr>
<td></td>
<td>• Multi-lane with divided carriageway.</td>
</tr>
<tr>
<td>Pavement surface type</td>
<td>Visual observations in the following categories:</td>
</tr>
<tr>
<td></td>
<td>• Asphalt;</td>
</tr>
<tr>
<td>Inventory Feature</td>
<td>Details of Measurement / Recording</td>
</tr>
<tr>
<td>------------------------</td>
<td>------------------------------------------------------------------------</td>
</tr>
<tr>
<td>Pavement width</td>
<td>Visual observations in the following categories:</td>
</tr>
<tr>
<td></td>
<td>• &lt; 3.75 m;</td>
</tr>
<tr>
<td></td>
<td>• 3.75 m - 5.50 m;</td>
</tr>
<tr>
<td></td>
<td>• 5.50 m - 7.5 m;</td>
</tr>
<tr>
<td></td>
<td>• 7.5 m - 9.0 m;</td>
</tr>
<tr>
<td></td>
<td>• 9.0 m.</td>
</tr>
<tr>
<td>Shoulder type</td>
<td>Visual observations in the following categories:</td>
</tr>
<tr>
<td></td>
<td>• None;</td>
</tr>
<tr>
<td></td>
<td>• Paved;</td>
</tr>
<tr>
<td></td>
<td>• Gravel;</td>
</tr>
<tr>
<td></td>
<td>• Earth.</td>
</tr>
<tr>
<td>Shoulder width</td>
<td>Visual observations in the following categories:</td>
</tr>
<tr>
<td></td>
<td>• No shoulder;</td>
</tr>
<tr>
<td></td>
<td>• &lt; 1.0 m;</td>
</tr>
<tr>
<td></td>
<td>• 1.0 m - 2.0 m;</td>
</tr>
<tr>
<td></td>
<td>• &gt; 2.0 m.</td>
</tr>
<tr>
<td>Median width</td>
<td>Visual observations in the following categories:</td>
</tr>
<tr>
<td></td>
<td>• No median;</td>
</tr>
<tr>
<td></td>
<td>• &lt; 1.0 m;</td>
</tr>
<tr>
<td></td>
<td>• 1.0 m - 3.0 m;</td>
</tr>
<tr>
<td></td>
<td>• 3.0 m - 5.0 m;</td>
</tr>
<tr>
<td></td>
<td>• &gt; 5.0 m.</td>
</tr>
<tr>
<td>Side Ditch Type</td>
<td>Visual observations in the following categories:</td>
</tr>
<tr>
<td></td>
<td>• Open unlined;</td>
</tr>
<tr>
<td></td>
<td>• Open lined;</td>
</tr>
<tr>
<td></td>
<td>• Covered lined;</td>
</tr>
<tr>
<td></td>
<td>• No drain;</td>
</tr>
<tr>
<td></td>
<td>• Drain not needed.</td>
</tr>
<tr>
<td>Cross section</td>
<td>Visual observations in the following categories:</td>
</tr>
<tr>
<td></td>
<td>• Cut;</td>
</tr>
<tr>
<td></td>
<td>• Fill;</td>
</tr>
<tr>
<td></td>
<td>• Cut and fill;</td>
</tr>
<tr>
<td></td>
<td>• Embankment.</td>
</tr>
</tbody>
</table>
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<table>
<thead>
<tr>
<th>Inventory Feature</th>
<th>Details of Measurement / Recording</th>
</tr>
</thead>
</table>
| Topography        | Visual observations in the following categories:  
|                   | - Flat;  
|                   | - Rolling;  
|                   | - Hilly. |
| Road furniture    | Visual observations in the following categories:  
|                   | - Crash barriers;  
|                   | - Signs;  
|                   | - Street Lights;  
|                   | - Retaining walls. |
| Land use          | Visual observations in the following categories:  
|                   | - Residential;  
|                   | - Commercial;  
|                   | - Industrial;  
|                   | - Agricultural;  
|                   | - Water bodies;  
|                   | - Public/community use;  
|                   | - Forest reserve. |

The location of the inventory features will be obtained through chainage measurement (from DMI) or GPS coordinates (from DGPS).

**Pavement Condition Data**

The pavement condition survey is an analysis of the visual distress manifestation (i.e., cracking and surface deformation) exhibited on the surface of pavement. The data will primarily be obtained from actual survey on the ground. The data will comprise distress characteristics of flexible or rigid pavement.

The data will be collected by using semi-automated equipment. Survey will be done continuously in each direction at speed of 30 km/h to 50 km/h. The data will be collected by single run aggregated to 200 m interval.

About 3 to 4 parameters will be collected from the following surface distresses using semi-automated technique:

- Cracking in % of the surface area;
- Ravelling in % of the surface area;
- Potholes in number;
- Disintegration in % of the surface area;
- Depressions in % of the surface area;
- Bleeding in % of the surface area;
- Patching in % of the surface area;
- Pavement edge damage in sqm.

In order to ensure that there is consistency in the rating, we will prepare a comprehensive rating manual for assessment. This will include definitions of the distresses, how they are to be measured, and have photographs to guide the raters.

The shoulder condition and drainage condition will be recorded from video images or in real time, which will be decided during the inception phase of the project.

However, the data collection processes will be simplified for the rural roads while some detailed information will be collected for higher order roads to enable running of HDM-4. The data items to be collected will be finalised from the perspective of RMS.

**Roughness**

Roughness will be measured in conjunction with pavement condition survey. The roughness data will be measured using ROMDAS Laser Profilometer or Bump Integrator. Single run in the outer lane will be performed to record Roughness at 10 m or 100 m interval. The speed will be recorded during the survey and taken into account when calculating the IRI from the raw data.

Factors that may influence the IRI will be recorded during the survey and the data will be corrected accordingly. These include, but are not limited to, traffic congestion, pavement construction activities, speed breakers, bridge abutments etc.

If the road conditions in some areas are found to be so extremely rough that collection of roughness data in the above-mentioned manner is not practical or safe; we will provide a means for estimating pavement roughness for use in such areas, calibrated by IRC standards or a similarly acceptable standard, and subject to Client approval.

**Pavement Deflection (Strength)**

The pavement strength data will be collected using Falling Weigh Deflectometer (FWD) equipment.

The FWD equipment will be towed by a suitable SUV. The target stress of 566Kpa (corresponding to a load of 40KN) will be used. The sensors spacing will be kept at 0, 200, 300, 450, 600, 900 and 1500 mm measured from the centre of the applied load or as per the IRC 115-2014 guidelines. The load pulse will be applied through a loading plate of diameter of 300 mm. The loading plate will have a rubber pad of at least 5 mm thickness.

The operator will follow the manufacturer’s instructions for use of the equipment. The test locations will be cleaned of loose stones and debris to ensure that the loading plate and deflection sensors are properly seated. The operator will lower the loading plate and the sensors and ensure they are resting on a firm and stable surface. Then raise the loading weights to the appropriate height to generate the target load level, and drop the weight. The software will record the peak load and resulting peak surface deflections. Three sets of deflection measurements will be recorded. The peak load, temperature and deflection sensor readings resulting from the third drop load constitute the test results. The pavement surface, GPS coordinates and ambient temperature will be measured at each test location.
The test results will be recorded at interval of 1 km. The factors affecting the test results will be recorded in the field. These include but not limited to deviation from the test lane, surrounding structures (culvert/bridge) and localized surface contamination etc.

Structural Number (SNP) of the pavement will be calculated using a relevant back calculation software or through empirical formula published.

**Pavement Composition Data**

Pavement composition data will be procured from field survey, either Test pits or DCP.

**Bridge Condition Data**

As per the TOR, we will verify the Bridge condition data. The extent of the verification is given in Section 4.9.

**CD Structures Inventory**

As per the TOR, we will verify the structures inventory. The extent of the verification is given in Section 4.9.

**Classified Traffic Volume**

The purpose of this classified traffic volume count survey is to determine the current traffic volumes and type of traffic travelling on the project roads.

The classified traffic volume count surveys will be carried out for 24-hours for three (3) continuous days, both bounds at the identified survey stations during normal period.

A standard vehicle classification system based on IRC:SP 19-2001 will be adopted for counting purposes. The vehicle classification break down is defined below.

<table>
<thead>
<tr>
<th>Vehicles Category</th>
<th>Slow Moving Vehicles</th>
</tr>
</thead>
<tbody>
<tr>
<td>Two Wheeler</td>
<td>Cycle</td>
</tr>
<tr>
<td>Three Wheeler/Auto Rickshaw</td>
<td>Cycle Rickshaw</td>
</tr>
<tr>
<td>Car/Jeep/Van/Taxi</td>
<td>Animal Drawn – Bullock Cart</td>
</tr>
</tbody>
</table>
Manual counting method will be deployed by enumerators situated at the side of the road to complement counting of non-motorised traffic. The enumerators will record each vehicle on a survey form according to the vehicle type. Each direction of the traffic will be recorded separately.

Information in the daily traffic summary sheet will be compiled and analysed and the results will be presented in tabular and graphical form.

Some of the outputs from the traffic count survey are:

- Traffic Composition;
- Hourly and Daily Variation;
- Peak Hour Traffic;
- Directional Split;
- Temporal Variations;
- Average Daily Traffic (ADT) by vehicle type;
- Annual Average Daily Traffic (AADT) by vehicle type etc.

Axle Load Data

Axle load survey will be carried out to determine the axle load distribution of the commercial vehicles plying on project roads. Axle Load Surveys of 24 or 12 hours duration using static Axle weigh pads equipment will be carried out at given locations on representative basis i.e. loaded full, partial or empty.

The survey locations will be finalised based on commercial vehicle intensity / homogeneity in various sections. While selecting the location(s) of axle load survey station(s), the locations of existing bridges with load restrictions, if any, will be taken into account and such sites will be avoided.

Road User Costs Survey

We propose to carry out road user costs survey at 20 locations as required by the TOR.
Task 2.12: Data Processing and Management

We propose to deploy our data processing and management software, called “DATAMAN” for processing and management of the survey data. The sample screenshots of the DATAMAN are given in Figure 5-9.

Figure 5-9: DATAMAN

DATAMAN has been developed by SATRA to process, manage and prepare RMS compatible files from ROMDAS output files. DATAMAN was used on several projects to process over 2,00,000 km of network data by us. DATAMAN will be used by us on this project for the processing of survey data at no extra cost to HPRIDC/HPPWD.

Task Group 3: Development of Planning Tools

Task 3.1: Pavement Management System (PMS)

The major functions of the Pavement Management System (Planning and Budgeting tool) are:

- **Preservation**: What is the appropriate periodic maintenance strategy to preserve the road asset;
- **Improvement**: What maintenance treatments are required for pavements whose condition requires a major treatment (like upgrading/strengthening) before periodic maintenance can be applied;  
- **Capacity Augmentation**: What capacity (width) is required for current and future traffic loading.

HDM-4 analysis engine, based on sound engineering and economic priority principles, is capable of undertaking both strategic and project level analyses appropriate for a typical road agency such as HPPWD. The HDM-4 based system will have following key functions:

- Facility to interface with RIS for obtaining location referencing data;
- Homogeneous sectioning methods for dividing roads into appropriate sections for maintenance;
- Data aggregation methods;
- HDM-4 input files;
- Thematic maps and summary reports.

Process flow of Pavement Management System is given in Figure 5-10.
One of the critical tasks of this sub system is to determine the appropriate “Homogeneous Sections”. To facilitate this process, a user interactive edit tool will be developed in addition to the auto generation of homogeneous sections. A sample screenshot is given in Figure 5-11.

![Figure 5-11: Sample Layout of Editing of Homogeneous Sections]

### 5.4.2 Task 3.2: HDM-4 Interface

For the PMS application, we will connect the RMS with established and widely accepted economic evaluation model based on sound engineering and economic priority principles, capable of undertaking both strategic and project level analyses at the appropriate organizational levels, namely; Highway Development and Management Model (HDM-4) latest version.

The latest version of HDM-4 economic evaluation model shall be capable of the following types of analyses, which should cover both road condition and capacity improvements.

- Network level planning;
- Project level planning;
- multi-project programming and budgeting;
- optimization of projects under budget constraints;
- overall network performance monitoring and evaluation against projected targets.

**Network Level Planning (Programme Analysis)**

The annual work programme (multiyear rolling programme) focuses on treatments on discrete road sections, needing maintenance. The following definition will be adopted:

Programme Analysis deals primarily with the prioritisation of a defined long list of candidate road projects into a one-year or multi-year work programme under defined...
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budget constraints. It is essential to note here that, we are dealing with a long list of candidate road projects selected as discrete segments of a road network.

The multiyear rolling programme will be comprise of: (i) identification (road segment/section); (ii) work programme and treatment; (iii) estimated output; (iv) estimated costs; and (v) economic priority ranking.

We will together with HPPWD develop and establish the best approach suited for the context of HPPWD. The PMS will be the key application in this. As part of Performance Indicators (PIs) analysis and enhancements, we will review existing targets. We will measure the achievements compare to current targets and investigate reasons for not meeting targets (if this is the case). Based on this knowledge we will develop as new and improved set of targets which is realistic under the given resource constraints. This means that targets will be set by realistic projected measures under realistic budget levels in order to ensure that the new targets are set ambitious, but also achievable.

A typical output from the programme analysis is shown in Figure 5-12.

![Figure 5-12: Multiyear Rolling Programme](image)

**Project Level Analysis**

We will carry the project level analysis studies for CRN in about 830 km for different technically feasible options such as periodic maintenance, resurfacing, rehabilitation, reconstruction, widening and geometric improvement etc. These options will be framed in consultation with professor of IIT /Research Institutions in India working in this area and then discuss it with HPPWD/HPRIDC based on the data collected. The analysis will be done using a life-cycle cost and other approaches using HDM-4 model.

Project analysis is carried out to evaluate one or more road projects or investment options. The application analyses a road link or section with user selected treatments, with associated costs and benefits projected annually over the analysis period. Economic indicators are determined for the different investment options based on
which the preferred option is selected. We propose this option to include different technically feasible options such as periodic maintenance, resurfacing, rehabilitation, reconstruction, capacity improvement, and other improvement and betterment works in the system.

Sample analysis outputs are shown below for a project level analysis is given below.

<table>
<thead>
<tr>
<th>Alternative</th>
<th>Present Value of Total Agency Costs (PVC)</th>
<th>Present Value of Agency Capital Costs (PVCAP)</th>
<th>Increase in Agency Costs (C)</th>
<th>Decrease in Time Costs (T)</th>
<th>Net Exogenous Benefits (E)</th>
<th>Net Present Value (NPV = PVC - C)</th>
<th>B/PV of (NPV/C)</th>
<th>B/PV of (NPV/AC)</th>
<th>Internal Rate of Return (IRR)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Without Project</td>
<td>1.470</td>
<td>1.400</td>
<td>0.000</td>
<td>0.000</td>
<td>0.000</td>
<td>0.000</td>
<td>0.000</td>
<td>0.000</td>
<td>3.000</td>
</tr>
<tr>
<td>Option 1: DBST on OB</td>
<td>3.037</td>
<td>1.950</td>
<td>2.333</td>
<td>56.890</td>
<td>0.000</td>
<td>56.540</td>
<td>14.950</td>
<td>14.850</td>
<td>142.310</td>
</tr>
</tbody>
</table>

Sample analysis outputs are shown below for a project level analysis is given below.

The following will be included as part of the programme and/or project level analysis

- multi-project programming and budgeting;
- optimization of projects under budget constraints;
- overall network performance monitoring and evaluation against projected targets.

5.4.3 Task 3.3: HDM-4 Calibration

It is understood that the HDM-4 is used as the ‘analysis engine’ in the PMS. In order to secure reliable analysis output it is imperative that the HDM-4 is calibrated to local conditions. We will perform the calibration and adaptation as needed. The current traffic and condition data in the RMMS, together with additional data from other sources will provide an important data pool for this calibration and will presumably support a Level 2 calibration focusing on the most sensitive data (data with high impact elasticity on the analysis output). Road data from research centres, or from IITs or other universities will also be consulted in this respect. We will calibrate HDM-4 for the Indian conditions preferably hill roads according to the research carried out in India by any IIT/ research institution in India and will take the help of IIT/ Research Institutions in India in certifying the parameters.

There are three levels of calibration that is generally carried out (as described in Volume 5: A Guide to Calibration and Adaptation of the HDM-4 documentation), as given in Table 5-1.

Table 5-1: HDM-4 Calibration Levels

<table>
<thead>
<tr>
<th>Level</th>
<th>Scope of Calibration</th>
<th>Applicability</th>
</tr>
</thead>
<tbody>
<tr>
<td>1: Basic Application (Low Level)</td>
<td>Adopts many default values, calibrated most sensitive parameters with best estimates, desk studies or minimal field surveys</td>
<td>General planning, quick prioritization, preliminary screening</td>
</tr>
<tr>
<td>2: Calibration</td>
<td>Measurement of additional input parameters,</td>
<td>Project appraisal, detailed</td>
</tr>
</tbody>
</table>
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<table>
<thead>
<tr>
<th>Level</th>
<th>Scope of Calibration</th>
<th>Applicability</th>
</tr>
</thead>
<tbody>
<tr>
<td>(Medium Level)</td>
<td>moderate field surveys to calibrate key predictive relationships to local conditions, slight modification of the model source code</td>
<td>feasibility</td>
</tr>
<tr>
<td>3: Adaptation (High Level)</td>
<td>Requires major field surveys and controlled experiments, develop new and locally specific relationships</td>
<td>Research and development</td>
</tr>
</tbody>
</table>

Figure 5-13 shows the efforts (resources and time) required for different levels of calibration. For HDM models, there are three types of calibration carried out as given below:

- **RDWE Unit Costs**: This includes unit costs of maintenance treatments or road works. Ex: cost of DBST, cost of AC surfacing and etc;
- **RUC Unit Costs**: All input parameters related to Road User Costs (RUC) and Vehicle Operating Costs (VOC). Ex: vehicle replacement cost, cost of tyre, cost of fuel, cost of time delays etc;
- **RDWE Models**: Calibration or adjustments of Road Deterioration and Works effects (RDWE) models. Ex: cracking initiation coefficient, roughness progression coefficient, roughness reset after an overlay etc.

![Figure 5-13: HDM-4 Calibration Efforts](image)

The TOR recommends Level 2 calibration of road works costs (that is RDWE Unit Costs as described above). The scope of the Level 1 and Level 2 calibration is given Table 5-2 (Level 3 is related to fundamental research and development of models which is out of the scope a project of this nature).
Table 5-2: HDM-4 Calibration Details

<table>
<thead>
<tr>
<th>Level</th>
<th>RDWE Unit Costs</th>
<th>RUE Unit Costs</th>
<th>RDWE Models</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Unit costs from previous reports/studies/agency’s schedule of rates</td>
<td>Vehicle replacement costs and some limited fuel and vehicle details.</td>
<td>Desk study of previous reports and studies and general engineering experience.</td>
</tr>
<tr>
<td>2</td>
<td>Unit costs from previous reports/studies/agency’s schedule of rates. Estimation of Rates from basic material and labour rates where reliable Unit Costs information is not available.</td>
<td>Vehicle replacement costs, speed, fuel consumption, tyre consumption, parts consumption and fixed costs related vehicle life and utilization.</td>
<td>Model calibration from data collection</td>
</tr>
</tbody>
</table>

We propose to perform Level 2 calibration for RDWE Unit Costs and RUE Unit Costs and Level 1 for RDWE Models. The calibration of the HDM4 is very much dependent on the quality and extent of the data available. Therefore the possibility, scope and extent of the calibration will depend on the data available.

The enhanced models will continuously be tested throughout the period of the Services.

5.4.4 Task 3.4: Routine Maintenance Management System (RMMS)

Routine Maintenance Management System (RMMS) will be developed to undertake routine maintenance activity for road assets, routing maintenance will be an important sub system in overall framework of RMS, proper utilisation of this system will be a preventing maintenance and will lead to preserve large and low value assets.

The system will be used for assigning pre-defined routine maintenance treatments on candidate sections not having periodic maintenance / improvement works. RMMS ensures improving the quality of the performance of the routine maintenance through standardisation of activities including Specifications, Performance Standards, Quantity Standards, & supervision.

The annual needs for routine maintenance activities for the candidate analysis sections are assessed through maintenance feature inventory and condition rating, quantity standards and unit rate. Quantity standards are expressed as the annual number of units of work as per the applicable unit for each activity based on the condition of the Asset (refer to Figure 5-14).
Consulting Services for Technical Assistance to Help Upgrade Road Maintenance Management System to Road Management System in the State of Himachal Pradesh

Figure 5-14: Routine Maintenance Needs

Annual needs (total work quantity) are assessed by multiplying the road network maintenance feature inventory data by the quantity standards of the work activities. The process flow is given in Figure 5-15.
5.4.5 **Task 3.5: ROW Features Information Management System (RWFIMS)**

RWFIMS will be created to:

- maintain all features such as structures, utility services both below and above ground, trees etc, within the Right of Way (ROW)
- generate strip maps showing these features.

HPPWD have simple road infrastructure maps of roads at divisional level. These maps and databases will be integrated with RMS. Essentially, RWFIMS will be a GIS based frontend with several layers prepared from the data to be provided by HPPWD. All required data for developing and implementing RWFIMS will be supplied by HPPWD/HPRIDC.

5.4.6 **Task 3.6: Acceptance Testing**

We propose to organise the Acceptance Testing for the RMS to be delivered as part of the services. Acceptance test is considered as the final test to be undertaken by
HPPWD, who is the end user of the system. The following are the main objectives of the acceptance test:

- To confirm the system has been developed as per the specifications or agreed conceptual design document;
- To confirm the system functions as per the specifications or agreed conceptual design document;
- To confirm the system can be used without any major errors (free of bugs);
- To confirm the design manuals, user manuals and system manuals are clear, concise and fit for the purpose.

We propose to develop the following documents/files to help HPPWD in carrying out the acceptance test:

- Acceptance test document describing the procedure to carry out acceptance test;
- A sample database extracted from the data collected/available.

We propose to submit the acceptance test document at least two weeks prior to the agreed testing date so that HPPWD staff has sufficient time to familiarize with the procedures to be followed for acceptance testing. A sample form that can be used in the acceptance test is given below.

<table>
<thead>
<tr>
<th>Item</th>
<th>Client (HPPWD) Authorised Rep</th>
<th>Consultant (HIMS) Authorised Rep</th>
<th>Comments / Complaints / Suggestions</th>
</tr>
</thead>
<tbody>
<tr>
<td>Import Data</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Links</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Roads</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Road Inventory</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>etc.……</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Network Maintenance</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Rename a road</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Break a link</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Move LRP</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>etc.……</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

During the acceptance test, if any comments/suggestions made by HPPWD staff or bugs identified will be listed and discussed within the team. These comments/issues will be addressed and the acceptance testing will be repeated.
5.5 **Task Group 4: Preparation of Road Condition Reports and Rolling Maintenance Plans**

5.5.1 **Task 4.1: Annual Condition Reports**

Using upgraded RMS, we will prepare an annual road condition and traffic report, using annually updated data, for 2015 and 2016. The annual report will include but not limited to:

- current network condition and traffic;
- road works in execution;
- road works completed;
- annual budget for routine maintenance, periodic maintenance, rehabilitation and improvement works;
- road accident and other traffic statistics;
- bridges condition and annual works; and
- projected network condition, traffic and road works for future years.

The report will be suitable for public dissemination and can be posted by the HPPWD/HPRIDC on its website. Our team is very experienced in preparing such report. A sample report prepared for RDA, Zambia by us in 2014 is given in Figure 5-16.

![Figure 5-16: Annual Condition Report](image)

5.5.2 **Task 4.2: Rolling Maintenance Plans**

We will produce a two year maintenance program for periodic and improvement works using the upgraded RMS. The indicative budget will be provided by the
Our team has prepared such maintenance plans for various clients. Sample maintenance needs plan prepared for ANE, Mozambique is given in Figure 5-17.

### Figure 5-17: Rolling Maintenance Plan

#### 5.6 Task Group 5: Road classification

##### 5.6.1 Task 5.1: Road Classification

The TOR required reviewing the existing road classification system and establishing a new classification system based on road functions. The existing classification system will remain but the consultant will superimpose the functional classification system over the existing one to develop a matrix of classification. The functional classification could be based on parameters such as traffic intensity and road function such as arterial, collector or access road. The functional classification will be used to define the improvement/maintenance priority and, recommend optimal standards for design, construction, and maintenance – which could be different for different categories of roads.

Our team has experience of a similar assignment (reclassification of road network) in various countries where projects reviewed generally adopted road classifications systems including functional classification system. We propose to review classification guidelines that are available with us and in conjunction with HPPWD, and we propose to finalise the functional classification criteria that are suitable for the intended purpose. Our proposed system HIMS has the facility for including the new classification system on top of the existing system in use.
The functional classification will be used to define the improvement/maintenance priority and, recommend optimal standards for design, construction, and maintenance – which could be different for different categories of roads.

5.6.2 **Task 5.2: Homogeneous Sections**

In line with TOR, project road network will be divided into homogenous road sections, to be used as a unit for periodic maintenance and improvement using the proposed RMS system. The database of the RMS will also allow for automatic sectioning so that road sections are created using factors such as condition, inventory and traffic as the criteria. The sectioning process will be interactive with the user being able to adjust the resulting sections.

The state of the art sectioning routine in HIMS possesses all needed functions by HPPWD. The end user can change the sectioning criteria for every run (each year of analysis) if needed – this is extent of flexibility available in HIMS. However, we propose to determine appropriate sectioning criteria in conjunction with HPPWD and implement in RMS. As rightly pointed out by the TOR, the homogeneous sections are the fundamental for deciding and carrying out the periodic maintenance and improvements. The following sectioning options are available in HIMS:

- Fixed Length;
- Value Range;
- Value Change;
- Small Sectioning;
- Amalgamation of Small Sections.

The above sectioning options can be used to their merit to determine the homogeneous sections for further analysis. Once the homogeneous sections are determined then HIMS visual or chart based manual adjustment or refinement of the sections will be undertaken. This provides road engineers to finalise maintenance analysis sections. An example screenshot is given in Figure 5-18, taken from the Gujarat Road Management System project which used the HIMS software platform for developing GRMS.
5.7 Task Group 6: Transfer of Skills and Training

The primary emphasis of the training is to assist in the implementation of new systems and concepts. At the outset we will gather information on present availability of HPPWD personnel with Asset Management competence. This will also include capturing information on Asset Management related training in the past. The Training Needs Assessment conducted in the past will also be reviewed.

5.7.1 Task 6.1: Training Needs Assessment (TNA)

The proposed approach by us towards TNA is based on such assessments undertaken successfully in HPPWD, number State PWDs and Highway Organisations in developed and developing countries. TNA is more than just about training. It gives an overall picture of the attitudes and competencies of the personnel, and the issues that they see as important for motivation and performance. The data collected, provided it is maintained, can provide as an on-going tool to assist in identifying training needs, selecting candidates for training and progression planning.

TNA is the key module of this entire training activity. The goal supported by this needs assessment is stated below:

- To strengthen the human resources of the HPPWD for the Asset Management (road maintenance and upgrading by data driven processes and use of scientific tools for planning, programming and budgeting);

- Performance analysis model is proposed for conducting TNA. It focuses on identifying and determining the cause of discrepancies between expected and actual performance. A basic tenet is that a training need exists only when a
performance discrepancy is attributed to a lack of knowledge or skills and not to other potent influences on work behaviours such as rewards, and punishments, which fail to support, desired performance.

Following modules are proposed as part of TNA:

Identify Key Functional Areas

This comprises of Asset management, identified during the development of job descriptions. These and their sub components may comprise, but not limited to the following:

- Data Collection
  - Road inventory and condition;
  - Pavement strength;
  - Bridge inventory and condition;
  - Culvert inventory and condition;
  - Axle load.

- RAMS
  - Location referencing management;
  - Asset register (Road information system);
  - Pavement management system;
  - Bridge information system;
  - Routine maintenance management system;
  - Etc.

Getting Responses on TNA Self-assessment Format

This includes obtaining responses from HPPWD personnel on the relevance, their present level of Knowledge and Skill and need for Training in these areas. Respondents will be self-assessed regarding existing knowledge and skills in each of the Key Functional Areas at one of the three levels: High Competency, Medium Competency and Negligible / Nil Competency levels as defined in Table 5-3.

**Table 5-3: Competency Level and Skill Set**

<table>
<thead>
<tr>
<th>Competency Level</th>
<th>Description of Expertise / What HPPWD Personnel Can Do</th>
</tr>
</thead>
<tbody>
<tr>
<td>Low / Negligible</td>
<td>Have a limited exposure or only a broad understanding of the subject. Unable to do any meaningful work on the same or utilize the knowledge in any related work.</td>
</tr>
<tr>
<td>Medium</td>
<td>The knowledge on the subject has been acquired through education and training or through hands on work. Is able to make limited use of it in the work under supervision and guidance.</td>
</tr>
<tr>
<td>High</td>
<td>Is capable of working on the subject independently with satisfactory results. At a higher expertise level, is able to train / coach others.</td>
</tr>
</tbody>
</table>
Compare Existing Level of Competence with Desirable Level of Competence

The Key Functional Areas identified as of (a) High relevance to their position in the HPPWD, (b) Low existing knowledge/skill level and (c) High Need for Training will be subjected to be precisely reported on their current level of knowledge and skills at three levels as given in Table 5-4.

<table>
<thead>
<tr>
<th>Level</th>
<th>Description</th>
<th>Example using RAMS</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>Has been introduced to the skill and understands the main principles</td>
<td>Managers who needs an understanding of the RMS and its input and output.</td>
</tr>
<tr>
<td>B</td>
<td>Can use the skills rather independently</td>
<td>RAMS operators at HPPWD who needs to update the data based and carry out planning and programming.</td>
</tr>
<tr>
<td>C</td>
<td>Can develop, adjust and reformulate and train peers</td>
<td>Super-users, who can assist and train other users, managed the RMS and describe needs for adjustments and enhancements.</td>
</tr>
</tbody>
</table>

The responses received will be utilised for Gap Analysis (identifying gaps in the desirable and existing competence levels). Model competencies desired at each hierarchical level would be identified through focus groups, requested to be formed at higher Management level in HPPWD.

Assessment through Multiple Choice Questionnaires

The assessment in the above modules above will attempt at closing in on Target Groups level of knowledge and skills systematically. It however has a limitation that these are subjective to the extent that these give self-perceived levels of existing knowledge/ skills. To overcome this weakness, we will finally be getting feedback on Pre-Training multiple choice Questionnaires.

We are aware that apart for honing and accentuating the asset management technical competence. Our training effort should be aimed at creating the needed asset management mindset at managerial levels in order to sustain its operation.

A factor often seen is lack of commitment from higher level of management. It is imperative that high level of management explicitly express their commitment to the road asset management mindset in order to shape the focus on the units involved. Additionally with the introduction of road asset management principles and mind-sets, organisations will need to undergo a change management process. If commitment to this change is not prioritised or obstacles not dealt with, the needed mindset will never materialise.

5.7.2 Task 6.2: Training

Training will be the focus of the Services and will be an integrated part of all activities. The training will include a variety of modes, including on-the-job training, coaching, formal training session and workshops. We recommend adopting a dynamic training approach, where the training is evaluated throughout the Services and adjusted as deemed necessary. Customised training will be planned for each target group.
Training will include the following:

- Data collection;
- RAMS operation (data entry, data import, analysis, interpretation);
- Network maintenance planning;
- System Administration (data backup / restore, troubleshooting, configuration, reports etc).

**Training in the Classroom**

Under this task, the concepts of RMS, its modules (sub-systems) and their application including expected outcomes in detail will be discussed with the Target Group from HPPWD.

The training on the data input, basic rules, data verification and validation methods and operation of RMS will also be undertaken at appropriate stages of this assignment.

The detailed and result oriented training along with the training materials will be provided to the participants. Class room trainings will be conducted at the HPPWD head office.

**Training in the Field**

The Target Group from HPPWD will be trained on various activities related to RMS. It will include, but not limited to identification of Node and Link, data collection and compilation of data at field level. The training will also be undertaken in the field on data collection.

The field training will be conducted, preferably during the field data collection. Alternatively a group of selected staff from HPPWD will visit the nearest and suitable location for field training on the data collection.

**Workshops**

In line with TOR, we propose to conduct three workshops during the course of the services, as follows to discuss and finalise:

- Initial stages of the project (RMS Architecture);
- At the end of Year-1 (outcome of Year-1 data and RMS system) ;
- At the end of Year-2 (outcome of Year-2 data).

The workshops will be conducted at the HPPWD head office to describe the proposed framework. The comments and suggestions received during the Workshops will appropriately be included in the final reports.

**International Training Courses**

We will identify and finalise the relevant international training courses. The training course will be finalised on the basis of the contents and format of the training.

We will look for possibilities of participating in international training programmes, if funds can be provided through HPPWD’s financial and development partners. Such training will be made an integral part of the training programme.
We will also, if applicable, assist HPPWD in preparing papers to national and international conferences where counterpart staff can exchange knowledge and ideas with their peers in the region and internationally.

**Continued Knowledge and Skills Up-gradation**

The process of Training Needs Assessment is not one time but dynamic. It changes with training efforts or otherwise. Successful implementation and sustainability of the RMS in HPPWD can be ensured through continued efforts towards knowledge/ skills up-gradation as suggested in Figure 5-19.

![Figure 5-19: Continued Knowledge and Skills Up-gradation](image)

**Training Efforts**

The training will be imparted as shown in Table 5-5.

<table>
<thead>
<tr>
<th>Indicative Training Programme</th>
<th>Duration of Training</th>
<th>No. of Batches</th>
<th>No. of Trainee in each batch</th>
<th>Type of Trainee</th>
</tr>
</thead>
<tbody>
<tr>
<td>Data acquisition, interpretation, collection including data entry</td>
<td>2 days at site</td>
<td>4</td>
<td>15</td>
<td>Surveyors/ Road Inspectors/ JE/DE/AE</td>
</tr>
<tr>
<td>Data acquisition, interpretation, collection including data entry</td>
<td>2 days at office</td>
<td>4</td>
<td>15</td>
<td>JE/DE/ AE</td>
</tr>
<tr>
<td>HDM-4</td>
<td>15 days</td>
<td>4</td>
<td>15</td>
<td>DE/AE/ EE/ SE</td>
</tr>
<tr>
<td>Data acquisition, interpretation, collection including data entry, Maintenance planning and budgeting including use of software applications, performance monitoring and reporting through use of</td>
<td>2 days at office</td>
<td>4</td>
<td>5</td>
<td>SE/EE</td>
</tr>
</tbody>
</table>
As described, the training schedule will be dynamic suiting to the needs of the HPPWD/HPRIDC.

5.7.3 **Task 6.3: Evaluation of Training**

Information will be obtained to determine if the training programme organised by us are achieving results, and whether those results are the one’s desired.

Before each training programme, the participants will be requested to indicate their level of knowledge and skills prior to holding the session/ demonstration/ hands-on/ field visit. At the end of the session they will again be requested to indicate the post-session level of knowledge and skills. This will help arriving at the knowledge/ skill gained during the session.

An example of the Pre and Post questionnaire for Training Programme on Data Collection is given in Table 5-6.

| Table 5-6: Evaluation of Training |

<table>
<thead>
<tr>
<th>Num</th>
<th>TOPICS</th>
<th>Prior</th>
<th>Post Training</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Knowledge or Skill</td>
<td>Knowledge or Skill</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Low</td>
<td>Average</td>
</tr>
<tr>
<td>1</td>
<td>Purpose of Data Collection</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

There will also be evaluation through an End-of-the-course Evaluation. The participants will report on:

- Course content was more than adequate, adequate or inadequate?
- Whether it helped in refreshing or updating knowledge?
- Did they learn anything new?
- Were the topics dealt in sufficient detail?
- Are they motivated to Train / Learn / Work?
5.8 Task Group 7: On-going Support

5.8.1 Task 7.1: Maintenance Support

We will provide implementation and maintenance support to the HPPWD/HPRIDC in using the RMS. This will include trouble shooting, resolving any problems faced by the HPPWD/HPRIDC, minor modifications and refinements required in the system to improve its effectiveness based on the feedback information collected from its use, and removing bugs from the Software. We will assist HPPWD in applying or modifying the system to develop an investment plan, 5-10 year maintenance program and the budget allocations. We will also conduct a refresher training of the staff as necessary. Number of trainings and location shall be mutual agreed during the currency of services. The timing and duration of visit will be discussed and agreed with HPPWD. We will submit annual Report comprising of the performance of RMS, Data Collection, Training aspects etc during this support period.

The maintenance support will be provided for a period of twelve months after the initial assignment of one year.

5.9 Task Group 8: Manuals and Reports

5.9.1 Task 8.1: Submission of Deliverables

We will develop comprehensive user manuals and technical guidelines for the RMS (software), data-collection, preparation of road improvement plans, annual maintenance plans, generation of road condition and other reports, and performing various analyses using the RMS. We will provide soft copies of all the manuals, technical guidelines and other reports. On completion of the services we will provide a completion report including the lessons learnt further work, and institutional and business procedure changes that may be required to further enhance the use of the RMS and sustain its use.

The deliverables schedule has been redrafted in line with TOR stipulation (no changes to schedule have been made) and is given in Table 5-7.

<table>
<thead>
<tr>
<th>Number</th>
<th>Deliverable</th>
<th>Estimated Timeframe (months)</th>
</tr>
</thead>
<tbody>
<tr>
<td>D-01</td>
<td>Inception report</td>
<td>1</td>
</tr>
<tr>
<td>D-02</td>
<td>Needs analysis and overall system architecture (Draft)</td>
<td>2</td>
</tr>
<tr>
<td></td>
<td>Needs analysis and overall system architecture (Final)</td>
<td>3</td>
</tr>
</tbody>
</table>
5.10 **Task Group 9: Assess Additional Need for Data Collection Equipment**

5.10.1 **Task 9.1: Data Collection Equipment**

We will assess additional data collection equipment required by HPPWD based on the needs analysis. The experience in collecting data in Year 1 will form the basis for identification of additional equipment. Initial requirement of equipment is described in Section 5.3.2.

5.11 **Task Group 10: Institutional Set-Up of RMS**

5.11.1 **Task 10.1: Institutionalisation of RMS**

Currently, HPPWD has only skeleton resources operate RMMS system. It is manned at HPPWD HQ by two junior level staff. Therefore, we propose to develop an institutional framework which is fit for the purpose. We will endeavour to develop the system and associated institutional framework considering the current practices as much as
possible. Our team is very well experienced and aware of the organisational evolution and change management. Any major changes in the existing system may not always lead to success. However, the necessary changes in terms of data flow and use of the system outputs will be given utmost importance.

The basic motive for taking up such project by HPPWD will form the basis of our focus. The framework will include, but not limited to the following:

- Who should own and manage RMS;
- How frequently it should be updated;
- How to source and collect data for updating;
- What measures required to use within HPPWD;
- How to disseminate its outputs;
- Any other relevant.

5.12 **Task Group 11: Result Monitoring**

5.12.1 **Task 11.1: Performance Monitoring**

We will assess and identify performance parameters of the current maintenance system; establish baseline performance indicators, as well as in agreement with HPPWD, set after-project targets after the implementation of the new RMS to measure improvements.
6. Project Deliverables

The most significant output of this project is to deploy a sustainable Road Management System for the Core Road Network (CRN) of State of Himachal Pradesh. Other deliverables which support this primary output include several intermediate outputs, reports and data.

6.1 Reports

6.1.1 Inception Report (This Report)

The inception report primarily includes the project understanding and detailed methodology to meet the requirements of the TOR finalised in consultation with the HPRIDC/HPPWD officers. This report will detail the work plan proposed to undertake the remaining activities and tasks, the staff deployment and deliverable schedule. This will form the basis for the remainder of the project adjusting (superseding) the methodology proposed earlier.

6.1.2 Needs Analysis and Overall System Architecture Report

Study the existing Road Maintenance Management System, assess and identify the strengths and weaknesses of the current data format, processes, planning and for maintenance management practices, decision-making process, organisational structure, and technical and managerial capabilities of the HPPWD/HPRIDC and propose changes aimed at providing adequate support for the RMS and ensuring that upgraded system will be efficient, effective and sustainable. Based on review of current practice needs analysis shall be undertaken by discussions with stakeholders for developing and recommending architecture for RMS.

6.1.3 Road Classification and GPS Road Referencing Report

Assess road referencing system currently in place in HPPWD if needed; recommend improvement in the method of referencing roads and bridges (road numbers, road sections, bridge numbers etc.) to be adopted in the RMS.

Review existing administrative road classification system and establish a new classification system based on road functions. The existing administrative classification system will remain but it will superimpose the functional classification system over the existing one to develop a matrix of classification.

Review existing data collection procedures and in light of additional data needs arising from the development of the RMS, prepare recommendations on the incremental improvement in data collection procedures, procurement of equipment and scheduling of surveys. This will also include preparing a road data collection manual including revised standard forms for data collection.

6.1.4 Training Needs Assessment Report

A set of training program shall be prepared, agreed with the client and delivered on all components of the RMS developed under the project. The training program will utilise a
number of techniques and tools to transfer skills, including workshops, field training and practical experience.

6.1.5 **Annual Road Condition and Traffic Report – 2016 & 2017**

The annual road condition and traffic report will be prepared using annual updated data, for 2016 and 2017 on entire road networks of Himachal Pradesh, comprising the National Highways (selected data), State Highways, Major District Roads and Rural Roads, in a format to be agreed with the client.

6.1.6 **Annual Report – 2016 & 2017**

The annual report will consist of:

- current network condition and traffic;
- road works in execution;
- road works completed;
- annual budget for routine maintenance, periodic maintenance, rehabilitation and improvement works;
- road accident and other traffic statistics;
- bridges condition and annual works; and
- projected network condition, traffic and road works for future years.

The report will be suitable for public dissemination.

6.1.7 **Rolling Two Year Maintenance Plan for 2016 & 2017**

On the basis of an indicative budget to be provided by the HPPWD/HPRIDC, we will use RMS to produce a two year program of maintenance and improvement works on the core road network, comprised of State and Major District Roads, with a focus on prioritising periodic maintenance, rehabilitation and improvement works. The program will be produced to a timeframe that meets the government’s budgeting cycle and is to be revised in an iterative process as more accurate forecasts of the next FY budget become known.

6.1.8 **Final Report**

This report includes the final details of various tasks performed during the course of the entire project, and will highlight the overall outcome of the project.

6.2 **Data Collection**

6.2.1 **Completion of Year-1 Data Collection**

Data collection will be undertaken using ROMDAS, FWD and Axle Pads equipment to be provided by HPPWD/HPRIDC. All equipment will be thoroughly calibrated regularly to maintain the accuracy of the data collection. Relevant training shall be provided to designated HPPWD/HPRIDC staff on its use and maintenance. Insurance will be taken by HPPWD/HPRIDC for the equipment to be provided by them while we will acquire the insurance for the equipment, if any brought by us. The operational expenses including fuel etc will be borne by us.
6.2.2 **Completion of Year-2 Data Collection**

Data collection will be undertaken by client using the ROMDAS, FWD and Axle Pads equipment for complete 100% of the network. We will verify the data as mentioned in Section in 4.9.

6.3 **RMS Handover**

This includes final deployment of RMS, user acceptance testing, software registration and system handover to HPPWD/HPRIDC

6.3.1 **Development of RMS system**

Develop Road Management System (RMS) through configuration of HIMS (COTS) and enter appropriate additional fields for data on the core network. This RMS will be linked to data management applications required to meet the needs of the other systems and the management requirements of the HPPWD/HPRIDC. This RMS includes RIS, BIS, TIS, PMS, RMMS & RWFIMS.

The following activities will be performed as part of configuration of HIMS:
- Supply licenses of HIMS software,
- Installation of HIMS software,
- Configure HIMS software,
- Population with data collected by HPPWD/HPRIDC and Consultant),
- Develop GIS and additional components (if required),
- Overall system acceptance testing,
- Provide implementation support,
- Train HPPWD/HPRIDC Users.

6.3.2 **Handing over of RMS**

Upgraded RMS will be handed over after loading Data along with analysis tools, after successful acceptance testing.

6.4 **Manuals**

6.4.1 **RMS User Manuals**

The User Manuals will provide step by step instructions to the end users for day to day operations of the system. A separate user manual will be developed specific to each of the sub system (RIS, BIS, TIS, PMS, RMMS and RWFIMS). These manuals will assist users in working with and extracting outputs from the system.

6.4.2 **System Installation Manual**

The System Installation Manual will provide step by step instructions to install RMS software. It will provide detailed instructions with illustrations or screen captures to assist with HPPWD/HPRIDC staff to further install and maintain the system.
6.5 **Workshops**

As per the TOR three workshops are required with wide participation of HPPWD/HPRIDC professional staff and GoHP administrative staffs at Shimla.

6.5.1 **Workshop 1**

This workshop aimed at discussing the initial stage (System Architecture report) with wider stakeholders to share their views and goals for the upgraded GIS based RMS and thereby help ensure the effective usage and sustainability of the RMS.

6.5.2 **Workshop 2**

This workshop aimed after completion of Annual Year-1, at discussing the data collection outcome along with some sample data and demonstration of system outputs with wider stakeholders.

6.5.3 **Workshop 3**

This workshop aimed after completion of Annual Year-2, at discussing the data collection outcome along with some sample data and demonstration of system outputs with wider stakeholders.

All workshops are proposed to be held at the head office of HPPWD/HPRIDC.

6.6 **Key Deliverables**

A complete list of project deliverables is given in Table 6-1. Along with the list of deliverables, their expected timelines, content of each report and payment linked to the deliverable are also described. It is noticed that some deliverables are duplicated or out of context. Hence, some minor corrections are made to the content of the deliverables to be in line with the scope of deliverables.
### Table 6-1: Project Deliverables

<table>
<thead>
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<td>Inception report</td>
<td>1</td>
<td>27 Jun 2016</td>
<td>Para 3.1</td>
<td>6</td>
<td>- Project appreciation; - Detailed methodology to meet the requirements of the TOR finalized in consultation with the HPRIDC/HPPWD officers; including scheduling of various sub-activities to be carried out for completion of various stages of the work; stating out clearly their approach &amp; methodology for data collection, data interpretation &amp; data analysis after due inspection of the some of the project stretches and collection / collation of necessary information; - Task assignment and Manning Schedule; - Work programme; - Proforma for data collection;</td>
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<tr>
<td>D-02</td>
<td>Needs analysis and overall system architecture (Draft)</td>
<td>2</td>
<td>26 Jul 2016</td>
<td>Para 2.4.1, 2.4.2, 3.2, 3.3 &amp; 3.4</td>
<td>11</td>
<td>- Study existing processes, practices, RMMS system and perform needs analysis and identify gaps in the system - Define System Architecture - Final road collection procedures - RMS &amp; TIS manuals</td>
</tr>
<tr>
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<td>Needs analysis and overall system architecture (Final)</td>
<td>3</td>
<td>26 Aug 2016</td>
<td>Para 3.3 &amp; 3.9</td>
<td>0</td>
<td>- Workshop will be held before or after finalisation of the Architecture Report</td>
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<tr>
<td></td>
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<td>D-03</td>
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<td>Para 3.4, 3.13 &amp; 3.26, 3.4.3</td>
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<td>- Study current road referencing system and suggest improvements (if any) - Review existing road classification system and suggest</td>
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Consulting Services for Technical Assistance to Help Upgrade Road Maintenance Management System to Road Management System in the State of Himachal Pradesh

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<td>6</td>
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<td>• Gap analysis will be done to identify areas of improvements. A detailed training program will be developed.</td>
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<td>9</td>
<td>27 Feb 2017</td>
<td>Para 2.4.3, 3.13</td>
<td>5</td>
<td>• Collect (Road Inventory &amp; Condition, Bridge Inventory &amp; Condition, pavement strength, traffic, axle load, test pits), Compile and Process the survey data for year-1.</td>
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<td></td>
<td></td>
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<td></td>
<td></td>
<td></td>
<td>• GPS reference data</td>
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<tr>
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<td>System Design document along with operational manual RIS, BIS &amp; TIS completion with GPS referencing and completion report (Development of RIS,BIS and TIS modules)</td>
<td>9</td>
<td>27 Feb 2017</td>
<td></td>
<td>5</td>
<td>• System Design Document along with operational manuals of RIS, BIS and TIS with GPS referencing.</td>
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<tr>
<td></td>
<td></td>
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<td></td>
<td>• Development of RIS, BIS and TIS completed and ready for User Acceptance Testing.</td>
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<td>Acceptance on demonstration of system with Year-1 data of RIS, BIS &amp; TIS completion with GPS referencing &amp; submission</td>
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<td>26 Apr 2017</td>
<td>Para 2.4.5 – 2.4.8, 3.5 - 3.13, 3.22</td>
<td>5</td>
<td>• Deploy the upgraded system with RIS,BIS &amp; TIS modules with GPS loaded with year-1 data</td>
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<tr>
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<td></td>
<td>• Acceptance testing of RIS, BIS &amp; TIS modules with GPS.</td>
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<td>D-08</td>
<td>System Design document along with operational manual Economical Evaluation Model, RMMS, RWFIMS, PMS completion with GPS referencing and completion report</td>
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<td>D-10</td>
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<td>Para 2.4.5 – 2.4.8, 3.5 - 3.13, 3.22</td>
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- Prepare system design document having functional details of Economical Evaluation Model, RMMS, RWFIMS, and PMS.
- Develop user manuals and technical guidelines for all modules of upgraded RMS.
- As per D-06 and D-10.
- Deploy the upgraded system with Economic Evaluation Model, RMMS, RWFIMS, PMS modules with GPS loaded with year-1 data.
- Acceptance testing of Economic Evaluation Model, RMMS, RWFIMS, PMS modules with GPS.
- Road Inventory & Condition, Bridge Inventory & Condition, pavement strength, traffic, axle load, test pits data shall be loaded into the system to generate standard statistical form including mean and standard
### Consulting Services for Technical Assistance to Help Upgrade Road Maintenance Management System to Road Management System in the State of Himachal Pradesh

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<th>Expected Date</th>
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<th>Payment (%)</th>
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<td>deviation of the respective data items, frequency distribution, etc. All of these shall be reported in both tabular and graphical form. All these data items are compiled in the Annual road condition and traffic report.</td>
</tr>
</tbody>
</table>
|        | Annual report – 2016 (Draft)               | ¶ 12                        | 26 May 2017    | Para 3.17 & 3.23           | 3           | • Annual report consists of details of  
  o network condition and traffic data;  
  o committed projects (works ongoing/completed);  
  o annual budget for routine maintenance, periodic maintenance, rehabilitation and improvements;  
  o road accident and traffic statistics;  
  o bridges condition and annual works;  
  o Projected network condition, traffic and road works for future years. |
<p>|        | Rolling two year maintenance plan for – 2016 (Final) |                            |                |                            | 0           |                                                                                                                                                             |
| D-14   | Completion of all training events           | ¶ 12                        | 26 May 2017    | Para 3.27-3.30             | 5           | • Completion of all training events for year-1.                                                                                                            |
| D-15   | Workshop-2                                 | 12                          | May 2017       | Para 3.3 &amp; 3.9             | 0           | • Workshops will be planned after completion of Annual Year-1.                                                                                              |
| D-16   | Handing over RMS (Acceptance of Data, Analysis Tool and) | 15                          | 28 Aug 2017    |                            | 0           | • Acceptance of Year-1 data, upgraded RMS system, and training manuals.                                                                                     |</p>
<table>
<thead>
<tr>
<th>Number</th>
<th>Deliverable</th>
<th>Estimated Timeframe (months)</th>
<th>Expected Date</th>
<th>Reference</th>
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<th>Year-2</th>
<th>Proposed Contents of the report</th>
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<td></td>
<td>accuracy thereof after rectification of errors/ variations if any in the final</td>
<td></td>
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<td></td>
<td></td>
<td></td>
<td>• HPPWD to provide the Year-2 data collected, compiled and processed in the required formats for loading into upgraded System having year-1 data.</td>
</tr>
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<td>D-17</td>
<td>Completion of year-2 data and submission of Data collection and verification completion report</td>
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<td>26 Dec 2017</td>
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<td>29 Jan 2018</td>
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<td>3</td>
<td></td>
<td>• Road Inventory &amp; Condition, Bridge Inventory &amp; Condition, pavement strength, traffic, axle load, test pits data shall be loaded into the system to generate standard statistical form including mean and standard deviation of the respective data items, frequency distribution, etc. All of these shall be reported in both tabular and graphical form. All these data items are compiled in the Annual road condition and traffic report.</td>
</tr>
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<td>Annual road condition &amp; Traffic report – 2017 (Final)</td>
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<td>Rolling two year maintenance plan for – 2017-18 (Final)</td>
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<td>Payment (%)</td>
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</table>
| D-20   | Annual report – 2017 (Draft)                                    |                              |                    |                            |             | • Annual report consists of details of  
|        | Annual report – 2017 (Final)                                    |                              |                    |                            |             |   o network condition and traffic data;  
|        |                                                                 |                              |                    |                            |             |   o committed projects (works ongoing/completed);  
|        |                                                                 |                              |                    |                            |             |   o annual budget for routine maintenance, periodic maintenance, rehabilitation and improvements;  
|        |                                                                 |                              |                    |                            |             |   o road accident and traffic statistics;  
|        |                                                                 |                              |                    |                            |             |   o bridges condition and annual works;  
|        |                                                                 |                              |                    |                            |             |   o Projected network condition, traffic and road works for future years. |
| D-21   | Workshop-3                                                      |                              |                    |                            |             | • Workshops will be planned after completion Annual Year-2.                                    |
| D-22   | Annual Performance Report at the end of 2nd year and completion |                              |                    |                            |             | • Final report containing activities performed, issues faced, lessons learnt and way forward. |
|        | of all activities                                               |                              |                    |                            |             |                                                                                              |
7. **Work Schedule**

7.1 **Work Plan**

As part of the Inception phase, we have reviewed and updated the work plan to confirm to the situation realised during the preliminary discussions held with the HPPWD/HPRIDC and other stakeholders of this assignment. The revised work plan is given in Figure 7.1. The work plan will be as the project progresses, if deemed necessary.

It is scheduled to deploy RMS with RIS, BIS & TIS modules in February 2017 subject to availability of year-1 data. The revised work plan reflects the proposed modifications, pending approval by HPPWD/HPRIDC.
<table>
<thead>
<tr>
<th>Num</th>
<th>Task Description</th>
<th>RMS Development Phase (12 months)</th>
<th>Support Phase (12 months)</th>
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<td>1.0</td>
<td>Assessment of Current RMMS</td>
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<td>1.1 Mobilisation and Interactions with HPPWD/HPRIDC</td>
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<td>1.2 Comprehension of Existing Practices and Data</td>
<td>●●</td>
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<td></td>
<td>1.3 Appreciation of HPPWD Organisational Framework</td>
<td>●●</td>
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<td>1.4 Comprehension of Policy, Procedures and Planning</td>
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<td></td>
<td>1.5 Preparation of Inception Report</td>
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<tr>
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<td>1.6 Comprehension of RMMS</td>
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<td>1.7 Finalise the RMS System Architecture</td>
<td>●●</td>
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</tr>
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<td>1.8 Review Location Referencing System</td>
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</tr>
<tr>
<td>2.0</td>
<td>Improvement in Data Collection and RIS</td>
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<tr>
<td></td>
<td>2.1 Data Review</td>
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<tr>
<td></td>
<td>2.2 Procurement / Upgrade of Data Collection Equipment</td>
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<td>2.3 Selection of COTS</td>
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<td>2.4 Configuration of HIMS</td>
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<td>2.5 Location Reference Management System (LRMS)</td>
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<td>2.7 Bridge Information System (BIS)</td>
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<td>2.8 Traffic Information System (TIS)</td>
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**Figure 7-1: Work Plan**

RMS Development Phase (12 months)

Support Phase (12 months)

Task Description

<table>
<thead>
<tr>
<th>Num</th>
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<td>1.8 Review Location Referencing System</td>
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<td>Improvement in Data Collection and RIS</td>
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<td>●● ●●</td>
<td></td>
</tr>
<tr>
<td></td>
<td>2.7 Bridge Information System (BIS)</td>
<td>●● ●●</td>
<td></td>
</tr>
<tr>
<td></td>
<td>2.8 Traffic Information System (TIS)</td>
<td>●● ●●</td>
<td></td>
</tr>
<tr>
<td></td>
<td>2.9 Prepare Data Collection Manual</td>
<td>●●</td>
<td></td>
</tr>
<tr>
<td></td>
<td>2.10 Data Migration</td>
<td>●●</td>
<td></td>
</tr>
<tr>
<td></td>
<td>2.1 Data Collection</td>
<td>●● ●●</td>
<td></td>
</tr>
<tr>
<td></td>
<td>2.1 Data Processing and Management</td>
<td>●●</td>
<td></td>
</tr>
<tr>
<td>3.0</td>
<td>Development of Planning Tools</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>3.1 Pavement Management System (PMS)</td>
<td>●● ●●</td>
<td></td>
</tr>
<tr>
<td></td>
<td>3.2 HDM-4 Interface</td>
<td>●● ●●</td>
<td></td>
</tr>
<tr>
<td></td>
<td>3.3 HDM-4 Calibration</td>
<td>●● ●●</td>
<td></td>
</tr>
<tr>
<td></td>
<td>3.4 Routine Maintenance Management System (RMMS)</td>
<td>●● ●●</td>
<td></td>
</tr>
<tr>
<td></td>
<td>3.5 ROW Features Information Management System (ROWFIMS)</td>
<td>●● ●●</td>
<td></td>
</tr>
<tr>
<td></td>
<td>3.6 Acceptance Testing</td>
<td>●●</td>
<td></td>
</tr>
<tr>
<td>4.0</td>
<td>Preparation of Road Condition Reports and Maintenance Plans</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>4.1 Annual Condition Reports</td>
<td>●●</td>
<td></td>
</tr>
<tr>
<td></td>
<td>4.2 Rolling Maintenance Plans</td>
<td>●●</td>
<td></td>
</tr>
<tr>
<td>5.0</td>
<td>Road classification</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>5.1 Road Classification</td>
<td>●●</td>
<td></td>
</tr>
<tr>
<td></td>
<td>5.2 Homogeneous Sections</td>
<td>●●</td>
<td></td>
</tr>
<tr>
<td>6.0</td>
<td>Transfer of Skills and Training</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>6.1 Training Needs Assessment (TNA)</td>
<td>●●</td>
<td></td>
</tr>
<tr>
<td>Num</td>
<td>Task Description</td>
<td>RMS Development Phase (12 months)</td>
<td>Support Phase (12 months)</td>
</tr>
<tr>
<td>-----</td>
<td>------------------</td>
<td>------------------------------------</td>
<td>---------------------------</td>
</tr>
<tr>
<td>6.2</td>
<td>Training</td>
<td>** ●● ●● ●● ●● ●● ●● **</td>
<td></td>
</tr>
<tr>
<td>6.3</td>
<td>Evaluation of Training</td>
<td></td>
<td></td>
</tr>
<tr>
<td>7.0</td>
<td>Ongoing Support</td>
<td></td>
<td></td>
</tr>
<tr>
<td>7.1</td>
<td>Maintenance Support</td>
<td></td>
<td>● ● ● ● ● ● ● ● ● ● ● ● ● ●</td>
</tr>
<tr>
<td>8.0</td>
<td>Manuals and Reports</td>
<td></td>
<td></td>
</tr>
<tr>
<td>8.1</td>
<td>Submission of Deliverables</td>
<td></td>
<td>● ● ● ● ● ● ● ● ● ● ● ● ● ●</td>
</tr>
<tr>
<td>9.0</td>
<td>Assess Additional Need for Data Collection Equipment</td>
<td></td>
<td></td>
</tr>
<tr>
<td>9.1</td>
<td>Data Collection Equipment</td>
<td></td>
<td>● ● ● ● ● ● ● ● ● ● ● ● ● ●</td>
</tr>
<tr>
<td>10.0</td>
<td>Institutional Set-Up of RMS</td>
<td></td>
<td>● ● ● ● ● ● ● ● ● ● ● ● ● ●</td>
</tr>
<tr>
<td>11.0</td>
<td>Result Monitoring</td>
<td></td>
<td></td>
</tr>
<tr>
<td>11.1</td>
<td>Performance Monitoring</td>
<td></td>
<td>● ● ● ● ● ● ● ● ● ● ● ● ● ●</td>
</tr>
</tbody>
</table>

**Deliverables**

- D-01 Inception Report
- D-02 Needs Analysis and Overall System Architecture (Draft)
- D-03 RMS conceptual design workshop No.1
- D-04 Road Data Collection manual (Draft)
- D-05 Road Classification and GPS Road Referencing (Draft)
- D-06 Training Needs Assessment Report (Draft)
- D-07 1st year Data Collection and Verification Report
- D-08 Development of LRMS, RIS, BIS and TIS along with system design documents
- D-09 Acceptance of LRMS, RIS, BIS and TIS (with 1st year Data)
- D-10 Development of PMS, RMMS and RWFIMS
- D-11 RIS and TIS User Manuals (Draft/Final)
- D-12 Acceptance of PMS, RMMS and RWFIMS (with 1st year Data)
- D-13 Annual Road Condition and Traffic Report - 2016
- D-14 Annual Report - 2016
- D-15 Rolling Two Year Maintenance Plan for 2016-17
- D-16 Completion of All Training
- D-17 RMS conceptual design workshop No.2
- D-18 Handing over of RMS
- D-19 2nd year Data Collection and Verification Report
- D-20 Annual Road Condition and Traffic Report - 2017
- D-21 Rolling Two Year Maintenance Plan for 2017-18
- D-22 Completion Report
8. **Focus Items**

During the discussions and detailing out the project implementation plan (work plan), some items were found attention or required some minor adjustments for the successful execution of the Project. These items are described below to draw attention of the Client. Once approved, these proposed modifications will form the basis for the execution of the Project.

8.1 **Project Road network**

As per Clause 3.13 of TOR, Appendix-E-1, E-2 and E-3 is provided with the list of SH and MDRs (3,890 km), tentative / indicative list of SH/MDR/Other roads (830 km) and List of Rural roads about 1,975 km out of which 310 km needs to selected for CRN.

We have noticed some inconsistencies in the length of the network and the comparison of the road network length as per TOR and provided Annexures List is given in Table 8-1 below.

<table>
<thead>
<tr>
<th>Road Type</th>
<th>Length (km) as given in TOR</th>
<th>Length (km) as per Annexure E-1, E-2, E-3</th>
<th>Final Agreed Length</th>
</tr>
</thead>
<tbody>
<tr>
<td>National Highways (NHs)</td>
<td>1,553</td>
<td></td>
<td>2,002.7</td>
</tr>
<tr>
<td>State Highways (SHs)</td>
<td>1,504</td>
<td>1466.3</td>
<td>1,466.3</td>
</tr>
<tr>
<td>Major District Roads (MDRs)</td>
<td>2,139</td>
<td>2144.9</td>
<td>2,397.7</td>
</tr>
<tr>
<td>Rural Roads (RRs)</td>
<td>27,575</td>
<td>1975.5</td>
<td>27,790.0</td>
</tr>
<tr>
<td>Border Roads (BRs)</td>
<td>720</td>
<td>689.0</td>
<td></td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>33,491</strong></td>
<td></td>
<td><strong>34,345.7</strong></td>
</tr>
</tbody>
</table>

As mentioned above when we sum up the SH and MDR the total is not matching to 3,890 km as specified in the TOR.

It is also mentioned that Traffic count survey, axle load survey locations also need to be identified in consultation with client.

Hence it is requested to provide required finalised list for following

1. Network list for GPS surveys of 5,595 km;
2. Network list for Roughness surveys of 4,200 km;
Consulting Services for Technical Assistance to Upgrade Road Maintenance Management System to Road Management System in the State of Himachal Pradesh

3. List of Traffic count survey, axle load survey locations;

4. List of Bridges and culverts to be cross verified.

The final road network list provided is as follows:

1. Length of SH and MDR is 3,864 km;

2. Network for GPS surveys of 6,176.7 km;

3. Network for Roughness surveys of 4,174 km;

8.2 Deliverables and Payment Terms

8.2.1 Content of Deliverables

As stated in Chapter 6, content of some of the deliverables is out of context. Hence, content of these deliverables is slightly revised to align with the scope of deliverables. In no case the relevance or effort of the deliverable is reduced.

<table>
<thead>
<tr>
<th>Number</th>
<th>Deliverable</th>
<th>Estimated Timeframe (months)</th>
<th>Reference</th>
<th>Proposed Contents of the report</th>
</tr>
</thead>
<tbody>
<tr>
<td>D-01</td>
<td>Inception report</td>
<td>1</td>
<td>Para 3.1</td>
<td>• Project appreciation;</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>• Detailed methodology to meet the requirements of the TOR finalized in consultation with the HPRIDC/HPPWD officers; including scheduling of various sub-activities to be carried out for completion of various stages of the work; stating out clearly their approach &amp; methodology for data collection, data interpretation &amp; data analysis after due inspection of the some of the project stretches and collection / collation of necessary information;</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>• Task assignment and Manning Schedule;</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>• Work programme;</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>• Proforma for data collection;</td>
</tr>
<tr>
<td></td>
<td>Needs analysis and overall system architecture (Draft)</td>
<td>2</td>
<td>Para 2.4.1, 3.2, 3.3 and 3.4</td>
<td>• Study existing processes, practices, RMMS system and perform needs analysis and identify gaps in the system</td>
</tr>
<tr>
<td></td>
<td>Needs analysis and overall system architecture (Final)</td>
<td>3</td>
<td></td>
<td>• Define System Architecture</td>
</tr>
<tr>
<td>D-02</td>
<td>Needs analysis and overall system architecture (Draft)</td>
<td>2</td>
<td>Para 2.4.1, 3.2, 3.3 and 3.4</td>
<td>Final road collection procedures</td>
</tr>
<tr>
<td></td>
<td>Needs analysis and overall system architecture (Final)</td>
<td>3</td>
<td></td>
<td>RMS &amp; TIS manuals</td>
</tr>
<tr>
<td></td>
<td>RMS conceptual design workshop (No.1)</td>
<td>3</td>
<td>Para 3.3 &amp; 3.9</td>
<td>Workshop will be held before or after finalisation of the Architecture Report</td>
</tr>
<tr>
<td>D-03</td>
<td>Road Classification and GPS road referencing (Draft)</td>
<td>4</td>
<td>Para 3.4, 3.13 &amp; 3.26, 3.26</td>
<td>• Study current road referencing system and suggest improvements (if any)</td>
</tr>
<tr>
<td></td>
<td>Road Classification and</td>
<td>5</td>
<td></td>
<td>• Review existing road classification system and suggest new classification system (if any)</td>
</tr>
<tr>
<td>Number</td>
<td>Deliverable</td>
<td>Estimated Timeframe (months)</td>
<td>Reference</td>
<td>Proposed Contents of the report</td>
</tr>
<tr>
<td>--------</td>
<td>------------------------------------------------------------------------------</td>
<td>-----------------------------</td>
<td>-----------</td>
<td>---------------------------------</td>
</tr>
<tr>
<td>D-05</td>
<td>GPS road referencing (Final)</td>
<td></td>
<td></td>
<td>• Final data collection procedures</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>• Data collection (of 3.13)</td>
</tr>
<tr>
<td></td>
<td>Completion of year-1 data (Data Acquisition on road condition such as FWD,</td>
<td>9</td>
<td>Para 2.4.3, 3.13</td>
<td>• Collect (Road Inventory &amp; Condition, Bridge Inventory &amp; Condition, pavement strength, traffic, axle load, test pits), Compile and Process the survey data for year-1.</td>
</tr>
<tr>
<td></td>
<td>roughness, surface distress, pavement strength, traffic, axle load etc. as mentioned under various tasks) and submission of Data collection and verification completion report</td>
<td></td>
<td></td>
<td>• GPS reference data</td>
</tr>
<tr>
<td>D-09</td>
<td>RMS and TIS user manuals – Draft</td>
<td>11</td>
<td>Para 3.32</td>
<td>• Develop user manuals and technical guidelines for all modules of upgraded RMS.</td>
</tr>
<tr>
<td>D-09</td>
<td>RMS and TIS user manuals – Final</td>
<td>12</td>
<td></td>
<td>• As per D-06 and D-10</td>
</tr>
<tr>
<td>D-11</td>
<td>Annual road condition &amp; Traffic report – 2016 (Draft)</td>
<td>12</td>
<td>Para 3.23</td>
<td>• Road Inventory &amp; Condition, Bridge Inventory &amp; Condition, pavement strength, traffic, axle load, test pits data shall be loaded into the system to generate standard statistical form including mean and standard deviation of the respective data items, frequency distribution, etc. All of these shall be reported in both tabular and graphical form. All these data items are compiled in the Annual road condition and traffic report.</td>
</tr>
</tbody>
</table>
| D-12   | Annual report – 2016 (Draft)                                                 | 12                          | Para 3.17 & 3.23 | • Annual report consists of details of  
|        |                                                                              |                             |           | a. network condition and traffic data; |
|        |                                                                              |                             |           | b. committed projects (works ongoing/completed); |
|        |                                                                              |                             |           | c. annual budget for routine maintenance, periodic maintenance, rehabilitation and improvements; |
|        |                                                                              |                             |           | d. road accident and traffic statistics; |
|        |                                                                              |                             |           | e. bridges condition and annual works; |
|        |                                                                              |                             |           | f. Projected network condition, traffic and road works for future years. |
Consulting Services for Technical Assistance to Help Upgrade Road Maintenance Management System to Road Management System in the State of Himachal Pradesh

<table>
<thead>
<tr>
<th>Number</th>
<th>Deliverable</th>
<th>Estimated Timeframe (months)</th>
<th>Reference</th>
<th>Proposed Contents of the report</th>
</tr>
</thead>
<tbody>
<tr>
<td>D-14</td>
<td>Completion of all training events</td>
<td>11 12</td>
<td>Para 3.27 – 3.30</td>
<td>• Completion of all training events for year-1.</td>
</tr>
</tbody>
</table>

8.2.2 **Payment Schedule**

It is noticed that the sequence of the payment schedule didn’t reflect sequence of deliverables. Hence, it is proposed to revise the order of the payments schedule or proposed to make payments as per the milestone completed (or deliverable submitted/approved). The revised payment terms are given in Table 8-3.

**Table 8-3: Payment Schedule**

<table>
<thead>
<tr>
<th>S.No</th>
<th>Current Payment Term</th>
<th>S.No</th>
<th>Revised Payment Term</th>
</tr>
</thead>
<tbody>
<tr>
<td>a</td>
<td>Five (5) percent of the contract price as Advanced Payment shall be paid after the receipt of advance payment guarantee by the client – Not applicable</td>
<td>a</td>
<td>Five (5) percent of the contract price as Advanced Payment shall be paid after the receipt of advance payment guarantee by the client – Not applicable</td>
</tr>
<tr>
<td>b</td>
<td>Six (6) percent of the lump sum amount shall be paid upon submission of inception report and acceptance by client</td>
<td>b</td>
<td>Six (6) percent of the lump sum amount shall be paid upon submission of inception report and acceptance by client</td>
</tr>
<tr>
<td>c</td>
<td>Eleven (11) percent of the lump sum amount on submission of Final Needs Analysis and overall RMS concept design, architecture Report and Final road data collection, RMS &amp; TIS Manuals</td>
<td>c</td>
<td>Eleven (11) percent of the lump sum amount on submission of Final Needs Analysis and overall RMS concept design, architecture Report and Final road data collection, RMS &amp; TIS Manuals</td>
</tr>
<tr>
<td>d</td>
<td>Six (6) percent of the lump sum amount on submission of Final Road Classification and GPS road Referencing</td>
<td>d</td>
<td>Six (6) percent of the lump sum amount on submission of Final Road Classification and GPS road Referencing</td>
</tr>
<tr>
<td>e</td>
<td>Six (6) percent of the lump sum amount on submission of Annual road conditions &amp; traffic report for 2015 &amp; 2016</td>
<td>e k</td>
<td>Six (6) percent of the lump sum amount on submission of Annual road conditions &amp; traffic report for 2015 &amp; 2016 &amp; 2017</td>
</tr>
<tr>
<td>f</td>
<td>Six (6) percent of the lump sum amount on submission of Annual report for 2015 &amp; 2016</td>
<td>f l</td>
<td>Six (6) percent of the lump sum amount on submission of Annual report for 2015 &amp; 2016 &amp; 2017</td>
</tr>
<tr>
<td>g</td>
<td>Five (5) percent lump sum amount on submission of Rolling two year maintenance plan for 15-16 &amp; 16-17</td>
<td>g m</td>
<td>Five (5) percent lump sum amount on submission of Rolling two year maintenance plan for 15-16 &amp; 16-17 &amp; 17-18</td>
</tr>
<tr>
<td>h</td>
<td>Five (5) percent lump sum amount on submission of Final Training Needs Assessment Report</td>
<td>e</td>
<td>Five (5) percent lump sum amount on submission of Final Training Needs Assessment Report</td>
</tr>
<tr>
<td>---</td>
<td>-----------------------------------------------------------------</td>
<td>---</td>
<td>-----------------------------------------------------------------</td>
</tr>
<tr>
<td>i</td>
<td>Five (5) percent lump sum amount on completion of 1st year data acquisition &amp; submission of Data Collection and verification completion report</td>
<td>f</td>
<td>Five (5) percent lump sum amount on completion of 1st year data acquisition &amp; submission of Data Collection and verification completion report</td>
</tr>
<tr>
<td>j</td>
<td>Five (5) percent lump sum amount on completion of 2nd year data acquisition &amp; submission of Data Collection and verification completion report</td>
<td>p</td>
<td>Five (5) percent lump sum amount on completion of 2nd year data acquisition &amp; submission of Data Collection and verification completion report</td>
</tr>
<tr>
<td>k</td>
<td>Five (5) percent lump sum amount on compliance testing, SDD along with operations manual of RIS, BIS &amp; TIS completion with GPS referencing &amp; submission of completion report</td>
<td>g</td>
<td>Five (5) percent lump sum amount on compliance testing, SDD along with operations manual of RIS, BIS &amp; TIS completion with GPS referencing &amp; submission of completion report</td>
</tr>
<tr>
<td>l</td>
<td>Five (5) percent lump sum amount on acceptance on demonstration of the system with 1st year data of RIS, BIS &amp; TIS completion with GPS referencing &amp; submission of completion report</td>
<td>h</td>
<td>Five (5) percent lump sum amount on acceptance on demonstration of the system with 1st year data of RIS, BIS &amp; TIS completion with GPS referencing &amp; submission of completion report</td>
</tr>
<tr>
<td>m</td>
<td>Five (5) percent lump sum amount on compliance testing, SDD along with operations manual of Economic Evaluation Model, PMS, RMMS, and RWFMS completion &amp; submission of completion report</td>
<td>i</td>
<td>Five (5) percent lump sum amount on compliance testing, SDD along with operations manual of Economic Evaluation Model, PMS, RMMS, and RWFMS completion &amp; submission of completion report</td>
</tr>
<tr>
<td>n</td>
<td>Five (5) percent lump sum amount on acceptance on demonstration of the system with 1st year data of Economic Evaluation Model, PMS, RMMS, and RWFMS completion &amp; submission of completion report</td>
<td>j</td>
<td>Five (5) percent lump sum amount on acceptance on demonstration of the system with 1st year data of Economic Evaluation Model, PMS, RMMS, and RWFMS completion &amp; submission of completion report</td>
</tr>
<tr>
<td>o</td>
<td>Ten (10) percent of the lump sum amount on acceptance of Data, Analysis Tool and accuracy thereof after rectification of errors/variations if any in the final form and Handing over of Assets to Client and Other training manuals to be identified &amp; submission of completion report</td>
<td>o</td>
<td>Ten (10) percent of the lump sum amount on acceptance of Data, Analysis Tool and accuracy thereof after rectification of errors/variations if any in the final form and Handing over of Assets to Client and Other training manuals to be identified &amp; submission of completion report</td>
</tr>
<tr>
<td>p</td>
<td>Five (5) percent on completion of all training events</td>
<td>n</td>
<td>Five (5) percent of the lump sum amount on completion of all training events</td>
</tr>
</tbody>
</table>
8.2.3 Payment Terms

It is noticed that a lump sum payment is assigned to the deliverables to be submitted in two years. Therefore it is proposed split this payment into two parts (50% in first year and remaining 50% in second year). This is described in Table 8-4.

<table>
<thead>
<tr>
<th>S.No</th>
<th>Current Payment Term</th>
<th>S.No</th>
<th>Revised Payment Term</th>
</tr>
</thead>
<tbody>
<tr>
<td>e</td>
<td>Six (6) percent of the lump sum amount on submission of Annual road conditions &amp; traffic report for 2015 &amp; 2016</td>
<td>e k-1</td>
<td>Six (6) Three (3) percent of the lump sum amount on submission of Annual road conditions &amp; traffic report for 2015 &amp; 2016 &amp; 2017</td>
</tr>
<tr>
<td>f</td>
<td>Six (6) percent of the lump sum amount on submission of Annual report for 2015 &amp; 2016</td>
<td>f l-1</td>
<td>Six (6) Three (3) percent of the lump sum amount on submission of Annual report for 2015 &amp; 2016 &amp; 2016 &amp; 2017</td>
</tr>
<tr>
<td>g</td>
<td>Five (5) percent lump sum amount on submission of Rolling two year maintenance plan for 15-16 &amp; 16-17</td>
<td>g m-1</td>
<td>Five (5) Two &amp; half (2.5) percent lump sum amount on submission of Rolling two year maintenance plan for 15-16 &amp; 16-17 &amp; 16-17 &amp; 17-18</td>
</tr>
<tr>
<td></td>
<td></td>
<td>g m-2</td>
<td>Five (5) Two &amp; half (2.5) percent lump sum amount on submission of Rolling two year maintenance plan for 15-16 &amp; 16-17 &amp; 16-17 &amp; 17-18</td>
</tr>
</tbody>
</table>

It was advised by HPRIDC/HPPWD that there will be no changes to Payment schedule and payments, as all the payments will be released partly/full based on the submittal of the deliverable as per the Contract and it is not required to maintain the order of payment schedule mentioned in the Contract.
8.3 **Procurement of Equipment**

As per Clause 3.13 of TOR, the following equipment will be made available by HPPWD/HPRIDC for this Project.

- ROMDAS Equipment for conducting inventory and roughness survey;
- Falling Weight Deflectometer (FWD) for conducting pavement strength survey;
- Portable Axle Weigh Pads for conducting traffic axle load survey.

It is therefore requested to make the equipment available within 5 months (i.e. by October 2016) from the commencement, as the Year 1 surveys will have to be completed by 9th month (February 2017). Any delay in making these equipment available to us will significantly hamper the schedule of the Project. Severe cold conditions or snow fall is expected from December to February months, making field data collection is almost impossible in most parts of the State.

The preliminary specifications for the equipment’s to be procured are attached in Annex-VII. These specifications will be detailed out and necessary support will be provided to HPPWD/HPRIDC at the earliest possible so that the procurement process can be initiated soon.

8.4 **Data Collection**

As per Clause 3.13 of TOR, the data collection in Year-1 (2016) is shared by us and HPPWD. Refer to Section 4.9 for more details on the scope and responsibility of Consultant and HPPWD/HPRIDC. It is expected that the same equipment, to be supplied by HPPWD/HPRIDC, will be used for the entire data collection. Given this, we feel excellent coordinated and planning is required to complete all data collection within the stipulated time of 9 months from commencement.

Alternatively, it is proposed that we (Consultant) will collect complete baseline data in Year-1 on the entire network with the equipment to be provided by HPPWD/HPRIDC. Year-2 data collection can be taken by HPPWD Engineers and we will perform the verification of the data as mentioned in Section in 4.9. The merits of this approach are listed below for discussion:

- Consistency in baseline data (Year 1);
- Removal of sharing equipment or coordinating between Client and Consultant survey teams;
- Risk of completing data within stipulated time transferred to Consultant;
- Adequate training to all Divisional or Sub-divisional Engineers in data collection making them prepared for Year 2 data collection.

Should this be the preferred approach, we will perform additional field surveys at the unit rates mentioned in the Contract. The preliminary additional cost estimate is given in Annex-VIII.

It was confirmed by HPRIDC/HPPWD that no additional services are envisaged at this stage, and if any additional services required in future the same will be discussed and mutually agreed.
8.5 **Workshops and Training**

As per the Clause 5.5 of TOR, it is suggested to conduct three (3) workshops with wide participation of HPPWD/HPRIDC professional staff and GoHP administrative staffs at Shimla (one at the initial stage and other two to be agreed with Client) to share their views and goals for upgraded GIS based RMS and thereby help to ensure the effective usage and sustainability of the RMS.

Hence it is proposed the workshops to be planned as follows:

- Workshop will be held before or after finalisation of the Architecture Report in the month of Aug 2016.
- Workshop will be planned after completion of Annual Year-1 in the month of May 2017.
- Workshops will be planned after completion Annual Year-2 in the month of May 2018.
9. Conclusion

The enhanced RMS will assist HPPWD/HPRIDC in making informed strategic planning decisions on the road network development and management. The data collection procedures and institutional framework to be developed under this assignment are aimed at providing adequate sustainability to RMS. It is envisaged a dedicated RMS cell be established to keep RMS updated and available to the internal and external stakeholders.

To ensure the smooth execution of the current assignment it is requested HPPWD/HPRIDC to finalise the following aspects at the earliest:

**Steering Committee:** It was agreed to setup a Steering Committee to monitor and provide technical direction to the Consultant team;

**Project Road Network:** As per the TOR, HPPWD/HPRIDC will provide the required list of road network and identify the locations for Traffic count and Axle load surveys.

**Data Collection:** As per the TOR, HPPWD/HPRIDC will make survey available for data collection. Further, majority of the network survey will be performed by HPPWD in Year-1 and complete survey in Year-2;

**Proposed Modifications:** Some modifications in the deliverables and associated payment schedule are proposed based on sequence of the deliverables.
## Annex-I: Summary of the Meetings

<table>
<thead>
<tr>
<th>Topic / Item</th>
<th>Department/Staff Name</th>
<th>Date</th>
</tr>
</thead>
<tbody>
<tr>
<td>Project Kick off meeting</td>
<td>Planning Division, HPRIDC</td>
<td>22.06.2016</td>
</tr>
<tr>
<td>Introduction of team members and project updates</td>
<td>Project Director, HPRIDC</td>
<td>22.06.2016</td>
</tr>
<tr>
<td>Discussion on Deliverables and its content, Work schedule and Payment terms.</td>
<td>Planning Division, HPRIDC</td>
<td>24.06.2016</td>
</tr>
<tr>
<td>Inspection of ROMDAS equipment</td>
<td>Er. Archana Thakur (SE WBP) Mr. Mahender (AE Works) Mr. Rajesh Kumar (SE Works)</td>
<td>25.06.2016</td>
</tr>
<tr>
<td>RMMS system overview and IT infrastructure</td>
<td>Mr. Bhavesh Mr. Lalit Kumar Pande - AE Nodal Officer (IT)</td>
<td>25.06.2016</td>
</tr>
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Annex-II: List of Documents supplied by HPRIDC
<table>
<thead>
<tr>
<th>Topic / Item</th>
<th>Document / File Name</th>
<th>Date</th>
</tr>
</thead>
<tbody>
<tr>
<td>Documents consisting of existing data collection manuals, data collection</td>
<td>Folder: Road Data Collection Manual</td>
<td>22.06.2016</td>
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<td>forms and defects catalog manual</td>
<td></td>
<td></td>
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<tr>
<td>Documents consisting of existing Quality Plan manual and various checklists</td>
<td>Folder: Road maintenance manual -3</td>
<td>22.06.2016</td>
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<tr>
<td>followed for RM, PM etc.</td>
<td></td>
<td></td>
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<tr>
<td>Documents consisting of User manual for existing RMMS system and Data</td>
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<td>22.06.2016</td>
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<td>collection Templates</td>
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<td></td>
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<td></td>
<td>SH-MDR-VR</td>
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</tr>
<tr>
<td>Appendix-E-1: List of SHs/MDRs roads</td>
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<td>24.06.2016</td>
</tr>
<tr>
<td>Appendix-E-2: Indicative list of SHs/MDRs/Other roads (830Km).</td>
<td>Hard copy - printed</td>
<td>24.06.2016</td>
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<td>Appendix-E-3: List of Rural roads about 1,975Km out of which 310Km roads</td>
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<td>will be selected for CRN).</td>
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<td>Shape files for the road core network, DRRP network along with</td>
<td>Folder : ARC GIS data HP</td>
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<td>administrative boundaries</td>
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Annex III: List of SH and MDR roads
# State Highways & Major Districts Roads

There are following State Highways in the State:

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<thead>
<tr>
<th>Sr. No.</th>
<th>Name of Road</th>
<th>District</th>
<th>Length (in Kms)</th>
<th>SH. No.</th>
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<tbody>
<tr>
<td>1</td>
<td>Kumarhatti-Sarahan-Nahan (Dosarka)</td>
<td>Sirmour/Solan</td>
<td>78.00</td>
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<td>2</td>
<td>Chhaila Neripul Yashwant Nagar Oachghat Kumarhatti</td>
<td>Shimla/Sirmour/Solan</td>
<td>86.30</td>
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<tr>
<td>3</td>
<td>Sainj Chopal Nerwa Shallu</td>
<td>Shimla</td>
<td>90.00</td>
<td>8</td>
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<tr>
<td>4</td>
<td>Shalaghat Arki Kunjhar Brotiwala</td>
<td>Solan</td>
<td>80.40</td>
<td>9</td>
</tr>
<tr>
<td>5</td>
<td>Theog Kotkhai Hatkoti Rohru</td>
<td>Shimla</td>
<td>80.00</td>
<td>10</td>
</tr>
<tr>
<td>6</td>
<td>Shamlal Tatapani Mandi</td>
<td>Shimla/Mandi</td>
<td>185.60</td>
<td>13</td>
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<tr>
<td>7</td>
<td>Shimla Kunihar Ramshehar Nalagarh Ghanoli</td>
<td>Shimla/Solan</td>
<td>112.30</td>
<td>16</td>
</tr>
<tr>
<td>8</td>
<td>Dharamshala Dadh Palampur Holta Chadhiar Sandhol (Except NH portion)</td>
<td>Kangra/Mandi</td>
<td>90.00</td>
<td>17</td>
</tr>
<tr>
<td>9</td>
<td>Jogindarnagar Sarkaghat Ghumarwin (except NH portion)</td>
<td>Mandi/Bilaspur</td>
<td>83.00</td>
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<td>10</td>
<td>Jawalamukhi Dehra Jawali Raja-ka-Talab</td>
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<td>Mehatpur Una Mubarakpur Daulatpur H.P. Boundary (except NH portion)</td>
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<td>12</td>
<td>Pong Dam Fatehpur Jassur</td>
<td>Kangra</td>
<td>53.00</td>
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<tr>
<td>13</td>
<td>Nurpur Lahru Tunuhatti</td>
<td>Kangra/Chamba</td>
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<tr>
<td>14</td>
<td>Una-Aghar Barsar Jahu Bhambla Nerchowk</td>
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<td>15</td>
<td>Chamba-Tissa</td>
<td>Chamba</td>
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<td>16</td>
<td>Hamirpur Sujuanpur Thural Maranda</td>
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<td>17</td>
<td>Shahpur Sihunta Chowari</td>
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<tr>
<td>18</td>
<td>Ranital to 32 mile (Kotla) 0/0 to 39.600</td>
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**Total** 1466.300
<table>
<thead>
<tr>
<th>Sr. No.</th>
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<td>4</td>
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<td>Kolar Bilaspur</td>
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<td>8</td>
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<tr>
<td>9</td>
<td>Solan Barog Kumarhatti</td>
<td>Solan</td>
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<td>Mandi Rewalsar Kalkhar</td>
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<td>Nore Wazir Bowl</td>
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<tr>
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<td>Barsar Deothsid</td>
<td>Hamirpur</td>
<td>11.30</td>
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<td>Sujanpur Sandhol Marhi</td>
<td>Hamirpur /Mandi</td>
<td>45.00</td>
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<td>No.</td>
<td>Place 1</td>
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<td>Dadh Malan</td>
<td>Kangra</td>
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<td>43</td>
<td>Banikhet Dalhousie Khajar</td>
<td>Chamba</td>
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<td>49</td>
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<td>44</td>
<td>Baroti-Rakhra-Dharampur-Marhi-Kamla-Galtu Road</td>
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<td>45</td>
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<td>Kangra</td>
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<td>AvahDevi Tihra Gandhidhar Sandhol Road</td>
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<td>52</td>
<td>Oddi Khante Kotgarh Road</td>
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<td>53</td>
<td>Una Rampur Haroli Palkwah Polian Jaijon (Punjab Border)</td>
<td>Una</td>
<td>23.00</td>
<td>62</td>
</tr>
<tr>
<td>54</td>
<td>Jalari – Deotsidh via Kangoo-Galore-Salauni-Bijhri</td>
<td>Hamirpur</td>
<td>51.00</td>
<td>63</td>
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<td>55</td>
<td>Rohru-Chirgaon-Dodrakawar</td>
<td>Shimla</td>
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<td>56</td>
<td>Una-Santoshgarh-Meh via Nangran-Chatterpur Dhada Road.tpur</td>
<td>Una</td>
<td>21.00</td>
<td>65</td>
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<tr>
<td>57</td>
<td>Tuti-Kandibifurcation to Sanjauli Dhalli bypass junction via Chhota Shimla and Sanjauli Chowk.</td>
<td>Shimla</td>
<td>11.195</td>
<td>66</td>
</tr>
<tr>
<td>58</td>
<td>Victory Tunnel to Sanjauli</td>
<td>Shimla</td>
<td>8.610</td>
<td></td>
</tr>
<tr>
<td>No.</td>
<td>Description</td>
<td>Location</td>
<td>Length (Km)</td>
<td>Page</td>
</tr>
<tr>
<td>-----</td>
<td>--------------------------------------------------</td>
<td>----------</td>
<td>-------------</td>
<td>------</td>
</tr>
<tr>
<td>59</td>
<td>Dhalli by pass via Lakkar Bazar junction and Dhalli</td>
<td></td>
<td></td>
<td>67</td>
</tr>
<tr>
<td>60</td>
<td>Seghali-Baggi-Prashar-Jawalpur-Pansara</td>
<td>Mandi</td>
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<td>60</td>
<td>Mehndli to Samoli</td>
<td>Shimla</td>
<td>5.705</td>
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<td></td>
<td><strong>Total</strong></td>
<td></td>
<td><strong>2397.730</strong></td>
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ORGANISATION CHART

Addl. Chief Secretary (PW)

E-in-C

E-in-C (QC)

CE Shimla

SE 3rd Circle Solan
EE Solan
EE Kasuli
EE Nalgarh
EE Arkhi
EE (D)

SE 4th Circle Shimla
EE Rural
EE Dhami
EE Shimla III
EE Theog
L A O Shimla

SE Joginder nagar
EE- J/Nagar
EE Dharampur
EE (D)

CE Mandi

SE 1st Circle Mandi
EE Mandi I
EE Mandi II
EE S/Nagar
EE Gohar
EE Karsog
EE Sarkaghat
EE (D)
LAO Mandi

SE 6th Circle Kulu
EE-Kullu I
EE-Kullu II
EE-Udaipur

SE 8th Circle
S.E (QC) Shimla
EE (QC) Mandi

S.E (QC) D/Shala

CE Hamirpur

SE 8 Circle Hamirpur
EE Hamirpur
EE Tauni Devi
EE Barsar

SE 9th Circle Nurpur
EE Nurpur
EE Jwali
EE Fathepur
EE Dehra
EE (D)

SE 7th Circle Dalhousie
EE Dalhousi
EE Chamba
EE Salooni
EE Bharmour
EE Killar Pangi

SE 11th Circle Rampur
EE Rampur
EE Kumarsain
EE Nirmand
EE karcham
EE kalpa
EE Kaza
EE (D)

SE 12th Circle Nahan
EE-Nahan
EE-Ponta
EE-Reiggarh
EE-Shillai
EE-Sangrah
EE-D

SE 14th Circle Rohru
EE-Rohru
EE-Jubbal
EE-Chopal
EE-Dodra
EE (D)

SE-D-III
EE-D (Bld)
EE-D (Road)
EE (Nabar)
EE (Mech/SP)

SE (P&M)
EE-M&P

SE- (Works)
EE (Works)
EE Bangana

SE- (P&D)

SE 15th Circle Una
EE Una
EE Bharwain
EE Bangana

SE 10th Circle Bilaspur
EE Bilaspur I
EE Bilaspur II
EE Ghumarwin

SE 9th Circle Nurpur
EE (D)

CE PamgSY

SE (NH) Shimla
EE Rampur
EE Solan

SE (NH) Shapur
EE J/Nagar
EE Pandoh
EE Hamirpur

SE Abt. Solan
EE (D)

SE Design

SE(WBP)

CE HRIDC

SE 1st Electrical Circle Shimla
EE (SML) I
EE (SML) II
EE (Mandi)

SE 2nd Electrical Circle D/Shala
EE-CMU D/Shala
EE-CMU Hamirpur
EE-CMU Shimla

SE 1st Mechanical Circle Shimla
EE Design
EE Dhilli
EE Rampur
EE Rohru

SE 2nd Mechanical Circle Dharamshala
EE-Kullu
EE-D/Shala
EE-Bilaspur

Architectural Wing

Chief Architect

Sr Arch. Shimla
Sr Arch. Shimla
Sr Arch. Shimla
Sr Arch. Mandi
Arch D/Shala
Archs Shimla
Annex-V: List of Road Data Collection Forms
# Annex-V : List of Road Data Collection Forms

1. **Form RDS01 – Construction and Treatment History Sheet**

   **Government of Himachal Pradesh**
   **Public Work Department**

   **CONSTRUCTION AND TREATMENT HISTORY SHEET**

<table>
<thead>
<tr>
<th>INFORMATION</th>
<th>DATA</th>
</tr>
</thead>
<tbody>
<tr>
<td>Current formation details</td>
<td>PC</td>
</tr>
<tr>
<td>Embankment/cutting</td>
<td>MSS</td>
</tr>
<tr>
<td>(attach drawing or sketch)</td>
<td>SDBC</td>
</tr>
<tr>
<td>Shoulder Width: mm</td>
<td>WBM</td>
</tr>
<tr>
<td>Shoulder Materials:</td>
<td>Kutchha</td>
</tr>
<tr>
<td>Pavement surface layer</td>
<td>Thickness: mm</td>
</tr>
<tr>
<td>Material Type</td>
<td></td>
</tr>
<tr>
<td>Base Layer</td>
<td></td>
</tr>
<tr>
<td>Sub-base Layer</td>
<td></td>
</tr>
<tr>
<td>Sub-grade Layer</td>
<td></td>
</tr>
<tr>
<td>Original Construction</td>
<td></td>
</tr>
<tr>
<td>Treatment History</td>
<td></td>
</tr>
<tr>
<td>WBM</td>
<td>Year: mm</td>
</tr>
<tr>
<td>BM</td>
<td></td>
</tr>
<tr>
<td>PC</td>
<td></td>
</tr>
<tr>
<td>MSS</td>
<td></td>
</tr>
<tr>
<td>SDBC</td>
<td></td>
</tr>
<tr>
<td>Data collected by:</td>
<td></td>
</tr>
<tr>
<td>Entered into database by:</td>
<td></td>
</tr>
<tr>
<td>Checked by:</td>
<td></td>
</tr>
</tbody>
</table>

**Notes:**

1. Source all information from available records and fill in where possible.
2. Where no records are available complete form providing all information after driving over road and noting changes in pavement width, surface texture and surface type. Where unsure provide only surface details.
3. Abbreviations:

   **Shoulder materials**
   - Gravel: G
   - Natural Earth: NE
   - Improved Sub-grade: IS

   **Sub-grade material type**
   - Silt Clay: SCL
   - Granular Soil: GS
   - Rockey Strata: RS
   - Expansive Clay: EC
**Form RDS 02 – Bridge and Major Culvert Inventory Report**

<table>
<thead>
<tr>
<th>Bridge / Culvert No:</th>
<th>Road Number/Link/Section:</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Road Name:</th>
<th>Year of Construction:</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>RD / Chainage of structure from origin:</th>
<th>District:</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Bridge / Culvert Name:</th>
<th>Subdivision:</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Inspector name:</th>
<th>Position:</th>
<th>Date of Inspection:</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Construction type:</th>
<th>without footpath:</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Yes / No</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Structure Length:</th>
<th>No. Spans:</th>
<th>No. Vents:</th>
<th>Carriageway Width:</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Foundation Type:</th>
<th>Open / Deep</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Cut-off walls:</th>
<th>length</th>
<th>width</th>
<th>depth</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

| Remarks: | |
|----------||

<table>
<thead>
<tr>
<th>General Configurations</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Structure Type:</th>
<th>Bridge / Culvert / Causeway</th>
</tr>
</thead>
<tbody>
<tr>
<td>Span:</td>
<td>Single / Multi / Vented / Flush</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Construction type:</th>
<th>without footpath:</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Yes / No</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Structure Length:</th>
<th>No. Spans:</th>
<th>No. Vents:</th>
<th>Carriageway Width:</th>
</tr>
</thead>
<tbody>
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<td></td>
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</tbody>
</table>

<table>
<thead>
<tr>
<th>Foundations</th>
</tr>
</thead>
<tbody>
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</tbody>
</table>

<table>
<thead>
<tr>
<th>Foundation Type:</th>
<th>Open / Deep</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Cut-off walls:</th>
<th>length</th>
<th>width</th>
<th>depth</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

| Remarks: | |
|----------||

<table>
<thead>
<tr>
<th>Substructure</th>
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<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Abutment: (near)</th>
<th>length</th>
<th>width</th>
<th>height</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Abutment: (far)</th>
<th>length</th>
<th>width</th>
<th>height</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Intermediate Pier(s):</th>
<th>length</th>
<th>width</th>
<th>height</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Crosshead:</th>
<th>length</th>
<th>width</th>
<th>height</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
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</tbody>
</table>

<table>
<thead>
<tr>
<th>Wing wall:</th>
<th>length</th>
<th>width</th>
<th>height</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Superstructure</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Superstructure Type:</th>
<th>Deck level:</th>
<th>HFL:</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Hand rail Type:</th>
<th>Bearing Type:</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Other</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Batter Protection</th>
<th>Yes</th>
<th>No</th>
</tr>
</thead>
<tbody>
<tr>
<td>Type:</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Paparet wall</th>
<th>Yes</th>
<th>No</th>
</tr>
</thead>
<tbody>
<tr>
<td>Length:</td>
<td></td>
<td>m</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Guardstone:</th>
<th>Yes</th>
<th>No</th>
</tr>
</thead>
<tbody>
<tr>
<td>Number:</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Signs</th>
<th>Yes</th>
<th>No</th>
</tr>
</thead>
<tbody>
<tr>
<td>Number:</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Maximum known flood level: (height above/below underside of beams)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>General condition of bridge:</th>
<th>Good</th>
<th>Fair</th>
<th>Poor</th>
</tr>
</thead>
</table>

<table>
<thead>
<tr>
<th>Inspectors name:</th>
<th>Position:</th>
<th>Date of Inspection:</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Incorporated into database:</th>
<th>on:</th>
</tr>
</thead>
</table>

---

This form is used for the inventory and inspection of bridges and major culverts in the state of Himachal Pradesh, India. It details various aspects of the structure, including its construction type, length, spans, vents, carriageway width, and various substructures. It also includes information about the general condition of the bridge, the inspectors' details, and the date of inspection.
# 3. Form DRS03 – Culvert and Drainage Details

**Government of Himachal Pradesh**  
**Public Work Department**

## CULVERT AND DRAIN INVENTORY DETAILS

<table>
<thead>
<tr>
<th>Culvert No</th>
<th>Location RD/Chainage</th>
<th>Culvert Type</th>
<th>Culvert size</th>
<th>Cell No</th>
<th>Head / Toe wall Type</th>
<th>Catch Pit Type</th>
<th>General Condition</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
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<td></td>
</tr>
</tbody>
</table>

**Lined and Unlined Side Drains**

<table>
<thead>
<tr>
<th>Location (chainage)</th>
<th>Length</th>
<th>Size</th>
<th>Catch Pit Type</th>
<th>Remarks</th>
</tr>
</thead>
<tbody>
<tr>
<td>from</td>
<td>to</td>
<td>width</td>
<td>depth</td>
<td>Yes/No</td>
</tr>
</tbody>
</table>

**Cross Drainage**

<table>
<thead>
<tr>
<th>Culvert No</th>
<th>Location RD/Chainage</th>
<th>Culvert Type</th>
<th>Culvert size</th>
<th>Cell No</th>
<th>Head / Toe wall Type</th>
<th>Catch Pit Type</th>
<th>General Condition</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
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<td></td>
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<td></td>
</tr>
</tbody>
</table>

**Entered into database by**: …………………………………………

**Date**: .... / .... / ......

**Inspected by**: ……………………………………………….

**Date**: .... / .... / ......
### 4. Form RDS04 – Road Link Priority Data

<table>
<thead>
<tr>
<th>Village Name</th>
<th>Village No</th>
<th>Location</th>
<th>Population</th>
<th>Total</th>
<th>School</th>
<th>Middle School</th>
<th>Primary School</th>
<th>Health</th>
<th>Market</th>
<th>Administration</th>
<th>Road Name</th>
<th>Dist</th>
<th>Chainage</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
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<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Codes used in Form:**
- SC = schedule cast
- ST = schedule tribe
- T = Town
- PH = Primary Health
- MIS = Middle School
- HS = High School
- P = Primary School
- D = District HQ
- SH = Sub Divisional HQ
- HS = High School
- SC = Schedule Caste

**Notes for use of Form RDS04:**
1. Record village names and Census code numbers.
2. Contained figures are fixed and total.
3. Drive road and locate exact chainage for start and end of village from origin.
4. Include administrative centre, medical services and market centre.
5. Drive road slowly and record chainage from origin to each item as requested.
6. For signs provide Indian standard type and number (if known).
7. For guard stones record start and end chainage of each group and number of markers.

### 5. Form RDS05 – Signs, Marker Posts and Miscellaneous Items

<table>
<thead>
<tr>
<th>RD / Chainage</th>
<th>Signs</th>
<th>Legend/symbol</th>
<th>Distance Markers</th>
<th>Legend on Marker</th>
<th>Miscellanous Items in Road Reserve</th>
<th>Guardianstones</th>
<th>Intersections</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Codes used in Form:**
- I = Information Sign
- R = Regulatory Sign
- W = Warning Sign
- H = Hazard post
- HS = Historic marker/monument
- TS = Telephone pole
- RB = Religious building

**Notes for use of Form RDS05:**
1. Drive road slowly and record chainage from origin to each item as requested.
2. Record type of item in appropriate column.
3. Provide detailed description and record exact legend.
4. For signs provide Indian standard type and number (if known).
5. For guard stones record start and end chainage of each group and number of markers.
6. Record all variance in location of distance markers from origin to that on site. Note in particular any changes in start of metrage and record difference in location.
7. Record chainage of all intersections from origin and name of destination.
6. **Form RDS06 – Traffic Count Data**

<table>
<thead>
<tr>
<th>Time</th>
<th>Truck - 3</th>
<th>Truck - 2</th>
<th>Truck - 1</th>
<th>Bus RTC</th>
<th>Bus Medium</th>
<th>Bus Mini</th>
<th>Car/Jep</th>
<th>Tractor</th>
<th>Two wheelers</th>
<th>Others</th>
<th>Total</th>
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</thead>
<tbody>
<tr>
<td>7.00</td>
<td>7.30</td>
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<td></td>
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<td>8.30</td>
<td>9.00</td>
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</table>

Data collected by: ........................................... on .... / .... / ....
Calculations by: ........................................... on .... / .... / ....
Data entered by: ........................................... on .... / .... / ....
Checked by: ........................................... on .... / .... / ....

---

**TRAFFIC COUNT DATA**

Government of Himachal Pradesh
Public Works Department

---

Form RDS06
### Form RCS01 – Road Section Determination Sheet

**Government of Himachal Pradesh**  
**Public Work Department**  
**ROAD CONDITION SECTION DETERMINATION DATA SHEET**

<table>
<thead>
<tr>
<th>Road name: ……………………………………</th>
<th>District: ……………………………</th>
<th>Road No.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Origin</td>
<td>Division</td>
<td>Circle</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Section No.</th>
<th>No. lanes</th>
<th>No. ways</th>
<th>Start name</th>
<th>Start code</th>
<th>Start RD/Chainage</th>
<th>End name</th>
<th>End code</th>
<th>End RD/Chainage</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
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</tr>
</tbody>
</table>

**Surface Type:**  
Average width: [m]  
Type: 
Comments: 

<table>
<thead>
<tr>
<th>Surface Type</th>
<th>Average width</th>
<th>Type</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
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</tr>
</tbody>
</table>

**Comments:**

Data collected by: ………………… on ….. / ….. / …..
Field map marked as: ………………… attached

Data entered by: ………………… on ….. / ….. / …..
Entry checked by: ………………… on ….. / ….. / …..  

**Notes on use of the form:**
1. Start a new sheet for each new road.
2. When more than one sheet is required for a road (more than 3 sections), enter the road number in the header section and number the pages.
3. Field data collectors are to sign the sheets and return them to the data entry office together with sketches and maps showing the road condition sections.

**Road condition sections:**
1. Find drive each direction of the road and determine the start and end of each uniform road condition section.
2. The road condition sections are to be numbered consecutively in the prescribed direction.
3. Comment on villages and other features of interest.

**Pavement surface type codes:**
- SD = surface dressing
- PC = Pre Mix Carpet
- SDBC = SemeDence Bitiminous Concrete
- MSS = Mix Seal Surfasing
- WBM = water bound macadam
- GR = gravel Suling
- GR-1 =Gravel <90mm
- GR-2 =Gravel <63mm
- GR-3 =Gravel <50mm

**Start and end codes:**
- KL = kerb line (at junction)
- CJ = centreline of junction
- CG = centre of gate/door
- SG = start kerb or gutter
- SB = start of BT
- SC = start of concrete
- SG = start of gravel/WBM
- SN = sign adjacent to road
- SV = start of village
- BL = building line
- ER = end of road
- BA = bridge abutment
- EG = end kerb or gutter
- EB = end of BT
- EC = end of concrete
- EG = end of gravel/WBM
- EV = end village
8. **Form RCS03 – Visual Road Condition Data Collection Sheet**

**Government of Himachal Pradesh**

**Public Work Department**

**Visual Road Condition Data Collection**

---

**Road Name:** …………………………………………………………..

**Road Number/Link/Sect No.:** …………………………………………

**District:** ……… Division: ……… Subdivision: ……….. Circle: ……….. Block: ………..

All data to be collected and totalled to cover each SECTION. Use multiple sheets as necessary.

---

**Road Surface by type & width**

<table>
<thead>
<tr>
<th>Item No</th>
<th>Defect</th>
<th>Units</th>
<th>Total</th>
<th>Quantity of Defect</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.2</td>
<td>0.4</td>
<td>0.6</td>
<td>0.8</td>
<td>1</td>
</tr>
</tbody>
</table>

**Sealed Pavement**

- **RM111** Roughness
  - IRI

- **RM112** Potholes
  - m

- **RM113** Edge break >200 mm wide
  - m

- **RM114** Surface Rutting >25 mm
  - m

- **RM115** Surface depressions >25 mm
  - m

- **RM116** Cracking - single >5 mm wide
  - m

- **RM117** Crocodile cracking (all)
  - m

- **RM118** Stripping & ravelling
  - m

- **RM119** Delamination
  - m

- **RM120** Bleeding & existing patching
  - m

- **RM121** Surface failure
  - m

**Concrete Surface**

- **RM122** Concrete jointing
  - m

- **RM123** Broken / cracked concrete
  - m

**Unsealed Shoulder**

- **RM211** Low shoulder (>50 mm)
  - m

- **RM212** Deformed/scoured shoulder
  - m

- **RM213** High shoulder
  - m

- **RM214** Embankment scour
  - m

**Roadside drainage**

- **RM311** Unlined drains blocked >30%
  - m

- **RM312** Lined drain blocked >20%
  - m

**Road Side Maintenance**

- **RM411** Vegetation/debris
  - m

- **RM412** Signs/Furniture
  - No

- **RM413** Distance markers
  - No

- **RM414** Guard stones / parapets
  - No

- **RM415** Breast / retaing walls
  - m

- **RM416** Land slides
  - m

**WBM / Kutcha Surface**

- **RM510** Comfortable speed
  - km/h

- **RM511** Rutting
  - m

- **RM513** Potholes all & edges (WBM)
  - m

- **RM514** Low shoulder WBM
  - m

- **RM515** Potholes/gullies gravel
  - m

- **RM516** Camber flat or depressed
  - m

- **RM517** Pavement depth
  - mm

- **RM518** Failed formation
  - m

---

Signed by Inspector: ……………………………………………………….. Date: ....... / ........

Data entered into database by: …………………………………………….. Date: ....... / ........
9. **Form RDS04 – Bridge and Major Culvert Inspection Report**

Government of Himachal Pradesh
Public Works Department

<table>
<thead>
<tr>
<th>Road No:</th>
<th>Action</th>
<th>Apprch</th>
<th>Signs</th>
<th>Debris</th>
<th>Joint</th>
<th>Deck</th>
<th>Drains</th>
<th>Rails</th>
<th>Protect</th>
<th>Stream</th>
<th>Supstr</th>
<th>Substr</th>
<th>Comments</th>
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<th>Signs</th>
<th>Debris</th>
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<th>Rails</th>
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<th>Signs</th>
<th>Debris</th>
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<th>Drains</th>
<th>Rails</th>
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**BRIDGE AND MAJOR CULVERT MAINTENANCE INSPECTION REPORT**

Collected by: ………………………………….. Date: …… / …… / ……
Entered into program by: ………………………………….. date: …… / …… / ……

Note: Once the inventory data is entered and road sections allocated this form is produced from within the RMMS/MIS data base.
## 10. Form RCS05 – Culvert Inspection Report

Government of Andhra Pradesh  
Panchayati Raj Engineering Department  
CULVERT INSPECTION REPORT

<table>
<thead>
<tr>
<th>Road No:</th>
<th>Action</th>
<th>Vent</th>
<th>Silted</th>
<th>RH Hwall</th>
<th>LH Hwall</th>
<th>RH Apron</th>
<th>LH Apron</th>
<th>RH Scour</th>
<th>LH Scour</th>
<th>RH Pit</th>
<th>LH Pit</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
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Note: Once the inventory data is entered and road sections allocated this form is produced from within the RMMS/MIS database.
**11. Form RCS06 – Pavement Roughness Determination (Unpaved Roads)**

**Government of Himachal Pradesh**

**Himachal Pradesh Public Work Department**

<table>
<thead>
<tr>
<th>PAVEMENT ROUGHNESS DETERMINATION - UNPAVED ROADS</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Road Name</strong></td>
</tr>
<tr>
<td><strong>Origin</strong></td>
</tr>
<tr>
<td><strong>Section From</strong></td>
</tr>
<tr>
<td>Vehicle No.</td>
</tr>
</tbody>
</table>

### SECTION No. \[ \] from \[ \] + \[ \] m to \[ \] + \[ \] m

**Paved**

**Unpaved**

**Attributes**

<table>
<thead>
<tr>
<th>Vehicle speed:</th>
<th>( &gt;40 )</th>
<th>( &gt;30 )</th>
<th>Extreme discomport</th>
</tr>
</thead>
<tbody>
<tr>
<td>( 40 - 30 )</td>
<td>( 30 - 25 )</td>
<td>Sharp movements</td>
<td></td>
</tr>
<tr>
<td>( 30 - 25 )</td>
<td>( 25 - 20 )</td>
<td>Depressions</td>
<td></td>
</tr>
<tr>
<td>( 25 - 20 )</td>
<td>( 25 - 15 )</td>
<td>Potholes</td>
<td></td>
</tr>
<tr>
<td>( &lt;20 )</td>
<td>( &lt;15 )</td>
<td>none</td>
<td></td>
</tr>
</tbody>
</table>

### SECTION No. \[ \] from \[ \] + \[ \] m to \[ \] + \[ \] m

**Paved**

**Unpaved**

**Attributes**

<table>
<thead>
<tr>
<th>Vehicle speed:</th>
<th>( &gt;40 )</th>
<th>( &gt;30 )</th>
<th>Extreme discomport</th>
</tr>
</thead>
<tbody>
<tr>
<td>( 40 - 30 )</td>
<td>( 30 - 25 )</td>
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<td></td>
</tr>
<tr>
<td>( 30 - 25 )</td>
<td>( 25 - 20 )</td>
<td>Depressions</td>
<td></td>
</tr>
<tr>
<td>( 25 - 20 )</td>
<td>( 25 - 15 )</td>
<td>Potholes</td>
<td></td>
</tr>
<tr>
<td>( &lt;20 )</td>
<td>( &lt;15 )</td>
<td>none</td>
<td></td>
</tr>
</tbody>
</table>

### SECTION No. \[ \] from \[ \] + \[ \] m to \[ \] + \[ \] m

**Paved**

**Unpaved**

**Attributes**

<table>
<thead>
<tr>
<th>Vehicle speed:</th>
<th>( &gt;40 )</th>
<th>( &gt;30 )</th>
<th>Extreme discomport</th>
</tr>
</thead>
<tbody>
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<td>( 30 - 25 )</td>
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<td></td>
</tr>
<tr>
<td>( 30 - 25 )</td>
<td>( 25 - 20 )</td>
<td>Depressions</td>
<td></td>
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<tr>
<td>( 25 - 20 )</td>
<td>( 25 - 15 )</td>
<td>Potholes</td>
<td></td>
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<tr>
<td>( &lt;20 )</td>
<td>( &lt;15 )</td>
<td>none</td>
<td></td>
</tr>
</tbody>
</table>

Data collected by: ........................................................................ on .... / .... / ....
Calculations by: ................................................................. on .... / .... / ....
Data entered by: ................................................................. on .... / .... / ....
Checked by: ................................................................. on .... / .... / ....

Notes on use of form:
1. Drive the vehicle at a speed that will safeguard the mechanical integrity of the vehicle and safety and comfort of the passengers and interference to the road users.
2. Driving conditions relate to a medium vehicle with independent suspension.
3. The driving sensation is to express the relationship of abrupt vibrations and movement as observed by the inspector at a given speed.
4. The driver must derive his own calibration based on the vehicle being used and experience.
5. Comfort level and surface defects to be assessed as per Table 9.1.
6. Cracking is to be ignored and severity is only to be based on depth and occurrence.
## 12. Form RCS07 - Pavement Surface Deflection Determination

**Government of Himachal Pradesh**  
**Public Work Department**  
**BENKELMAN BEAM DEFLECTION DETERMINATION**

Road Name: ..........................................................  
Road Number/Link/Sect No.: .................................

Road Section: RD/Chainage from .........................  
Road Section: RD/Chainage to .............................

District: ........................................  
Division: ...........................................

Subdivision: ...........................................

Circle: ...........................................

Block: ...........................................

No of traffic lanes: ...........................................

Date: .... / .... / ........

Air Temperature: .... °C  
Time: .................................  
Annual rainfall: ........ mm

<table>
<thead>
<tr>
<th>S.No.</th>
<th>RD/Chainage</th>
<th>Location of test point</th>
<th>Pavement temperature, °C</th>
<th>Soil Type &amp; PI</th>
<th>Moisture content %</th>
<th>Initial Reading</th>
<th>Intermediate Reading</th>
<th>Final Reading</th>
<th>Rebound Deflection</th>
</tr>
</thead>
<tbody>
<tr>
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</table>

Data collected by: ........................................ Date: .... / .... / ........  
Checked by: ........................................ Date: .... / .... / ........

Entered into database by: ........................................ Date: .... / .... / ........
13. Form RCS08 - Insitu CBR Using DCP

<table>
<thead>
<tr>
<th>Layer</th>
<th>Material description</th>
<th>Material condition</th>
<th>Thickness of layer (mm)</th>
<th>DCP average mm blow</th>
<th>CBR assessed</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td></td>
<td></td>
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<tr>
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<tr>
<td>3</td>
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Excavate asphalt and dense crushed roack material
Depth to layer being tested (mm)

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Annex-VI: Indicative list of 830 km
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Annex-VII: Specifications for Equipment to be procured by HPPWD/HPRIDC
Annexure-VII: Technical Specifications of Proposed Equipment

1. Falling Weight Deflectometer (FWD)

1.1. Technical Specifications

a. In-vehicle mounted 120 kN Falling Weight Deflectometer (FWD) - fitted to an Indian production vehicle. Should have 9 geophone sensors and load cell - with provision for possible later incorporation of up to 15 deflection channels, split loading plate, temperature sensors (ambient and road surface) and specifications which meet or exceed those required under ASTM D4694-09, with PC data collection capabilities in accordance with ASTM D4695 – 03 (2008) including matching data collection and analytical software, DMI, and DGPS (sub meter accuracy) integrated in data collection software.

b. The FWD shall be new, currently advertised production model. This model or line of equipment shall specifically one (1) year or more prior operation and maintenance experience. This FWD will be used on mountainous terrain and hence should have a frame with the support legs to direct the load-generating unit perpendicular to the surface of the pavement.

c. There should be an arrangement in the FWD which practically eliminates the risk of damaging load plate and sensors by driving away before they are raised after the test.

d. The FWD shall include falling weight which raised to a predetermined height and dropped on the upper rubber buffer set. The falling weight, the intermediate weight, the two buffer sets, the foot, the loading plate with its smoothing rubber plate and the ground should all be parts of a dynamic system shaping the force pulse. The resulting force pulse transmitted to the pavement is reproducible and suitably shaped.

e. The FWD shall include all standard equipment parts and accessories as necessary to fully function whether or not specifically called herein including a stacking tower, fully installed DGPS, wireless connection unit and an automatic spray marking equipment. Resolution of deflections shall be to 0.1 microns with accuracy of better than 2% +/- 2 microns. Load accuracy shall be better than 2% +/- 0.3 kN. It should be possible to do the mass-spring inspection inside the deflection sensor, i.e. seismometer on site. Each seismometer should have a built-in micrometer screw for absolute calibration.

f. Temperature Sensor Type: IR
   No of sensors: 3 - one for ambient temperature measurement, one for pavement surface and the third hand held one for measurement in drill holes
   Temperature range: -15 to + 70 deg C
   Temperature Accuracy: 0.5%
   Temperature resolution: 0.1 deg C

g. FWD should have a pulse duration of 50 ms or more for loads up to 65kN.

h. The load pulse should have reproducible peak value which offers possibility to compare measured and expected peak load from a certain drop height, and ensures the correctness of the load measurement.
i. The loading system shall be capable of applying impact and impulse loads of 20-60 ms at peak load and shall be a minimum of 4 peak loads with magnitude in the range of 7 – 150 KN, and shall be capable of carrying out a typical complete test sequence within approximately 45 seconds and obtain Time-history on all geophones and load cell. The equipment shall have necessary features including software and electronic hardware such that can be operated by a single operator. It should be a four segment load plate, loaded with equal loads by four independent plungers. It should be possible to tilt each sector. There should be minimum 16 mm ribbed rubber to evenly distribute the pressure within each sector.

j. The supplier shall supply two (2) complete sets (hard and soft) of comprehensive FWD user manuals (suitably customized as necessary) including FWD operator manuals; data recording and analysis manuals; and Troubleshooting/Maintenance Manuals;

k. The Supplier shall install, commission and carry out relative and full calibration at final destination. Certification of load cell calibration shall be provided.

l. The supplier shall carry out training and provide certification of proficiency in FWD calibration, operation and maintenance, recording and analysis techniques for 10 days. A team will be composed of five (5) engineers and four (4) technologists.

m. Provide spare parts, tools and consumables for two-year consumption. The Supplier of the FWD shall have full parts inventory and established service support arrangements, including a well established record of equipment support. Additionally, the Supplier shall have a complete parts list, including current prices, which shall be submitted with the bid.

n. To ensure minimal future down-time, basic spare parts should be available in India and replaced immediately. Special parts that are needed to be imported should be available within a nominal 2 weeks.

o. Price to include an after sale and standard service contract for the FWD, to comprise calibration, service and maintenance for a 24 months period after delivery and acceptance.

p. The vehicle to be provided should be fitted out to meet the specifications below;
   o In-vehicle mounting in a suitable size and capacity van or pick-up - of Indian manufacture of diesel 4WD vehicle. In the case of a pick-up, the tray should have a customized removable and lockable canopy.
   o The vehicle horse-power, alternator and wiring, requirement for auxiliary battery, upgraded alternator should conform to the supplier's vehicle specification for the in-vehicle FWD.
   o Specialist roof mounted (flashing) warning lights to be fitted.
   o It should be registered as Government vehicle with “G” in license plate, in the name of CE, HPPWD.

q. The equipment shall have a warranty of 24 months for FWD (extendable), and 36 months for the vehicle - with free maintenance/services. The bidder should have service for both FWD and vehicle - in India/local support/assured services in India.

r. Accessories
   o Extra Headlight Beam with flash lights;
   
   o In-vehicle CPU of rugged (military rating) construction with at least I7 processor, above 15” screen, minimum 500 GB HDD, 4 GB RAM loaded with licensed copies of Windows 7/8
ultimate, MS office 2010, Data collection program, and program for the derivation of layer elastic moduli from deflection readings (back calculation). Data format to be compliant with industry standard format of PDDX (Pavement Data Deflection Exchange) and acceptable to ASTM code. Latest DLP and DIS viewer, Operating and processing software DVD±RW/DVD-RAM burner.

- One rechargeable electric drill and 4 tungsten bits with three metal case thermometers for internal measurement of pavement temperature.
- One complete set of absolute and traceable calibration equipment for geophone and load cell.
- Supply of recommended tools and spare parts and necessary additional batteries to cover extended operations in remote regions of the State of Himachal Pradesh.
- 1 set of Hand-held GPS of submachine Garmin Oregon 450 or equivalent.
- 2 sets of two-way Radios (Walky – Talky) model of Garmin Rino 655T GPS Radio or equivalent. It should be able to cover 1000m radius.

s. Spare Parts
- Geophones, spikes and cable
  1. Cover for geophone- Yellow plastic cover for geophone
  2. Geophone spikes- Long metal spike for centre geophone and short metal spike for other geophones
  3. Geophone cable– 2-core cable for geophones
  4. Extension device for geophones-Metal device for corrected positioning of outer geophone in case of sloping geophone beam
  5. Geophone beam cable- Steel wire for beam
  6. Burndy geophone plug (male & female)
  7. Pins for Burndy geophone plug (male & female)
  8. Burndy plug tool
- Electric equipment
  1. Motor relay
  2. Power relay
  3. Auxiliary relay
  4. 100A fuse
  5. Non-contact control switch
  6. Non-contact control switch with cable
  7. Three-pin plug- For hydraulic valve
  8. Temperature probe- For manual measurement of temperature
- Buffers and rubber for load plate
  1. Rubber for load plate foot
  2. Buffers
- Light
  1. Warning light
  2. Bulbs
- Tools
  1. Adjustable wrench
  2. Fork Wrench
  3. Set of ratchet
  4. Set of Allen keys
1.2. **Inspection and tests prior to shipment of Goods and at final acceptance are as follows:**

(i) The inspection of goods shall be carried out to check whether the goods are in conformity with the technical specifications attached to the purchase order form and shall be in line with the inspection/test procedures laid down in the technical specifications and the General Conditions of contract. Following broad test procedure will generally be followed for inspection and testing of machine. The supplier will dispatch the goods to the ultimate consignee after internal inspection testing along with the supplier’s inspection report, manufacturer’s warranty certificate. The purchaser will test the equipment after completion of installation and commissioning at the site of the installation. For site preparation, the supplier should furnish all details of the equipment. Complete hardware and software as specified in Technical Specifications should be supplied, installed and commissioned properly by the supplier prior to commencement of performance tests.

(ii) The acceptance test will be conducted by the purchaser/their consultant or any other person nominated by the purchaser, at its option. The acceptance will involve trouble-free operation for five consecutive days. There shall not be any additional charges for carrying out acceptance tests. No malfunction, partial or complete failure of any part of hardware or excessive heating of motors attached to printers, drivers etc., or bugs in the software should occur. All the software should be complete and no missing modules/sections will be allowed. The supplier shall maintain necessary log in respect of the results of the tests to establish to the entire satisfaction of the purchaser, the successful completion of the test specified. An average uptake efficiency of 99.99% for the duration of test period shall be considered as satisfactory.

(iii) In the event of the hardware and software failing to pass the acceptance test, a period not exceeding two weeks will be given to rectify the defects and clear the acceptance test, failing which the purchaser reserves the rights to get the equipment replaced by the supplier at no extra cost to the purchaser.
1.3. **Manuals**
- Before the goods and equipment are taken over by the Purchaser, the Supplier shall supply operation and maintenance manuals of the goods and equipment. These shall be in such detail as to enable the Purchaser to operate, maintain, adjust and repair all parts of the equipment as stated in the specifications.
- The manuals shall be in the ruling language (English) and in such form and numbers as stated in the contract.
- Unless and otherwise agreed, the goods and equipment shall not be considered to be completed for the purpose of taking over until such manuals have been supplied to the Purchaser.

1.4. **For the System and Other Software the following will apply.**
The Supplier shall provide complete and legal documentation of hardware, and licensed operating systems. The Supplier shall also indemnify the purchaser against any levies/penalties on account of any default in this regard.

1.5. **Acceptance Certificates:**
On successful completion of acceptability test, receipt of deliverables etc., and after the purchaser is satisfied with the working of the system, the acceptance certificate signed by the supplier and the representative of the purchaser will be issued. The date on which such certificate is signed shall be deemed to be the date of successful commissioning of the systems.

1.6. **Available Vendors**

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<tr>
<td></td>
<td></td>
<td>Phone: +91 11 308 10200</td>
</tr>
<tr>
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<td>COMPLETE INSTRUMENTATION SOLUTIONS PRIVATE LIMITED&lt;br&gt;SUITE 511, SUNCITY BUSINESS TOWER&lt;br&gt;GOLF COURSE ROAD, SECTOR 54&lt;br&gt;GURGAON 122002&lt;br&gt;TEL: +91-124-4929000&lt;br&gt;FAX: +91-124-4929010&lt;br&gt;e-mail: <a href="mailto:info@instrumentation-solutions.com">info@instrumentation-solutions.com</a></td>
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2. Axle Weigh Pads

2.1. Technical Specifications

- The equipment shall be very light and can be placed easily on any compacted ground/road. (However, the level of the ground should be uniform). Each pad shall have multiple micro load cells. Two weigh pads shall be placed on a level ground to determine the weight of each wheel of the vehicle.
- Weigh pads shall be of size 720 x 450 and interconnected to a digital weight indicator. The width of the pad shall be around 39mm so that vehicle can easily climb on the pad. Each weigh pad should be able to take a load of 20 tons.
- Technical Details
  - Capacity of each pad : 20T per pad
  - Interval : 5kg
  - Accuracy: 0.2% per axle in static.
  - Accuracy : 1-3 % in inmotion @ speed 5 KMPH
  - Digital indicator with battery backup
  - Wireless connection
  - Power supply of 230V/AC/single phase 50Hz to charge the battery

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2.2. Available Vendors

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Email: palash.debnath@essae.in  
Web: www.eassaedig.com  
Mob: 09892132612, 9394690852, 9866212501 |
<p>| 2     | Avery Weigh-Tronix | Avery India Limited |</p>
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<th></th>
<th>Plot Nos. 50-59, Sector 25, Ballabgarh - 121004, Haryana Tel: 00 91 129 409 4400 / Fax: 00 91 129 223 1173 Website: <a href="http://www.averyweigh-tronix.com/india">www.averyweigh-tronix.com/india</a> Email: <a href="mailto:indiasales@awtxglobal.com">indiasales@awtxglobal.com</a></th>
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<tr>
<td>4</td>
<td>Marsden Marsden Weighing Machine Group Limited Unit 1, Genesis Business Park Sheffield Road Rotherham, S60 1DX Tel: 0845 130 7330 Fax: 0845 130 7440 E-mail: <a href="mailto:sales@marsdengroup.co.uk">sales@marsdengroup.co.uk</a> <a href="http://www.marsden-weighing.co.uk/index.php/contact/">http://www.marsden-weighing.co.uk/index.php/contact/</a></td>
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<tr>
<td>6</td>
<td>SS INSTRUMENTS NO.96,2ND MAIN,4TH CROSS, INDUSTRIAL LANE NEAR SAIBABA MANDIR KAMAKSHIPALYA BANGALORE-560079 KARNATAKA INDIA PH:080-23485069 MOBILE : 98451 23806</td>
</tr>
<tr>
<td>7</td>
<td>EagleScales 302, Ashoka Complex Near Golden Triangle Building Opp, Sardar Patel Stadium Road Navrangpura Ahmedabad - 380014, Gujarat Phone : 079-26560311, 99099 46694 E-mail : <a href="mailto:corporate@eaglescales.com">corporate@eaglescales.com</a></td>
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3. ROAD CONDITION AND INVENTORY SURVEY VEHICLE (ROMDAS)

The equipment should comprise; 1-360° camera for asset views (Optional); 2-ROW Video Camera; 2- World Bank Class-3 roughness device (BI); 2-Geometry Unit; two (2) operator console; 2-Distance Measurement Instrument (DMI); and 2-DGPS (Trimble SPS461 GPS With GA810 Antenna) module (to 1 meter); 1-Hand held GPS; with in-vehicle and office processing and viewing software.

The equipment should meet international standards ASTM E950, E1845, ISO 13743 and AASHTO PP37.

The equipment shall be supplied with a compatible vehicle meeting the minimum specifications below:

- Dedicated heavy duty utility vehicle. In-vehicle mounting in a suitable capacity SUV of Indian manufacture. Diesel powered and Engine capacity 2400-3000cc, Max power 70Kw/4000rpm, maximum torque of 220Nm/2000rpm, Four Wheel Drive (4WD), Manual/Automatic Transmission and Power Steering.
- Extra Headlight Beam with flash lights
- The vehicle registered with Government of Himachal Pradesh registration and should conform to the Indian vehicle licensing authority requirements, with rear sidelights, and rear reflective chevron boards.
- Specialist roof mounted (flashing) warning lights to be fitted.
- The vehicle should have air conditioner, dashboard navigation system, hands free cell phone operation, stereo and with computer table installed.
- Suitable support to third party software for exporting and importing.
- Camera Pixels 1,280 x 960 minimum resolution
- 1 set of Hand-held GPS of Garmin Oregon 450 or equivalent.
- The vehicle will be engaged on survey of a 6,000 km network and will be away from head office for extended periods. On-board data storage should be sufficient for 5,000 kilometres (at recommended frames/second rate for visual condition surveys)
- The bidder should have service for both survey equipment and vehicle - in India /local support/assured services in India.

Rebate on Buy-back of Existing HPPWD Road Survey Equipment.

The tendered price should be all inclusive and shall include a rebate for the buy-back of one unit of the Department's existing Road Survey Equipment. These comprise "ROMDAS" Bump Integrator and GPS unit. The units are approximately 8 years old and are in working condition. They can be inspected by prior arrangement or photographs can be provided on request.

Accessories, commissioning and training

- In-vehicle CPU of rugged (military rating) construction with at least I7 processor, above 15" screen, 500 GB HOD, 4 GB RAM loaded with licensed copies of Windows 7 ultimate or later, MS office 2010, latest DLP and DIS viewer, Operating and processing software with
import and export capabilities to Pavement Management System, GIS and HDM-4 applications, DVD±RW/DVD- RAM burner.

- Two full sets of hard and soft copies of operating and troubleshooting manuals to be provided;
- Spare parts for two-year consumption. The Supplier shall provide a full parts inventory and established service arrangements, including a well-established record of equipment support. Additionally, the Supplier shall have a complete parts list, including current prices, which shall be submitted with the bid.
- Installation and commissioning.
- After sales and Standard service at project site, calibration and maintenance for 24 month contract period (extendable) after delivery and acceptance. For vehicle, warranty period should be 36 months.
- A full set of standard tools for assembly, operation and as required for calibration (reference profiler) and maintenance.
- Training and certification for proficiency of six (6) No. staff for 3 days on operation and maintenance and two (2) No. staff in operation, maintenance and data processing for 3 days.
- The equipment shall have a warranty of 12 months.
- To ensure minimal future down-time, basic spare parts should be available in India and replaced immediately. Special parts that are needed to be imported should be available within a nominal 2 weeks.
- The bid should include details of data storage format and transfer compatibility.

3.1. INSPECTIONS AND TESTS

The following inspections and tests shall be performed:

I. Inspection and tests prior to shipment of Goods and at final acceptance are as follows:

- The inspection of the goods shall be carried out to check whether the goods are in conformity with the technical specifications attached to the purchase order form and shall be in line with the inspection /test procedures laid down in the technical specifications and the General Conditions of contract. Following broad test procedure will generally be followed for inspection and testing of machine. The supplier will dispatch the goods to the ultimate consignee after internal inspection testing along with the supplier’s inspection report, manufacturer’s warranty certificate. The purchaser will test the equipment after completion of the installation and commissioning at the site of the installation. For site preparation, the supplier should furnish all details of the equipment. Complete hardware and software as specified in TOR should be supplied, installed and commissioned properly by the supplier prior to commencement of performance tests.

- The acceptance test will be conducted by the purchaser or any other person nominated by the purchaser, at its option. The acceptance will involve trouble-free operation for three days. There shall not be any additional charges for carrying out acceptance tests. No
malfunction, partial or complete failure of any part of hardware or excessive heating of motors attached to printers, drivers etc., or bugs in the software should occur. All the software should be complete and no missing modules/sections will be allowed. The supplier shall maintain necessary log in respect of the results of the tests to establish to the entire satisfaction of the purchaser, the successful completion of the test specified. An average uptake efficiency of 99.99% for the duration of test period shall be considered as satisfactory.

- In the event of the hardware and software failing to pass the acceptance test, a period not exceeding two weeks will be given to rectify the defects and clear the acceptance test, failing which the purchaser reserves the rights to get the equipment replaced by the supplier at no extra cost to the purchaser.

3.2. **Manuals**
Before the goods and equipment are taken over by the Purchaser, the Supplier shall supply operation and maintenance manuals of the goods and equipment. These shall be in such detail as will enable the Purchaser to operate, maintain, adjust and repair all parts of the equipment as stated in the specifications.

- The manuals shall be in English and numbers as stated in the contract.
- Unless and otherwise agreed, the goods and equipment shall not be considered to be completed for the purpose of taking over until such manuals have been supplied to the Purchaser.

3.3. **For the System and Other Software the following will apply.**
The Supplier shall provide complete and legal documentation of hardware, and licensed operating systems. The Supplier shall also indemnify the purchaser against any levies/penalties on account of any default in this regard.

3.4. **Acceptance Certificates:**
On successful completion of acceptability test, receipt of deliverables etc., and after the purchaser is satisfied with the working on the system, the acceptance certificate signed by the supplier and the representative of the purchaser will be issued. The date on which such certificate is signed shall be deemed to be the date of successful commissioning of the systems.

3.5. **Available Vendors**

<table>
<thead>
<tr>
<th>S.No.</th>
<th>Vendor</th>
<th>Address</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>DCL Ltd</td>
<td>DCL Ltd</td>
</tr>
<tr>
<td></td>
<td></td>
<td>8C Bentinck Street</td>
</tr>
<tr>
<td></td>
<td></td>
<td>New Lynn, Auckland 0600</td>
</tr>
<tr>
<td></td>
<td></td>
<td>New Zealand</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Phone: +64-9-827 7703</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Fax: +64-9-827 7704</td>
</tr>
<tr>
<td></td>
<td></td>
<td><a href="mailto:info@romdas.com">info@romdas.com</a></td>
</tr>
</tbody>
</table>
Consulting Services for Technical Assistance to Help Upgrade Road Maintenance Management System to Road Management System in the State of Himachal Pradesh

Annex-VIII: Variation Cost Proposal for excess Surveys (Year-1)
Annex-VIII - Variation Costs for additional surveys proposed for Year-1

<table>
<thead>
<tr>
<th>Type of Survey</th>
<th>Unit</th>
<th>Unit Rate</th>
<th>Quantity included in the Contract</th>
<th>Contracted Amount (INR)</th>
<th>Additional Quantity Proposed</th>
<th>Additional Cost Implecation (INR)</th>
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<tbody>
<tr>
<td>Survey Costs</td>
<td></td>
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<td></td>
<td></td>
<td></td>
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<tr>
<td>GPS Referencing: Year 1: 5955Km (with own instrument)</td>
<td>Per Km</td>
<td>500</td>
<td>5,955</td>
<td>2,977,500</td>
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<tr>
<td>Inventory of Pavements</td>
<td>Per Km</td>
<td>750</td>
<td>830</td>
<td>622,500</td>
<td>3,370</td>
<td>2,527,500</td>
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<tr>
<td>Pavement Composition</td>
<td>Per Location</td>
<td>4,500</td>
<td>200</td>
<td>900,000</td>
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<td>-</td>
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<tr>
<td>Inventory of CD Structure (Year 1 and 2)</td>
<td>2,500</td>
<td>400</td>
<td>500,000</td>
<td>-</td>
<td>-</td>
<td>-</td>
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<tr>
<td>Roughness (Year 1 and 2)</td>
<td>Per Km</td>
<td>250</td>
<td>4,400</td>
<td>1,100,000</td>
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<td>-</td>
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<tr>
<td>Surface Distress (Year 1 and 2)</td>
<td>Per Km</td>
<td>500</td>
<td>1,230</td>
<td>615,000</td>
<td>3,170</td>
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<tr>
<td>Pavement Strength (FWD)</td>
<td>Locations</td>
<td>5,000</td>
<td>820</td>
<td>4,100,000</td>
<td>3,200</td>
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<td>Bridge Condition Data</td>
<td>No of Bridges</td>
<td>5,000</td>
<td>25</td>
<td>125,000</td>
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<tr>
<td>Traffic Counts</td>
<td>Locations</td>
<td>25,000</td>
<td>40</td>
<td>1,000,000</td>
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<td>Axel Load</td>
<td>Locations</td>
<td>25,000</td>
<td>40</td>
<td>1,000,000</td>
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<tr>
<td>Road User Cost</td>
<td>Locations</td>
<td>5,000</td>
<td>20</td>
<td>100,000</td>
<td>-</td>
<td>-</td>
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<td></td>
<td>Total Cost (INR)</td>
<td>13,040,000</td>
<td>20,112,500</td>
</tr>
</tbody>
</table>

Assumptions
1. Total road network considered for Year-1 is 4,200 km instead of 830 km for additional surveys,
2. Only those surveys which may get affected due to sharing of equipment in Year-1 (inventory, condition and FWD surveys) are considered for additional scope. Other surveys, such as CD Structures and Bridges, Traffic volume and Axle load are not considered as these could be carried out independently by HPPWD.