



**SUDAN UNIVERSITY OF
SCIENCE & TECHNOLOGY**
COLLEG OF GRADUATE STUDIES



**Preventive Maintenance for (MADANI - HAYIA)
Highway**

الصيانة الوقائية للطريق السريع (ودمدني - هيا)

**Thesis submitted in partial fulfillment of the requirement for
the degree of M.Sc. in Civil Engineering
(Highway & Transportation)**

PREPARED BY: HAMID HAMDOON ELHIREIKA

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JANUARY 2017

بسم الله الرحمن الرحيم

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BY:

HAMID HAMDOON ELHIREIKA

Dedication

I dedicate This thesis to my family, especially my wife dear ISLAM and my sons AHMED &ABU OBAIDA, also I would like express my feeling and my gratitude to my parents (HAMDOON and HAWA) for their support and encouragement and their prayers to me, and also I dedicate to my brothers and sisters and my friends and my colleagues.

I would like to dedicate this thesis to; MARWA MOHAMMED FARAH to support and encouragement, and which didn't never hesitate for service to me.

I dedicate also this thesis to my great country Sudan and wish him always development and stability.

Acknowledgement

First, thanks to God that helped me to write this thesis, and thanks again to Dr. KAMAL MASOUD MARGI, who do all his energies and bright ideas and precious time so generously to this thesis can see the light.

I would like also to thank all my professors including Dr. FATAH AL-RAHMAN MOHAMMED ADAM and Dr. MASOUD GAMEEL and Dr. NOHA MOAWIA. And thanks go to the National Authority for Roads and Bridges to help in this search.

Abstracts

The pavement management system in its broadest sense means all activities necessary to preservation the pavement, including: planning, design, construction, maintenance and rehabilitation of the pavement.

Maintenance considered an important activity to preservation the performance of the pavement which is itself divided into corrective maintenance and preventive maintenance and emergency maintenance.

In this thesis it has been reviewing preventive maintenance and so are several considerations her characterize an effective cost and prolong the life of the pavement and provide convenience to users of the road.

In this research it was conducted a visual inspection for several sectors, namely: (Madani – EL-Gadarif) and (EL-Gadarif - Kassala) and (Kassala - Hayia).

And so as to reach the pavement condition index, which we can the decision making to execute preventive maintenance or corrective maintenance and rehabilitation of each sector, so that the pavement condition index over 70 is performed preventive maintenance treatments, as well as the type and severity of distress, we can choose the right treatment for deformation or the possibility of implementing the multiple treatments on a sector.

Therefore, conduct routine inspection for the road network, and storage the data help us to put the schedules to the priorities conduct preventive maintenance, and preventive maintenance of the pavement is considered the cornerstone of preservation on the pavement, and longevity and delay of the need for corrective maintenance or rehabilitation because they are high cost and lead to the closure of the road and disrupt traffic and other reasons.

التجريد

إن نظام إدارة الرصف يعني بمفهومه الواسع كل الأنشطة اللازمة للمحافظة على الرصف ومنها:

التخطيط، التصميم ، التشييد، الصيانة و إعادة التأهيل للرصف.

باعتبار الصيانة نشاط مهم للمحافظة على أداء الرصف وهي في حد ذاتها تنقسم إلى صيانة تصحيحية و صيانة وقائية و صيانة طارئة.

في هذا البحث تم استعراض الصيانة الوقائية و لذلك عدة إعتبارات تسم بها وهي التكلفة الفعالة و إطالة عمر الرصف و توفير الراحة لمستخدمي الطريق.

في هذا البحث تم إجراء فحص بصري لعدة قطاعات وهي: (مدني - القضارف) و (القضارف - كسلا) و (كسلا - هيا) و ذلك للوصول لمؤشر حالة الرصف و التي منها نستطيع إتخاذ القرار بتنفيذ الصيانة الوقائية أم الصيانة التصحيحية و إعادة التأهيل لكل قطاع، بحيث أن مؤشر حالة الرصف أكثر من ٧٠ يتم تنفيذ معالجات الصيانة الوقائية و كذلك من نوع و شدة العيوب نستطيع إختيار نوع العلاج المناسب للتشوه أو إحتمال تنفيذ عدة معالجات على قطاع واحد .

لذلك اجراء الفحوصات الدورية لكامل شبكة الطرق و حفظ البيانات تساعد على وضع جدول لأولويات إجراء الصيانة الوقائية، كما أن الصيانة الوقائية للرصف تعتبر حجر الزاوية للمحافظة على الرصف و إطالة عمره و ذلك بتأخير الحاجة للصيانة التصحيحية أو إعادة التأهيل لأنها ذات تكلفة عالية و تؤدي إغلاق الطريق و ربك حركة المرور و غيرها من الأسباب.

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LIST OF ABBREVIATIONS

PMS	Pavement Management System
AASHTO	American Association of State Highway and Transportation Officials
FHWA	Federal Highway Administration
CSS-1	Cationic Slow Setting Emulsion
Mn/DOT	Minnesota Department of Transportation
PPM	Pavement Preventive maintenance
PCI	Pavement Condition Index
IRI	International Roughness Index
PSI	Present Serviceability Index
NCHRP	Nation Comprehensive Highway Research Program
AC	Asphalt Concrete
DV	Deduct Value
CDV	Corrected Deduct Value

CHAPTER I

INTRODUCTION

1-1 General:

Importance of pavement management system: Pavement management system in its broad sense includes all the activities involved in the planning, design, construction, maintenance, and rehabilitation of pavement. A pavement management system (PMS) can provide an organized methodology to assist decision makers in finding optimum strategies for providing and maintaining pavements in a serviceable condition over a given period of time. The function of PMS is to improve the efficiency of decision making, expand its scope, provide feedback on the consequences of decisions, and insure the consistency of decisions made at different management levels within the same organization.

The essential requirement of PMS includes:

- Basic inventory data including traffic and structure information.
- Ability to consider alternative maintenance and rehabilitation strategies.
- The ability to identify a prioritized or optimized set of alternative strategies.
- A feedback process to update system models as better information becomes available.

The basic functions of the PMS are to:

- Collect inventory, condition, and cost data.
- Assign strategies, identify needs, and arrange priorities.
- Project future needs and build long range programs.
- Provide management information.
- Support budgets.

It is clearly, the objective of this thesis to provide vital road condition data for assist researchers, decision makers and maintenance engineers to generate strategy, to develop PMS framework and data base and to select the suitable maintenance treatment at the project level.

Pavement management systems (PMS) include a subsystem for pavement maintenance which may contain models to determine the most cost effective treatment. These are generally based on pavement type, condition, and other important factors. It is critical,, however, that the proper maintenance treatment be placed at the right time for the pavement to function as designed and for the maintenance program to be cost effective. A limitation of many PMS systems is their inability to comprehensively analyze individual project and determine the proper timing and cost of treatment.

Two types of pavement maintenance are generally recognize: (preventive and corrective) Preventive maintenance is used to arrest minor deterioration, retard progressive failures, and reduce the need for corrective maintenance. It is performed before the pavement shows significant distress to provide a more uniform performing pavement system. Corrective maintenance is performed after a deficiency occurs in the pavement; i.e., loss of friction, moderate to severe rutting, or extensive cracking. Although there are many different definitions for these terms, these are the ones used in this thesis.

Although each type of maintenance is needed in a comprehensive pavement preservation program, the emphasis should be placed on preventing a pavement from reaching the condition where corrective maintenance is required, since the cost associated with this approach can be substantial.

What is really needed is a determination of the cost effectiveness: the preventive maintenance (PM) approach compared with standard practices of rehabilitation when the pavement wears out.

Preventive maintenance is a relatively new concept for most highway agencies, therefore, not surprisingly, there has been widespread misunderstanding and confusion throughout the transportation community over what preventive maintenance is and what it isn't. This has led, in some cases, to lack of agency and public support for preventive maintenance. As practitioners become more familiar with the concepts and tools of preventive maintenance, the definition offered by AASHTO standing committee of Highway is gaining acceptance.

AASHTO definition: Preventive maintenance is the planned strategy of cost-effective treatments to an existing roadway system and its appurtenances that preserves the system, retards future deterioration, and maintains or improves the functional condition of the system (without substantially increasing structural capacity).

Pavement preventive maintenance narrows that focus to the application of one or more treatments, generally to the surface of a structurally sound roadway.

AASHTO's lead state team on pavement preservation summed things up quite nicely by defining pavement preventive maintenance as,

(Applying the right treatment to the right pavement at the right time)

1.2 Problem Statement:

The purpose of this thesis is to increase important of road maintenance and rehabilitation of Sudan paved road network and to provide a tool for formulating rational bases for assessment of pavement condition and evaluation options.

The study covers for determination the condition pavement for some roads from Sudan network, through visual surveys using the Pavement Condition Index (PCI) method for quantifying pavement condition, and provide necessary information for scheduling preventive pavement strategies for Sudan paved road network.

1-3 Objectives and Methodology:

The objectives of the proposed thesis include:

- Evaluating the optimal application time of different maintenance treatments used in highway;
- Developing a practical guide for applying preventive maintenance treatments for highways;
- Investigating and establishing the treatment performance models for the typical treatments used in highway; and
- Developing a decision making method for the preventive maintenance in highway;

The roads in case study shall be subdivided into links which are uniform in respect of traffic, environment, geometry, and pavement type and construction history. The links shall be subdivided into sections which are uniform in respect of pavement condition. For the purpose of project analysis the links, sections and unit samples shall

be the same for every strategic analysis, then type and severity of pavement distress shall be assessed by visual inspection.

The distress data are used to calculate the PCI for each sample unit. The PCI of the pavement section is determined based on the PCI of the inspected sample units within the section.

1.4 Thesis Format:

This Thesis includes the following contents:

Chapter One; gives us a general idea of preventive maintenance and its importance in maintaining the pavement performance. And thereafter, determine the objectives of the research.

Chapter two; will give us an idea of the theoretical backgrounds started for preventive maintenance of paving, as well as, About some research which stated subject of research, , and finally, for preventive maintenance manual for Flexible Pavements referred to in this study.

Chapter three; we review the case study and method to determine distress, also how to collect data for define the pavement condition index.

Chapter four; is the analysis of the case study data and determines the rate of pavement condition index, and determine the appropriate treatment for surface.

Chapter five; will talk about the conclusions and recommendations about thesis.

CHAPTER II

LITERATURE REVEIW

2.1 Introduction:

A Pavement Management System (PMS) is a process to cost-effectively manage a roadway system. The formal process includes a systematic, consistent approach of gathering and analyzing data and generating recommendations and reports so those who control road maintenance budgets can make informed investment decisions. PMS generally include a subsystem for pavement maintenance which may contain models to determine the most cost-effective treatment (FHWA 1997 and 1998[1, 2]). It is critical, however, that the proper maintenance treatment be placed at the right time for the pavement to function as designed and for the maintenance program to be cost effective (Hicks et al., 2000[3]). They implied also that a limitation of many systems is their inability to comprehensively analyze individual projects and determine the proper timing and cost of PMS treatment.

The foundation of all PMS is a database that includes the following four general types of data (Flintsch et al., 2004[4]):

- Inventory (including pavement structure, geometrics, and environment).
- Road usage (traffic volume and loading).
- Pavement condition (ride quality, surface distresses, friction, and/or structural capacity).
- Pavement construction, maintenance, and rehabilitation history.

PMS analysis capabilities include network-level and project-level tools. “Network-level” analysis tools support planning and programming decisions for the entire network or system.

“Project-level” analysis tools are used to select the final alternatives and to design the projects included in the work program.

A PMS process is usually conducted in six steps (Peng and Ouyang, 2010[5]):

- Determine pavement condition indices.
- Develop prediction model.
- Define treatments.
- Build decision tree.
- Determine criteria.
- Develop prioritization approach.

With the nationwide highway infrastructure largely in place and transportation budgets stretched, most Departments of Transportation are focusing more of their time and money on highway maintenance and rehabilitation. One strategy for maximizing these efforts is “preventive maintenance,” the periodic application of relatively inexpensive pavement treatments to the existing roadway systems in order to retard further deterioration and improve the functional condition of the system.

Many country have been investing a significant portion of budget on pavement preservation activities based on the widely accepted assumption that these efforts are cost effective. According to a study conducted by the Michigan State University, for every dollar spent on pavement preventive maintenance, \$4 to \$10 can be saved on rehabilitation.

Figure (2.1) illustrates the relative high cost for rebuilding and low cost for preventive maintenance of highways. Studies have shown that rehabilitation and reconstruction costs about 14 times as much as pavement preservation projects per lane mile over the

life of the project. A simple optimizing scheme is to find the point on the curve where the cost of reconstruction crosses the cost of maintenance and repair.

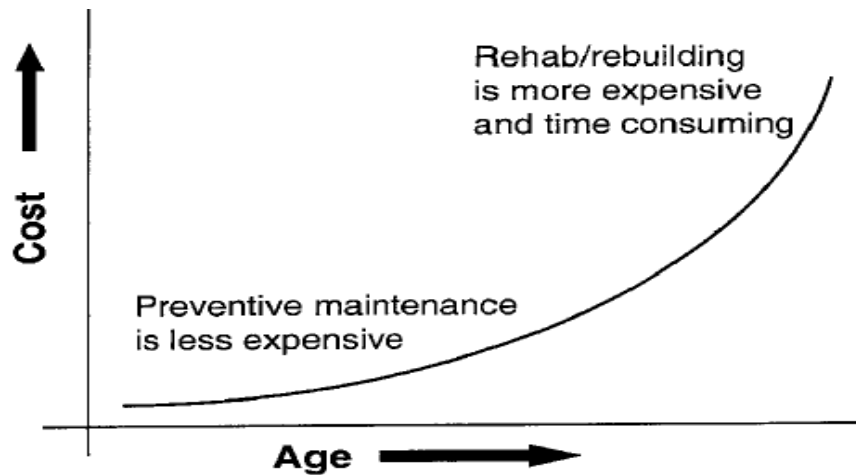


Figure 2.1 Cost of Maintenance VS. Age

During recent years, the development of many of the techniques of preventive maintenance of the sidewalk by the industry. More and more of the road administrations have adapted to these newly developed techniques to help save the limited funding. Although some of the Ministries of Transportation has introduced some of the applications of preventive maintenance for paving (such as small float on the surface and fog seal), which led to some benefits, such practices are still facing many obstacles. Among the obstacles is the lack of evidence that the cost of preventive maintenance and effective evidence is insufficient when it should be applied to preventive maintenance treatments. Thus, the Roads and Transport departments need to measure that could help to demonstrate the cost-effectiveness of preventive maintenance and processors and provide evidence on the optimal timing for such treatments.

However, deciding the optimal point on the curve(s) representing different types of pavement is no easy task. It varies based on different treatment technologies with proven efficiencies for the region. Figure 2.2 illustrates how the trigger point for preventive maintenance differs from the trigger point for rehabilitation. In addition, various pavement distress conditions (such as rutting, cracking, raveling, moisture stripping and roughness, etc.) should also be considered.

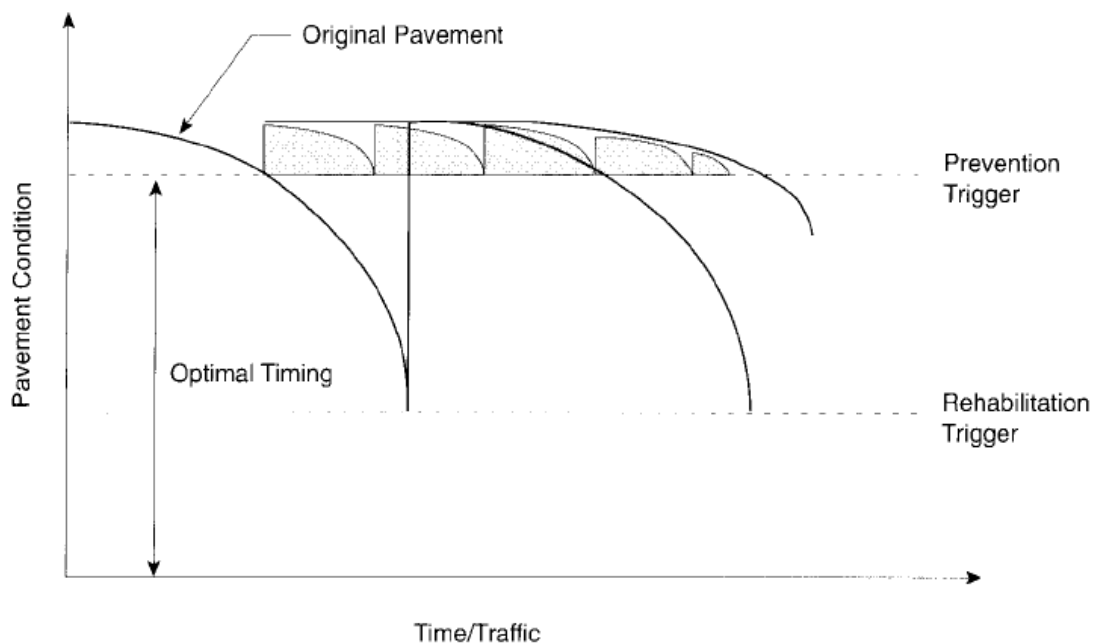


Figure 2.2 Optimal Timing of Preventative Maintenance

Even for the purpose of prevention, the timing for a treatment to be applied is critical. Figure 2.3 illustrates an ideal point in which the treatment must be applied early enough that a high quality of pavement can be maintained. This way, the total pavement life can be significantly extended. Within the budget limitations, the pavement condition (or quality) index can usually be used to maximize the benefit of correct timing of applying a specific preventive maintenance treatment.

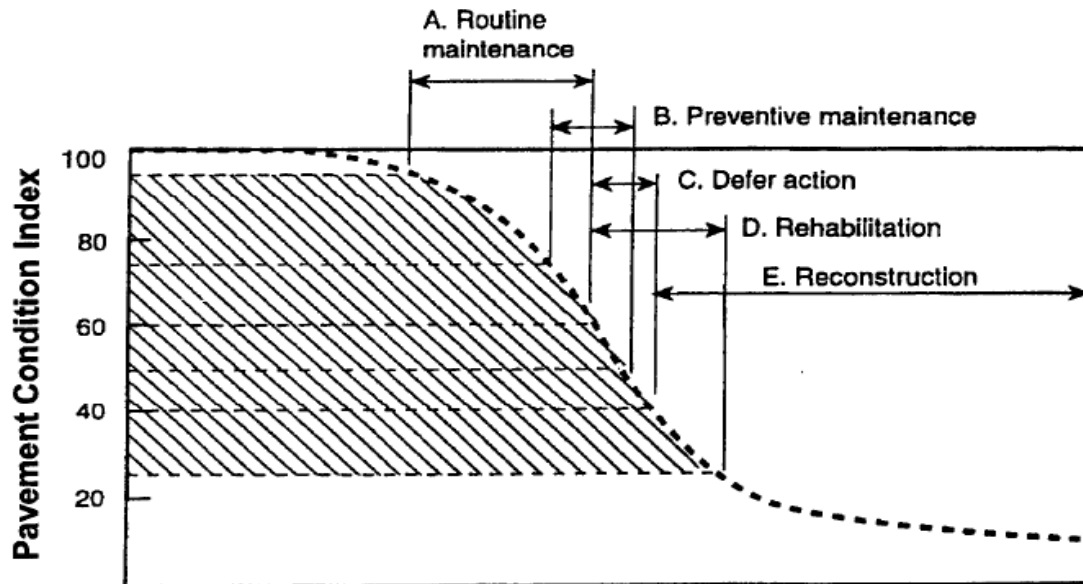


Figure 2.3 Timing of Rehabilitation vs. Different Treatments Required

In order to stretch a limited budget, and improve the performance of the public sidewalk and the preservation of public satisfaction on the road system, and will be very useful for the maintenance departments of roads and the development of guidance on issues related to the optimal time to implement or improve preventative maintenance practices. Baoshan Huang and Dragon Vukosavljevic (October 2009[6]).

Today's increasing budget constraints require that roads and maintenance departments and ministries of transportation performing more work with little money. Historically, the focus of the departments to build highways and new roads, but the new focus is on the maintenance and preservation of the existing pavement surfaces. This has resulted in a shift in the three types of pavement maintenance operations.

2-1-1 Preventive Maintenance: Performed to improve or extend the functional life of a pavement. It is a strategy of surface treatments and operations intended to retard progressive failures and reduce the need for routine maintenance and service activities.

2-1-2 Corrective Maintenance: Performed after a deficiency occurs in the pavement, such as loss of friction, moderate to severe rutting, or extensive cracking. May also be referred to as “reactive” maintenance.

Corrective maintenance differs from preventive maintenance primarily in cost and timing. While preventive maintenance is performed when the pavement is still in good condition, corrective maintenance is performed when the pavement is in need of repair, and is therefore more costly.

Corrective maintenance is much more reactive than preventive maintenance, and is performed to correct a specific pavement or area of distress.

Delays in maintenance increase pavement defects and their severity so that, when corrected, the cost is much greater. Consequently, the life cycle costs of the pavement will be considerably increased when corrective maintenance is performed.

Corrective maintenance activities include structural overlays, mill and overlays, pothole repair, patching, and crack repair.

2-1-3 Emergency Maintenance: This maintenance activity may be performed during an emergency situation, such as when a blowout or severe pothole must be repaired immediately, generally for safety reasons, or to allow for traffic to use the roadway.

Emergency maintenance also describes those treatments that hold the surface together until a more extensive rehabilitation or reconstruction treatment can be accomplished.

When emergency maintenance is needed, some of the typical considerations for choosing a treatment method are no longer important. Cost may be the least important consideration, after safety and time of application are considered. Materials that may not be acceptable when used in preventive or corrective maintenance activities, for cost or long-term performance reasons, may be highly acceptable when used in an emergency situation.

All types of maintenance are needed in a comprehensive pavement maintenance program. However, emphasizing preventive maintenance may prevent a pavement from requiring corrective maintenance. Preventive maintenance is completing the right repair on the right road at the right time.

Many pavement treatments can be used for preventive, corrective, or emergency maintenance. Figure 2-4 illustrates the differences among these three types of maintenance. As indicated on the graph, the main difference is the condition of the pavement when the treatment is applied. There are no clear boundaries between when a treatment is preventive versus corrective, or corrective versus emergency.

Although all three types of maintenance are important, this thesis focuses on preventive maintenance activities because these are the most cost effective and offer the best means for prolonging pavement service life (Ann M. Johnson, PE February 2000 [7]).

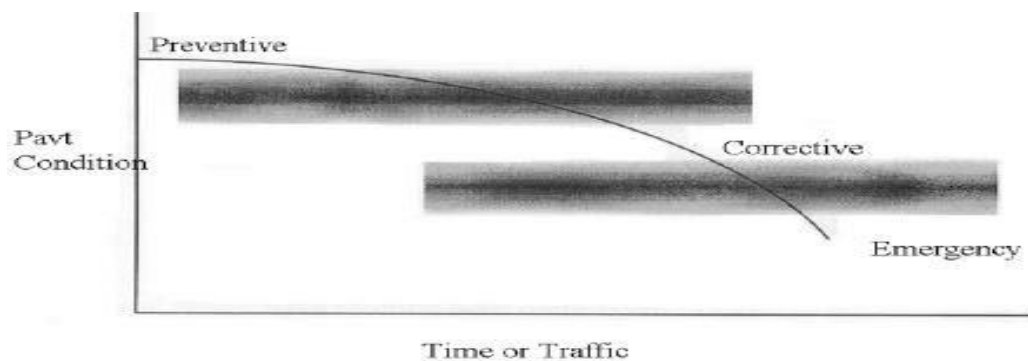


Figure 2-4: Maintenance Categories

2-2 Surface Treatment:

Surface treatments include sealing the existing asphalt pavement surface with asphalt, and in some cases, following that application with an aggregate if additional friction is desired. The asphalt may be a cutback or emulsion, but emulsions are recommended based on the added safety and reduced environmental ramifications.

The treatments outlined in this topic include fog seal, seal coat, double chip seal, slurry seal, micro surfacing, and thin hot-mix asphalt overlays. The seal treatments differ only in the amount and type of aggregate that is placed over the asphalt emulsion that seals the pavement surface. Sand sealing is not included in this manual and is not recommended because quantities are difficult to control, resulting in bleeding or excess sand on the pavement surface.

2-2-1-Fog Seal:

Description:

A fog seal is an application of diluted asphalt emulsion without a cover aggregate, used to seal and enrich the asphalt pavement surface, seal minor cracks, prevent raveling, and provide shoulder delineation. An asphalt distributor is normally used to apply the fog seal.

Fog seals are used on both low- and high-volume roads. Its primary use on high-volume roads has been to prevent raveling of open-graded friction courses and to delineate between the mainline and the shoulder. Its wider use on heavily trafficked roads is restricted because the pavement friction may be reduced until traffic wears some of the asphalt from the surface.

Timing:

As light to moderate raveling and/or oxidation and weather develop. Generally, the coarser the surface and thinner the initial asphalt film thickness in the existing asphalt mixture, the sooner treatment is required.

Purpose:

Use this method to seal and enrich the asphalt pavement surface, seal minor cracks, prevent raveling, and delineate shoulders.

Existing Pavement Condition:

Only use fog seals where the existing pavement is sufficiently porous to absorb a substantial amount of the emulsion.

Maintenance Methods:

Before placing the fog seal, make sure the pavement is dry and clean, and complete all necessary repairs or reconditioning work. Then apply sealer with an asphalt distributor. The application rate is the key element.

Seasonal Limitations:

Best applied when temperatures are warm or hot. Cool temperatures require longer curing times prior to opening the roadway to traffic.

Traffic Control Concerns:

Keep traffic off the emulsion until it has cured significantly. Under favorable conditions, two to three hours may be sufficient. Require reduced speeds until traffic wears some of the asphalt off the surface. Emulsion rates usually range from 0.1 to 0.15 gallon per square yard, depending on the pavement texture, weather conditions, and traffic. The application rate is kept low to prevent splashing and decreased skid resistance. A spraying temperature of 125oF to 160oF and surface temperature of at least 50oF and rising are recommended.

You may also use sand cover to improve the surface friction.

Anticipated Performance and Service Life:

Expected life depends on the properties of the underlying pavement and its exposure to sunlight. The performance life of this type of treatment is fairly short, ranging from one to two years.

Limitations:

Under adverse weather conditions it may be several hours before the road can be opened to traffic. For these reasons, fog seals are most often used on shoulders and in parking lots where the potential for reduced pavement friction is not a concern.

Precautions:

Use only where the existing surface is sufficiently porous to absorb substantial amounts of the emulsion. Do not use in areas with cracks larger than hairline. Use with caution on high-volume roadways.

Materials:

Asphalt emulsion diluted mix with 50 percent water (such as CSS-1, CSS-1H) or proprietary rejuvenators meeting Mn/DOT Specification 3151.

Construction Specifications that Apply:

Special Provision for Bituminous Fog Sealing.

Unit Cost for Estimating:

Fog sealing is very inexpensive. Price is normally about \$0.10 to \$0.20 per square yard depending on the type of binder, the application rate, and the size of the project.

2-2-2 Seal Coat:**Description:**

A seal coat is an application of asphalt followed immediately with an aggregate cover. Applications with two layers are referred to as a double chip seal. Rapid-setting asphalt emulsions are normally used when placing a seal coat. Seal coats can waterproof the surface, provide low-severity crack sealing, and restore surface friction.

Timing:

You can seal coat at any time in a pavement's life.

Purpose:

The primary reason to seal coat an asphalt pavement is to protect the pavement from the deteriorating effects of sun and water. When an asphalt pavement is exposed to sun, wind, and water, the asphalt hardens, or oxidizes.

This causes the pavement to become brittle, cracking the pavement. A seal coat provides a waterproof membrane that not only slows down the oxidation process but also helps the pavement shed water, preventing it from entering the base material.

A secondary benefit is an increase in the surface friction, which happens when the cover aggregate adds additional texture to the pavement. A seal coat can increase surface texture on a raveled pavement.

Existing Pavement Condition:

Pavements that are dry and raveled are good candidates for seal coating. Some agencies also choose to seal coat pavements in good condition as a preventive maintenance technique.

Maintenance Methods:

One of the most important factors when considering a seal coat is the design procedure used to determine the quantities of asphalt binder and cover aggregate. The goal is to have the aggregate particles approximately 70 percent embedded into the asphalt layer. You must make adjustments to account for the traffic volume on the roadway; the absorption of the asphalt binder into the existing pavement; the absorption of the asphalt binder into the cover aggregate; the texture of the existing pavement; and the size, shape, and gradation of the cover aggregate. The correct application rate will result in a single layer of chips embedded approximately 70 percent into the binder with little or no excess chips to remove.

To ensure that the application rates are correct, calibrate the equipment used in chip sealing. You can place a series of rubber mats on the pavement to calibrate the chip spreader. Calibration procedures also exist for determining the application rate of asphalt distributors. On the distributor, adjust the nozzle angle in relation to the spray bar so that the spray fans will not interfere with each other. The recommended angle is between 15 and 30 degrees. The nozzle size, spacing, and angle will determine the spray bar height. The Seal Coat Handbook (Mn/DOT document number 1999-07) provides very detailed information about seal coat placement and design.

Sequence:

1. Sweep the existing surface to clean and remove loose debris.
2. Apply the asphalt binder with a distributor.
3. Apply cover aggregate using a chip self-propelled spreader.
4. Roll the chip-sealed surface with pneumatic-tired rollers. Five to six passes should be the goal.
5. Sweep excess chips as soon as possible without damaging the sealed surface. You can normally do this the next day, sooner if modified binders are used.

Seasonal Limitations:

Seal coats are affected greatly by weather conditions, especially during construction. A warm, sunny day with low humidity is the ideal condition.

Humidity and cool weather will delay the curing time and keep the seal coat tender for a longer period of time, making it more susceptible to damage by traffic. Rain can cause major problems when seal coating. If the asphalt binder has not cured, it can become diluted and rise above the top of the cover aggregate. After the water evaporates, asphalt may cover the entire surface, causing tires to pick up aggregate or track the binder across the surface. Never seal coat when showers are threatening.

Conduct seal coating operations (including traffic restrictions on the freshly constructed seal coat), only during daylight hours, when the pavement and air temperature are 60oF or higher, and when the relative humidity is less than 75 percent. In addition, do not conduct seal coat operations in foggy or rainy weather.

Traffic Control Concerns:

Do not permit traffic on the sealed road surface until after all rolling has been completed and the bituminous material has set and will not pick up on vehicle tires.

Anticipated Performance and Service Life:

Expected life of a seal coat is approximately three to six years.

Limitations:

Loose chips not embedded in the asphalt membrane will become airborne and possibly damage vehicle windshields. Excessive binders or wet aggregates could cause flushing. Traffic noise will also increase after application of a chip seal.

Precautions:

Although seal coats provide effective sealing and friction, the possibility of loose chips and broken windshields along with excessive noise has prompted some states to restrict use of chip seals to low-volume roads.

Materials:

Bituminous material meeting the specifications of Mn/DOT 3151. Seal coat aggregate meeting the specifications as.

Construction Specifications that Apply:

Special Provisions for Bituminous Seal Coat.

Unit Cost for Estimating:

Placing a seal coat varies widely depending on the type of binder, type of aggregate, and the size of the project. Using conventional emulsions results in a range between \$0.40

and \$0.70 per square yard. Using a latex-modified binder adds an additional \$0.04 to \$0.08 per square yard.

2-2-3 - Double Chip Seal:

Description:

This treatment involves the application of two single seal coats. The second coat is placed immediately after and directly over the first. Sixty percent of the total asphalt binder required is placed in the first pass, with larger aggregate. The remaining forty percent is placed in the second pass, with aggregates half as large as those placed first.

Timing:

Generally later in a pavement's service life than for crack sealing or fog sealing.

Purpose:

Waterproofs the surface, seals small- to medium-sized cracks, and improves surface friction. This treatment reinforces the benefits of a single chip seal.

As the top layer of aggregate wears off, the bottom remains. It offers better aggregate retention overall, as the bottom layer is more deeply embedded. A double chip seal results in a quieter, smoother surface than a single chip seal, and is a good alternative for pavements in poor condition.

Existing Pavement Condition:

A stable pavement on a sound base with a good cross section and good lateral support. Visible surface distresses may include moderate raveling, surface wear, longitudinal cracks, and transverse thermal cracks with some secondary cracking and some deterioration along crack faces. A minor amount of patching in good condition is acceptable. Surface may show signs of slight to moderate block cracking, moderate to severe oxidation, and/or slight to moderate flushing or polishing.

Maintenance Methods:

Before placing the double chip seal, make sure pavement is dry and clean and complete all necessary repairs or reconditioning work.

Seasonal Limitations:

Conduct seal coating operations (including traffic restrictions on the freshly constructed seal coat) after, only during daylight hours, when the pavement and air temperature are 60oF or higher, and when the relative humidity is less than 75 percent. In addition, do not perform seal coat operations in foggy or rainy weather.

Traffic Control Concerns:

Do not permit traffic on the sealed road surface until after all rolling has been completed and the bituminous material has set and will not pick up on vehicle tires.

Anticipated Performance and Service Life:

Life extension depends on the type and amount of traffic and the roadway geometry. Heavy commercial traffic and frequent stopping and turning movement reduce the life of this application and cause local deterioration.

Limitations:

Loose chips not embedded in the asphalt membrane will become airborne and possibly damage vehicle windshields. Excessive binders or wet aggregates could cause flushing. Traffic noise will also increase after application of a chip seal.

Other limitations include a limited life or premature failure if the chip seal is not properly designed or constructed, and prolonged traffic disruption during construction and curing.

Precautions:

Do not place chip seals in cool weather or on days with high humidity. Also do not place them when there is a chance of rain.

Materials:

The bituminous material for seal coat will be one of the following kinds and grades conforming to Mn/DOT Specification 3151.

When the Contract quantity exceeds 2000 gallons, and unless the Plans or Special Provisions permit other options, the kind to be used will be Emulsified Asphalt, Cationic grades. In all cases the grade to be used will be as designated by the Engineer. It is strongly recommended that a polymer-modified emulsion be used on double seal to increase early retention of aggregate.

Aggregate for bituminous double seal coat shall conform to the requirements in the specification for grading and quality. The size of the first seal aggregates should be twice as big as the final seal aggregate.

Construction Specifications that Apply:

Draft Special Provisions for Bituminous Seal Coat Double Seal.

Unit Cost for Estimating:

Unit costs for a double chip seal are about \$1.50 per square yard depending on the type of binder, the application rate, and the size of the project.

2-2-4 - Slurry Seal:**Description:**

A slurry seal is a mixture of fine aggregate, asphalt emulsion, water, and mineral filler. The mineral filler most often used is Portland cement.

Slurry seals are used to seal the existing asphalt pavement surface, slow surface raveling, seal small cracks, and improve surface friction. Slurry seals are similar to chip seals in that they use a thermal break process, requiring heat from the sun and pavement. This process takes anywhere from two to eight hours depending on the heat and humidity.

Timing:

As minor surface cracking first develops, or to treat light to moderate raveling and/or oxidation.

Purpose:

Slurry seals are effective where the primary problem is excessive oxidation and hardening of the existing surface. Use slurry seals to retard surface raveling, seal minor cracks, and improve surface friction. Slurry seals will not perform well if the underlying pavement contains extensive cracks.

Existing Pavement Condition:

Excessive oxidation and hardening of the pavement surface.

Maintenance Methods:

Make sure the pavement is dry and clean, and complete all necessary repairs or reconditioning work prior to placing the slurry seal. Apply a thin film of water to control premature breaking and improve bond with the existing pavement. Then apply slurry over pavement surface.

Seasonal Limitations:

Place slurry seals when the air and pavement temperature are both at least 50°F and there is no chance of freezing within 24 hours after placement. Do not place slurry seals during rain, and do not apply them if rain is expected before the slurry is set.

Traffic Control Concerns:

A curing period is necessary before allowing traffic on the treated surface. Therefore, use of a slurry seal may not be appropriate where traffic must be allowed very soon after application. In warm weather, slurry seals require at least two hours to cure, depending on the ambient air temperature, humidity, and type of emulsion. Adjusting the

mineral filler will help reduce the set time of the slurry mixture but may hamper workability.

Anticipated Performance and Service Life:

Expected life of a slurry seal is three to five years. Factors affecting performance include traffic loading, environmental conditions, existing pavement condition, material quality and mix design, and construction quality.

Limitations:

Do not use on high-volume roads since friction initially may be reduced until traffic wears some of the asphalt from the surface?

Precautions:

Slurry seal will not perform well if the underlying pavement is cracked. Use only where the existing surface is stable with low-severity cracking.

Materials:

Slurry seals are generally produced and placed using a truck-mounted slurry machine. Aggregate, water, filler, and emulsion are proportioned and mixed together in a mixer and applied immediately to the pavement surface with a spreader box.

Aggregates for slurry mixes may consist of most hard crushed aggregates such as granite, limestone, trap rock, slag, and taconite tailings. They conform to one of three gradations: Type 1, Type 2, and Type 3. The maximum size for slurry aggregates is 2.36 mm (#8 sieve) for Type 1, and 9.5 mm (3/8-inch sieve) for Types 2 and 3. Type 3 has a coarser gradation than Type 2. All slurry gradations have between 5 and 15 percent passing the 75-micron sieve (#200). The slurry is applied basically one aggregate layer thick.

A tack coat is not necessary unless the pavement to be sealed is extremely dry and raveled or the slurry is being placed on a concrete surface.

Unit Cost for Estimating:

Costs are approximately \$1.50 per square yard depending on the size of the project, materials used, and the rate of application.

2-2-5 – Micro-surfacing:

Description:

Micro-surfacing is sometimes incorrectly referred to as a polymer-modified slurry seal. The major difference is that the curing process for micro-surfacing is chemically controlled, whereas slurry seals and chip seals use the thermal process. Micro-surfacing was designed for use as a rut-filling material in Europe in the 1970s and introduced to the United States in 1980. Since then, many states have used this treatment for both surfacing and rut filling on roads with moderate- to heavy-volume traffic.

Timing:

Use when ruts exceed 3/4 inch or friction drops to unacceptable levels. You may also use it as a preventive maintenance technique to prolong pavement life when oxidation becomes moderate to severe on pavements with minor cracking.

Purpose:

As a preventive maintenance or surface treatment for an existing AC pavement, micro-surfacing provides a skid-resistant surface and reduces the amount of water that enters the pavement layers through the pavement surface. Micro-surfacing restores the transverse cross-section profile and may also be used to fill ruts.

Existing Pavement Condition:

Excessive oxidation and hardening of the pavement surface.

Maintenance Methods:

Make sure the pavement is clean, and complete all necessary repairs or reconditioning work prior to micro-surfacing.

Seasonal Limitations:

Avoid late season application.

Traffic Control Concerns:

Re-route traffic until the treatment cures. Micro-surfacing cures and develops strength faster than conventional slurry seals and can be opened to rolling traffic in about an hour.

Anticipated Performance and Service Life:

Service life is about seven or more years for high traffic and considerably longer for low to moderate traffic. The service life is dependent on the condition of the pavement at the time of micro-surfacing placement.

Factors affecting performance include traffic loading, environmental conditions, existing pavement condition, material quality and mix design, and construction quality.

Limitations:

Do not use on pavements with moderate to heavy cracking.

Precautions:

Materials used in micro-surfacing must be designed to work together.

Materials:

Micro-surfacing is a mix of polymer-modified emulsion, well-graded crushed mineral aggregate, mineral filler (normally Portland cement), water, and chemical additives that control the break time. The aggregate, mineral filler, emulsion, and water are mixed in a truck-mounted traveling plant, which is deposited into a spreader box. No compaction is needed and, under normal environmental conditions, traffic may be allowed over the application within an hour after placement.

Because this is a chemical curing process, material selection and the mix design are crucial. The mix design normally sets the amount of polymer-modified emulsion and filler as a function of the amount of mineral aggregate.

You can adjust the amount of water, mineral filler, and additives in the field to control the time at which the emulsion breaks and the time at which traffic can be allowed. It can also be changed due to change in temperature, humidity and texture of the existing surface.

Unit Cost for Estimating:

Micro-surfacing normally ranges between \$1.50 and \$2.00 per square yard depending on the materials used and the size of the project.

2-2-6 Thin Hot-Mix Overlays:

Description:

Thin hot-mix asphalt (HMA) overlays are blends of aggregate and asphalt cement. Three types of HMAs (dense-graded, open-graded friction courses, and gap-graded) have been used in the United States to improve the functional (non-structural) condition of the pavement. Thicknesses typically range from 3/4 to 1-1/2 inch. These mixes are often modified with polymers to meet high performance expectations.

Timing:

Prior to the onset of fatigue-related pavement distress.

Purpose:

Thin hot-mix asphalt overlays are used on all types of roadways for functional improvements. Functional improvements are those improvements that enhance the smoothness, friction, and/or profile of the roadway while adding little or no additional load-carrying capacity. These are particularly suitable for high-volume roads in urban

areas where longer life and relatively low-noise surfaces are desired. These applications are used in all climatic conditions.

Existing Pavement Condition:

A stable pavement with a sound base with a fair cross section and good lateral support. Visible surface distresses may include moderate to extreme raveling and longitudinal and transverse cracks with some secondary cracking. A moderate amount of patching in good condition is acceptable. Milling prior to overlay is recommended when severe surface distress is present.

Maintenance Methods:

Milling or a leveling course should precede thin HMAs where pavements need cross-section improvements. In addition, seal all cracks prior to application.

Use tack coats when using thin HMAs.

Seasonal Limitations:

Place mixes in warm weather (55oF minimum) and roll immediately. Due to their low mass, they lose heat to the atmosphere very quickly. As a result, achieving density is only possible if they are compacted very quickly while they are still hot.

Traffic Control:

Traffic control requirements for thin HMAs are minimal.

Anticipated Performance and Service Life:

Expected life of thin HMA overlays has varied but is expected to average five to eight years. Some states report as low as two to four years; others report as many as ten years.

Limitations:

Thin HMA overlays add little structure to the existing pavement and should not be used on pavements showing structural distress or deterioration, unless the distress is

corrected first. Deteriorated cracks and localized pavement failures will quickly reflect through the new surface.

Precautions:

The principal problems with thin HMAs are similar to those of other thin overlay techniques. A recent AASHTO survey reported problems such as delamination, reflective cracking, poor friction, low durability, excessive permeability, and maintenance problems.

Materials:

Mix 2350 LV type 5 is recommended and should be placed with a paver. Compaction is important to performance. Non-designed “sand mixes” are not recommended.

Construction Specifications that Apply:

Mn/DOT 2350 and 2360.

Unit Cost for Estimating:

The cost of thin HMA overlays depends largely on the layer thickness and the size of the project. Thin HMA overlays using Specification 2350 usually range from \$18 to \$30 per ton of mix.

2-2-7 Mill & fill:

Description:

Mill and fill is the process of removing approximately 20 mm of existing asphalt through a process called cold milling, then replacing it with a suitable depth of new hot mix asphalt.

Purpose:

Mill & fill is mainly used to create a smooth ride by eliminating the effects of tire ruts and asphalt movement that occur over years of use.

Existing Pavement Condition:

The existing pavement should have a good base. Visible surface distress may include: severe surface raveling, multiple longitudinal and transverse cracking with slight raveling, a small amount of block cracking, patching in fair condition, de-bonding surface and slight to moderate rutting.

The cold milling operation is used to correct rutting in the existing asphalt surface layer where the rutting is not caused by a weak base and when the condition of the existing pavement has deteriorated to a point where it is not practical to correct the rutting problem by a more economical treatment. The cold milling operation is also used to remove an existing asphalt course that is debonding.

Existing pavement crown and super elevation sections that have been identified as having a relationship to accidents can be modified by cold milling. In a curb and gutter section, cold milling can be used to remove a portion of the existing asphalt surface to retain the existing curb face. Cold milling can also be used in those areas where the existing pavement grade cannot be raise.

Existing Pavement Surface Preparation:

The existing pavement should be prepared by repairing minor base failures and depressions.

Performance:

- Functional: Mill & fill treatment can correct several surface deficiencies including longitudinal, transverse and block cracking, raveling, friction loss, roughness and bleeding. Mill & fill performs best on remedying severe cracking and rutting.
- Structural: no Mill & fill adds limited structural capacity.
- Traffic: Performance should not be influenced by different traffic.

Performance Limitations:

Mill & fill should not be placed on an existing pavement that shows evidence of a weak base.

Contraindications:

Structural failure (i.e., extensive fatigue cracking or high severity rutting)
Extensive pavement deterioration, little remaining life.

Construction Considerations:

Surface must be clean. Milled asphalt materials must be removed.

Expected Life Extension:

Pavement	Years
Flexible	8 to 12
Composite	8 to 10

Typical Costs:

The cost is the sum of milling cost and placing cost of HMA.

2-3 Preventive Maintenance and Pavement Preservation:

A preventive maintenance program is a systematic approach to using a series of preventive maintenance treatments over time. One treatment will improve the quality of the pavement surface and extend the pavement life, but the true benefits of pavement maintenance are realized when there is a consistent schedule for performing the preventive maintenance.

An effective pavement preservation program integrates many preventive maintenance strategies and rehabilitation treatments. The goal of such a program is to extend pavement life and enhance system-wide performance in a cost-effective and efficient way. Studies show that preventive maintenance is six to ten times more cost-effective than a “do nothing” maintenance strategy.

The benefits include keeping the pavement to improve customer service and achieve significant savings in life-cycle costs; treatments, especially cost-effective when applied in the life of the pavement early. In addition, by extending the life of the pavement so that the sector rehabilitation and preventive maintenance departments to allow maintenance of roads even outside the budget from year to year, which otherwise can vary greatly.

Department of Transportation has used preventive maintenance by building programs to balance the budget, and reports that they send their programs to enable them to improve the condition of the network while maintaining a certain budget, resulting in more stability for the funding needs.

Critical elements of a successful pavement preservation program are:

1. Selecting the roadway
2. Determining the cause of the problem
3. Identifying and applying the correct treatment(s)

4. Determining the correct time to do the needed work

5. Observing performance

Preventive maintenance activities can include conventional treatments such as crack sealing, chip sealing, fog sealing, rut filling, and thin overlays. They can also include emerging technologies such as ultra-thin wearing courses, very thin overlays, and micro-surfacing applications. Aside from crack treatments, all of these treatments leave the pavement with a new wearing surface. A fog seal provides a new wearing surface, although it generally has a lower friction number than the original surface (Ann M. Johnson, P.E. February 2000[7]).

Preventive maintenance is not a single pavement maintenance or rehabilitation treatment. Rather it is defined as a planned strategy of cost-effective treatments. There is a difference between preventive maintenance (a strategy) and a preventive maintenance treatment (an action). The following key words provide background information to facilitate the understanding of preventive maintenance concepts. [8]

Preventive Maintenance Treatment – treatment is performed to prevent premature deterioration of the pavement or to retard the progress of pavement defects. The objective is to slow down the rate of pavement deterioration and effectively increase the useful life of the pavement. The key is to apply the treatment when the pavement is still in relatively good condition with no structural damage (U.S. Federal Highway Administration, 2000[9]). Examples of preventive maintenance treatments include:

- sealing cracks to prevent water from entering the pavement structure;
- stitching cracks in Portland concrete cement (PCC) pavement to restore load transfer; and
- Applying a thin overlay to protect open and porous pavement surfaces from accelerated deterioration.

Typically, preventive pavement maintenance treatments are applied to pavement in good or very good condition. Once structural damage occurs, preventive maintenance is no longer a viable option.

Corrective Maintenance Treatment – maintenance actions are taken to correct deficiencies that are potentially hazardous and to repair defects that seriously affect serviceability. Corrective maintenance is also referred to as “reactive” maintenance.

Examples of corrective maintenance treatments include:

- filling potholes to retain safe driving conditions;
- removing and replacing cracked PCC slabs; and
- Re-grading gravel shoulders to remove shoulder drop-off.

Emergency Maintenance Treatment – treatments are performed during an emergency situation, such as immediate repair of a severe pothole or a shoulder washout. Emergency repairs may be necessary for both old and new pavements.

Holding Maintenance Treatment – holding maintenance is also called “temporary” maintenance. It includes maintenance actions designed to hold the pavement surface together until more permanent or substantial rehabilitation takes place. Holding maintenance may be necessitated by the timing of future rehabilitation or reconstruction activities or by lack of funds.

Rehabilitation Treatment – actions are taken to restore initial pavement serviceability such as by pavement overlay or in-situ recycling. Pavements may receive several rehabilitation treatments (or undergo several rehabilitation cycles) before they are reconstructed.

Reconstruction – this covers actions that include the removal of all surface layer materials and possible substantial changes to base and sub base layer materials.

Pavement Preservation Treatments – preservation treatments encompass all types of maintenance and rehabilitation treatments.

Asset Management – this is the systematic process of maintaining, upgrading and operating physical assets effectively, combining engineering principles with sound business practice and economic theory, providing tools to facilitate a more organized, logical approach to decision making (Transportation Association of Canada, 1999[10]).

Pavement Management – this includes the tools or methods that assist decision makers in finding optimum strategies for providing, evaluating and maintaining pavements in a serviceable condition over a period of time (AASHTO, 1993[11]).

Life-Cycle Costing – in the context of pavement management, it is an economic analysis procedure used to compare alternative pavement structures over an extended period of time (often 30 years or more) taking into account the costs (initial construction costs as well as all subsequent maintenance and rehabilitation costs). Some a costs might include user cost.

A preventive maintenance treatment, as defined above, is not determined by the type of treatment, but by the reason for the treatment. For example, a micro-surfacing treatment applied to seal an open and slightly porous asphalt concrete surface is a preventive maintenance activity; micro-surfacing applied to counteract moderate rutting is a corrective maintenance activity. An overlay applied to pavement sections (that are below an average or required strength due to poor local soil conditions or unforeseen traffic loads), before major pavement distresses appear, is a preventive maintenance treatment; an overlay applied to restore pavement serviceability is a rehabilitation treatment.

The construction technology of pavement maintenance treatments (e.g., micro-surfacing, or routing and sealing) is similar whether the treatments are considered

preventive or corrective. There are also no clear boundaries between preventive and corrective maintenance treatments. Often, when a treatment is initially planned, it may be preventive; when it is finally implemented it may be considered corrective.

The anticipated effect of a preventive maintenance treatment is illustrated in Figure 2-5. The curve that shows the change in pavement condition with time is referred to as the “pavement performance curve.” Typically, preventive pavement maintenance treatments are applied while the pavement is in a relatively good condition. Usually, on the scale of 0 to 100, where 100 represents a new pavement, the first preventive maintenance treatment is applied before the pavement condition drops below 70.

Figure 2-5 also shows the effect of a preventive maintenance treatment on extending the life span of the pavement.

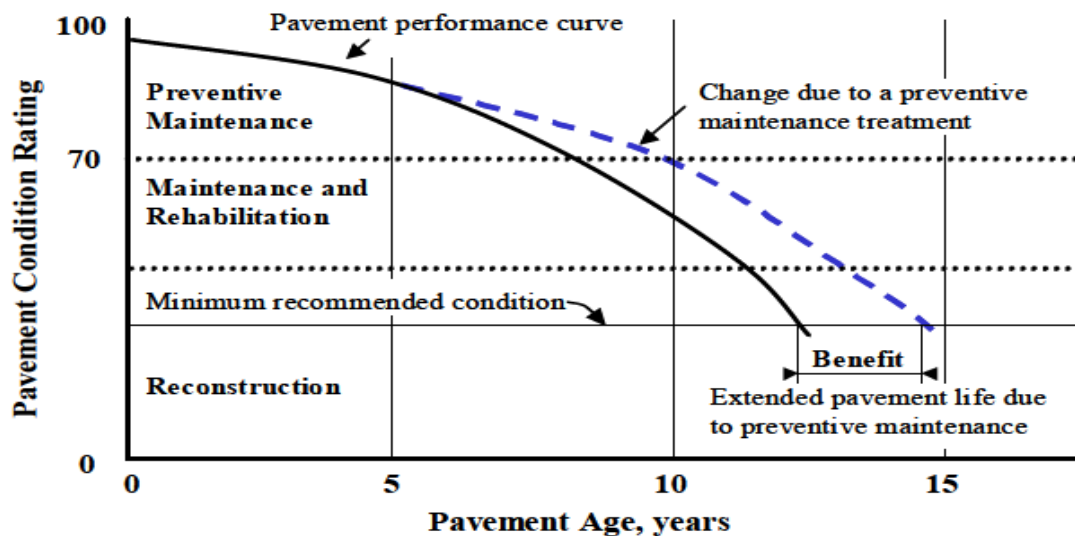


Figure 2-5: Benefits of Preventive Maintenance for Extended Pavement Life

The pavement preventive maintenance (PPM) successful programs in many departments of transportation. However, other departments that are currently struggling to find ways to start such programs.

The guidelines that follow were developed from generally accepted knowledge of PPM principles and processes along with information received from the agencies. The guidelines are meant to provide basic information to those agencies embarking on PPM as a new or improved way of doing business, and to provide them with some strategies that have proven successful elsewhere. The guidelines will answer the following questions:

- What is pavement preventive maintenance?
- Why become involved with pavement preventive maintenance?
- What are the benefits of pavement preventive maintenance?
- What are the barriers and/or potential pitfalls to the development of a pavement preventive maintenance program?
- What are the steps necessary to implement a pavement preventive maintenance program?

2-3-1 What is Pavement Preventive Maintenance?

Preventive maintenance is a relatively new concept for most highway agencies. Therefore, not surprisingly, there has been widespread misunderstanding and confusion throughout the transportation community over what preventive maintenance is and what it isn't. This has led, in some cases, to lack of agency and public support for Preventive Maintenance. As practitioners become more familiar with the concepts and tools of preventive maintenance, the definition offered by the AASHTO Standing Committee of Highways is gaining acceptance.

AASHTO defines preventive maintenance as: ...the planned strategy of cost-effective treatments to an existing roadway system and its appurtenances that preserves the system, retards future deterioration, and maintains or improves the functional condition of the system (without substantially increasing structural capacity).

Pavement preventive maintenance narrows that focus to the application of one or more treatments, generally to the surface of a structurally sound roadway.

AASHTO's Lead State Team on Pavement Preservation summed things up quite nicely by defining pavement preventive maintenance as, (Applying the right treatment to the right pavement at the right time).

2-3-2 Why Become Involved with Pavement Preventive Maintenance?

Traditionally, highway agencies have allowed the ride quality and structural condition of a pavement to deteriorate to fair to poor condition before taking steps to rehabilitate the pavement.

The aim of rehabilitation is to repair structural damage and restore measurable pavement conditions such as ride, rutting and cracking. This is costly and time consuming activity with associated traffic disruptions and inconvenience to adjacent businesses and residences.

This “worst-first” scenario came about for many reasons, including the requirements for Federal-aid funding, the maximization of capital growth, and a long-standing philosophy of, “If it ain't broke, don't fix it.”

Highway agencies have found that applying a series of low-cost preventive treatments can extend the service lives of their pavements. This translates into a better investment, better ride quality, and increased customer satisfaction and support.

The experience with pavement preventive maintenance in a number of agencies demonstrates this success – each dollar spent now has been estimated to save up to six dollars in the future.

2-3-3 What Are the Benefits of Pavement Preventive Maintenance?

The benefits associated with pavement preventive maintenance, both perceived and documented, vary from agency to agency depending not only upon a particular

agency's strategic objectives, but also on what stakeholder is promoting the concept. For example, the traveling public will be most attracted to improved ride, while the pavement management engineer will find value in the fact that overall condition of the network will improve over time, and the executive management of an agency will be drawn to the reported cost savings.

The benefits most often associated with successful pavement preventive management programs are listed below. Although not all these benefits are currently being measured, they are the ones that appear repeatedly in the literature and practitioner discussions:

- **Higher Customer Satisfaction** – Nationwide, surveys commissioned by the National Quality Initiative and the Rebuild America Coalition as well as studies undertaken in Arizona, California, and Washington have reported that a focus on customer satisfaction should be a part of every preventive maintenance program. The surveys indicated that, for the most part, motorists recognize that a well-maintained highway system is important in terms of enhanced safety, mobility and pavement conditions. Furthermore, the general public is willing to pay more in taxes to achieve this goal.

Clearly, the end results of an effective pavement preventive management program are smoother pavements, fewer delays for reactive maintenance activities such as pothole patching, and less disruptions for major rehabilitation projects. These positive changes will be noticed and supported by the traveling public.

- **Better Informed Decisions** – Agencies with successful pavement preventive maintenance programs have a proven track record of applying the, “right treatment to the right pavement at the right time.” This does not simply happen, of course, since PPM programs are based on a combination of past performance

history, current conditions of the existing pavements, and expected performance of the different treatment options available. The availability of and accessibility to information are critical elements to the success of any PPM program.

While better-informed decisions are important benefits of a PPM program, getting the necessary information collected and assembled into a usable format presents a formidable challenge to most agencies. Please see further discussion in the Barriers section, below.

- **Improved Strategies and Techniques** – As an agency ventures into the PPM arena, it quickly becomes clear that preventive maintenance treatments must provide the highest level of performance possible. Improved methods or materials, or a combination of the two, can accomplish increased performance. As a result of these increased needs and demands, many of today's materials have been designed to provide improved performance. Industry has also stepped to the plate in this regard, by developing new application methods and equipment that add to the overall performance of the treatments.

While the initial costs of the new and improved treatments may be higher in some cases, the expected life of the treatments is going to be much greater than conventional applications. The net effect is an overall reduction in maintenance costs.

- **Improved Pavement Condition** – Successful pavement preventive maintenance programs have been shown time and again to extend the performance cycle of individual pavements and entire networks. This benefit is also one of the better measured and documented. Some of the agencies with excellent supporting data in this regard include New York, Michigan, Wisconsin, California and Ohio.
- **Cost Savings** – From an agency standpoint, one of the most significant benefits of pavement preventive maintenance programs is financial. Historically, true cost

savings are one of the most elusive benefits to document. There have been comparisons made of treatment strategy costs over theoretical pavement networks, in which the effects on the overall condition of the pavement network for the given treatments are compared. These comparisons have documented a theoretical cost savings for PPM. Unfortunately, for existing roads what is available is a comparison between the historic costs of reactive maintenance and the anticipated costs of a preventive maintenance strategy. Cost savings are easier to document if an agency has made a commitment to providing a certain level of service, such as maintaining a ride quality or a threshold pavement condition index. In these cases, it can be shown that the agency can consistently provide a higher level of service with a PPM program than without.

Nonetheless, some agencies that have active pavement preventive programs feel they can see substantial financial advantages. Michigan (\$700 million since 1992) and California (a 4:1 to 6:1 benefit with preventive maintenance treatments) are reporting the benefits of their PPM programs. These savings are generally realized in the form of better overall pavement condition, or the same condition for a reduced cost, rather than a decrease in revenue required.

- **Increased Safety** – From the customer’s viewpoint, improving safety is priority number one. Safety is also high on the national level; the Federal Highway Administration has a Strategic Plan Goal to reduce fatal and injury crash rates 20 percent over 10 years.

By their very nature, pavement preventive maintenance programs provide measurable safety benefits. Today’s improved treatments can be relied upon to provide better surfaces, from better aggregate retention to fewer safety related defects such as ruts, raveling and potholes. This resultant improved surface texture has a direct positive

influence on surface friction (both wet and dry), surface water spray and road noise. In addition, pavements in better overall condition require fewer and less disruptive repairs. This translates into less exposure of the traveling public and contractor personnel to the hazards of construction activities.

The agencies were asked to identify the benefits they considered important in a pavement preventive maintenance program, along with whether or not there were measurements in place to document these benefits. The identified benefits of pavement preventive maintenance are considered important by nearly every agency responding to the survey. Also, with the exception of Improved Pavement Condition which can be readily measured by an agency's Pavement Management System (PMS), agencies are struggling to subjectively measure the benefits gained from their PPM programs. However, intuitively and anecdotally, the benefits are real.

Pavement Preventive Maintenance Guidelines January 2001 (Updated March 27, 2001[12])

2-3-4 What are the Barriers and/or Potential Pitfalls to the Development of a Pavement Preventive Maintenance Program?

In some agencies, the development of a pavement preventive maintenance program is a major shift in philosophy, impacting not only agency staffs but external stakeholders as well. As with any change, progress is oftentimes slow and met with barriers, both real and perceived. Some of the most common barriers agencies face when developing a pavement preventive maintenance program are outlined below:

- **Public Perception** – Motorists are accustomed to seeing roads deteriorate to a certain level before repairs are made. And, usually the roads in the worst shape have received the most attention both from the motorists in the form of complaints

and from the agencies in terms of a worst-first rehabilitation strategy. Pavement preventive maintenance programs steer work toward pavements that are in relatively good condition and away from pavements that are failing.

A common concern among agency personnel who wish to move away from this worst-first philosophy is that the public will never accept this change. However, recent surveys have shown that the public is interested in sound fiscal practice, improved pavement performance, and shorter and fewer delays. With proper information and education, this interest could be channeled into support of an agency's pavement preventive maintenance program.

- **Management Perceptions** – The status of maintenance activities has historically been low with the management of most public agencies. There has always been more management interest (and Federal funding for that matter) in building new roads than maintaining existing ones.

While the engineering climate is right to support the shift to pavement preventive maintenance, management support needs to be fostered and strengthened. This will be an ongoing effort since the management level in many agencies is the one that changes the most.

- **Research Needs** – Actual data to support and promote the advantages of pavement preventive maintenance programs are difficult to locate, or oftentimes do not exist. This lack of “hard proof” makes it difficult for agencies to convince decision makers that the move from the old worst-first way of doing business to a preventive maintenance approach makes good business sense, especially in light of stakeholder concerns and complaints.
- **Training** – owner agencies and contractors have successfully constructed various maintenance treatments for years. However, in the emerging field of pavement

preventive maintenance it is not enough to simply be familiar with mechanics of applying high quality surface treatments. There is a need to be able to select candidate projects and identify the appropriate treatments and timing of those treatments.

Just-in-time training is needed to get necessary information to those who need to know, when they need to know it.

- **Data Management** – Performance monitoring of pavement preventive maintenance treatments is necessary to enable agencies to identify what works and what doesn't.

Unfortunately, for the most part, only minimal performance monitoring has been performed on maintenance treatments, usually as a part of research projects.

The objective of maintenance is to recognize a problem, fix it, and move on to the next problem. This is no time and little interest in monitoring the performance of past work. However, if the status of pavement preventive maintenance is to be raised from its current level, performance monitoring must become the standard practice within agencies.

- **Dedicated Funding Challenges** – Because applying pavement preventive maintenance treatments at the proper time is critical, funding for PPM work must be dedicated and predictable. A fact of life within most agencies is that priorities can shift with changes in political climate, agency management or funding structure. A program that is strategic to an agency today may be cut back or eliminated tomorrow by reducing or diverting to other programs, staffing, funding or both.

Pavement preventive maintenance programs are particularly susceptible to funding variability. Since PPM programs require treatments applied on a regularly scheduled cyclical basis, any gaps in funding will decrease the overall conditions of the agency's

network. This, in turn, tends to push the agency back into a worst-first programming mode.

- **Crew Acceptance** – Buy-in at all levels within an organization is critical to the success of pavement preventive maintenance initiatives. One of the levels too often ignored when changes are made is the crew level where the work actually gets done.

Crews often feel threatened with changes to the way they have historically done business.

They perceive these changes as an indication that their prior work methods and strategies were unsatisfactory and/or not valued. These feelings of discontent, if not addressed, will get PPM programs off to a tenuous start and may most likely doom them to failure.

2-3-5 What are the Steps necessary to implement a pavement preventive maintenance program?

The successful implementation or modification of any agency's pavement preventive maintenance program involves identifying the specific needs for the development of a successful program. Furthermore, the agencies must develop strategies to meet these needs. While each agency will approach this process in a manner that is best suited to its individual situation, it is useful to know what other agencies in similar circumstances have done.

As part of the Pavement Preventive Maintenance Survey, the agencies were asked to list what they consider their top needs in the development of a successful PPM program.

The top identified needs are listed below with the number of agencies indicating that particular need in parentheses:

- Adequate/Dedicated Funding

- Top Management Support/Commitment
- Data Collection and Management
- Crew Acceptance
- Training
- Improved Models/Project Selection
- Legislative Support
- Publicity

Using responses from the Survey, information presented in NHI Course No. 13154, Pavement Preventive Maintenance, and conventional wisdom, some strategies and lessons learned relating to these critical needs are presented below.

Clearly, each of the needs does not necessarily stand on its own. They are interrelated. For example, success of fund requests and management commitment are contingent upon current, accurate, and objective data showing that PPM is effective. For this reason, some of the recommended strategies can be applied to more than one need.

A brief summary of the identified needs follows:

- **Adequate/Dedicated Funds** – Agencies that have succeeded in implementing pavement preventive maintenance programs recognize the importance of obtaining an adequate, secure, and ongoing source of funds. The establishment of dedicated funds helps to ensure that a stable flow of funding is provided to enable the agency to apply the necessary techniques in a timely manner. Annex C contains information regarding PPM funding levels, sources of funds, and distribution of these funds among treatment types, for the past 5 years.
- **Top Management Support Commitment** – Establishment of an effective pavement preventive maintenance program requires top management commitment and support.

There are many demands on agency resources and those programs supported at the highest levels have the best chance of succeeding.

- **Data Collection and Management** – Objective, accurate, repeatable measurements are critical to the success of pavement preventive maintenance programs. Most agencies rely on their Pavement Management Systems to provide the needed information. In most cases, modifications to the PMS are required to capture the information necessary to fully support the PPM program.
- **Crew Acceptance** – In order for a pavement preventive maintenance program to be successful, those responsible for performing and monitoring the work must buy-in to the philosophies and concepts of PPM. If those people doing the work do not support it, the chances of success are unlikely.
- **Training** – The concepts and philosophies of pavement preventive maintenance are new to most agencies. In fact, PPM is a major shift in direction, requiring not only knowledge of the technical and mechanical aspects of the work, but also an understanding and appreciation of the overall purpose of PPM as well.
- **Improved Models/Project Selection** – There are numerous pavement preventive maintenance treatment options available for both asphalt concrete and Portland cement concrete pavements. Some of the options are appropriate, others are not. In order to choose “the right treatment at the right time,” agencies need to develop a treatment selection process based on performance and life cycle costs. In most cases, this is much easier said than done.
- **Legislative Support** – Most agency budgets and major fund requests are touched in some way by the Legislative process. Therefore, Legislative support is a critical element in the success of an agency’s pavement preventive maintenance

program. If a program isn't funded to an adequate and consistent level, it won't happen.

- **Publicity** – Pavement preventive maintenance does not make news; there are no ribbon cuttings or groundbreaking ceremonies. In fact, many people question the wisdom/rational of a program that devotes resources to well-performing pavements, while pavements clearly in need have repair are ignored. The public is interested in sound fiscal practices. With proper information and education, this interest can be channeled into support of a PPM program.

2-4 When to Apply Preventive Maintenance Treatments:

The effectiveness of a preventive maintenance treatment is directly related to the condition of the pavement. Conducting preventive maintenance activities on a sound pavement in good condition will be very effective in prolonging that pavement's service life. Conducting an inappropriate repair (either method or timing) can actually accelerate the rate of distress development.

Preventive maintenance is generally planned and cyclical in nature. Its intent is to repair early pavement deterioration, delay pavement failures, and reduce the need for corrective maintenance and service activities. Although this type of maintenance is not performed to improve the load-carrying capacity of a pavement, it extends the pavement useful life and level of service. Figure 2-3 shows the relationship between pavement condition and time (or traffic).

Often, preventive maintenance methods are designed to repair damage caused by the environment. Periodic renewal of the pavement surface can provide several benefits, including sealing the pavement surface (which prevents water from penetrating into the

pavement structure), and controlling the effects of oxidation, raveling, and surface cracking.

To help choose the correct time to apply a treatment, a condition survey and non-destructive testing can be used. This provides a more rational approach to determining which pavements need treatment and when the treatment should be done. Using the output of the pavement condition survey, threshold limits can be developed to define when a treatment type should be implemented, Ann M. Johnson, P.E. February (2000[7]).

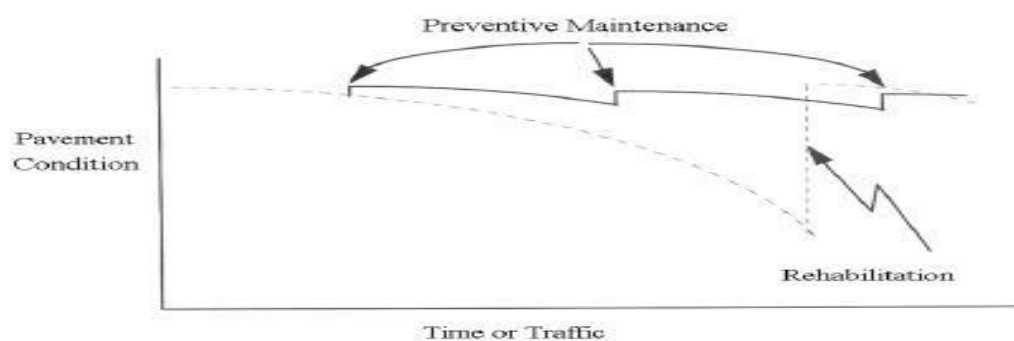


Figure 2-6. Performance of Preventive Maintenance Treatments

2-5 Why Wasn't Preventive Maintenance Used in the Past?

Preventive maintenance has been around for a long time but was not used as much in the past for several reasons:

- Many of the available preventive maintenance treatments were considered unsuitable for high-volume roadways.
- Lack of federal aid for maintenance encouraged management of Transportation to allow pavements to deteriorate sufficiently to qualify for rehabilitation that was funded by federal aid.
- Information was lacking about the performance and cost effectiveness of preventive maintenance practices.

- Highway management of Transportation wished to minimize driver exposure to roadway operations and lane closures. This prevailing philosophy is reactive rather than proactive or preventive.

Some highway agencies are also reluctant to program treatments on pavements in good condition when there is a large backlog of pavements in poor condition within the system. It is common for preventive maintenance to be forgotten when potholes and other maintenance problems demanding immediate attention consume much of a limited maintenance budget. The public expects that problems such as potholes get fixed first, causing preventive maintenance work to be neglected.

Another reason preventive maintenance funding may be limited is because pavement maintenance and winter maintenance (snow and ice removal) operate from the same budget. Because of its direct effect on driver safety, winter maintenance is usually given a higher priority, and any money that remains when winter is over funds pavement maintenance. This leftover amount may not be sufficient to fund an adequate maintenance program.

2-6 Keys to a Successful Program:

2-6-1 Education:

To implement a pavement preservation program effectively, elected officials, top management, and maintenance staff should be educated about pavement preventive maintenance, why it is needed, and why it should be a priority. This education should stress that it is more economical to preserve pavements in good condition than it is to replace them when they wear out. Highway agency professionals need to develop a better understanding of the benefits of a program and the differences among preventive, corrective, and emergency maintenance.

The general public also should be educated about pavement preservation. An uninformed public can contribute to the reluctance to adopt pavement preservation strategies. For example, motorists often misunderstand the purpose of preventive maintenance and will complain when they see work crews fixing a road that seems to be in fine shape. The public may perceive that the agency is not using funds appropriately by taking care of pavements in need of repair.

2-6-2 Philosophy:

Developing a preventive maintenance program requires a shift in thinking, from rehabilitation and reconstruction to preservation.

2-6-3 Timing:

Treatments must be applied in time to preserve the structure of the pavement. Distressed pavements may not be suitable candidates for preventive maintenance.

2-6-4 Funding:

An effective preventive maintenance program requires adequate funding. Criteria need to be established for the selection of pavements that qualify for preventive maintenance, and this policy must be enforced (Ann M. Johnson, P.E. February 2000[7]).

2-7 Preventive Maintenance Treatments:

There are a number of preventive maintenance treatments for flexible pavements. A comprehensive discussion of each treatment may be found in the Basic Asphalt Emulsion Manual (13), including the conditions in which each can be effective, and the pavement distress (es) which each is intended to address. The timing the various treatments are applied determines whether they are preventive or corrective maintenance treatments. The most common types of distress in flexible pavements include:

- Potholes.

- Rutting.
- Cracking (i.e., fatigue, shrinkage, and thermal).
- Bleeding.
- Roughness (due to one or several of the above).
- Weathering
- Raveling

Table 2.1 provides possible maintenance treatments matched to various distress types. The causes of these distresses are not discussed. If the distresses identified in the pavement condition survey are related to structural deficiencies, the pavement is most likely not a candidate for a preventive maintenance treatment and should be programmed for rehabilitation or reconstruction. The different types of maintenance treatments considered in this table include:

Table 2.1. Possible Preventive Maintenance Treatments for Various Distress Types

Pavement Distress	Crack Sealing	Fog Seal	Microsurfacing	Slurry Seal	Cape Seal	Chip Seal	Thin HMA Overlay	Mill or Grind ^a
Roughness								
Nonstability Related			X		X		X	X
Stability Related							X	
Rutting			X				X	X
Fatigue Cracking ^b		X	X	X	X	X	X	
Longitudinal and Transverse Cracking	X		X	X	X	X	X	
Bleeding			X			X		X
Raveling		X	X	X	X	X		

Key: X = appropriate strategy

^aThis is a corrective maintenance technique

^bFor low severity only; preventive maintenance is not applicable for medium to high severity fatigue cracking

1. Crack Sealing. This treatment is used to prevent water and debris from entering cracks in the pavement. The treatment might include routing to clean the entire crack and to create a reservoir to hold the sealant.

2. Fog Seal. An application of diluted emulsion (normally 1 to 1) to enrich the pavement surface and hinder raveling and oxidation. This is considered a temporary application.

Table 2.2. Typical Unit Costs and Expected Life of Typical Pavement Maintenance Treatments

Treatment	Cost/m ²	Cost/yd ²	Expected Life of Treatment		
			Min.	Average	Max.
Crack Treatment ^a	0.60	\$0.50	2	3	5
Fog Seals ^b	0.54	\$0.45	2	3	4
Slurry Seals ^c	1.08	\$0.90	3	5	7
Microsurfacing ^d	1.50	\$1.25	3	7	9
Chip Seals ^e	1.02	\$0.85	3	5	7
Thin Hot-Mix Overlay ^f	2.09	\$1.75	2	7	12
Thin Cold-Mix Overlay ^f	1.50	\$1.25	2	5	10

Notes:

^aAssumes typical crack density of 0.25 yd / yd²

^b0.2 l/m² (0.05 g/yd²) of a 1:1 dilution of CSS emulsion and water

^c7 kg/m² of ISSA Type II slurry

^d14 kg/m² of ISSA Type II microsurfacing

^e15 kg/m²

^f30 to 44 mm/m²

3. Chip Seal. This treatment is used to waterproof the surface, seal small cracks, and improve friction. Although typically used on low volume roads and streets, it can also be used on high volume highways and expressways.
4. Thin Cold Mix Seals. These treatments include slurry seals, cape seals, and micro-surfacing which are used on all types of facilities to fill cracks, improve friction, and improve ride quality.
5. Thin Overlays. These include dense-, open-, and gap-graded mixes (as well as surface recycling) that are used to improve ride quality, provide surface drainage and friction, and correct surface irregularities. They are generally 37 mm in thickness.

Table 2.2 summarizes typical unit costs and expected lives for various treatments. These values (which are based on the authors' experiences) will vary depending on the project location, quantities placed, and environmental conditions

(Dr. R. Gary Hicks, Stephen B. Seeds, and David G. Peshkin, (June 14, 2000[15])).

Note: The costs would be expected to vary with size and/or location of job.

The expected lives would also vary depending on the traffic and environmental conditions.

2-8 COMPONENTS OF A PREVENTIVE MAINTENANCE PROGRAM:

The beneficial effects of preventive maintenance treatments depend on the characteristics of the pavement structure, type and extent of distresses, and other factors such as drainage and materials. For cost-effective preventive maintenance, it is necessary to apply the right treatment to the right pavement at the right time. Because management of transport are responsible for the preservation of many pavement sections in various stages of deterioration, procedures need to be developed to identify the sections that would benefit most from preventive maintenance (the right pavement), to identify pavement preventive maintenance needs in timely manner (the right time) and to select the most beneficial treatment (the right treatment).[8]

2-8-1 THE RIGHT PAVEMENT:

Identification of the right pavement requires that all pavement sections are inventoried and their condition surveyed. Pavement condition surveys that determine type, severity and extent of pavement distresses are typically an integral part of pavement management systems and are also a required part of preventive maintenance programs. However, for preventive maintenance, it is also necessary to identify specific conditions and look for early indicators that trigger the need for preventive maintenance.

Pavement condition surveys must identify pavement distresses that are associated with the basic premises for the application of preventive maintenance outlined previously, and aid in identifying the sections that would benefit most from preventive maintenance.

2-8-2 THE RIGHT TIME:

Preventive maintenance treatments need to be applied before distresses progress and not only affect pavement performance and life expectancy adversely, but also require more expensive corrective action. For example, routing and sealing of asphalt concrete pavement should be carried out before single transverse cracks develop into multiple cracks. As suggested in Figure 2-5, preventive maintenance treatments are typically carried out during early stages of pavement life.

The pavement conditions that exist at the time of the survey must be extrapolated to the future because it is not possible to apply a preventive maintenance treatment immediately. Typically, these treatments are planned from two to 18 months in advance. To ensure that preventive treatments are applied at the right time, the following two conditions must be met.

Timely maintenance program: Pavement condition surveys must be carried out and translated into a preventive maintenance construction program in a timely manner.

Dedicated funding: Funding for preventive maintenance must be made available in time because it is the “stitch-in-time.” Because timing is essential for achieving cost-effectiveness, many practitioners advocate the establishment of adequate, dedicated funds. Postponing preventive maintenance treatments may invalidate effectiveness.

2-8-3 THE RIGHT TREATMENT:

Selection of the right treatment involves the following four phases:

- Generation of possible treatments;
- Treatment selection for individual sections;
- Needs and priorities of other sections in the network; and
- Selection of materials and construction methods.

2-9 INTRODUCTIONS TO THE METHODOLOGY USED TO DETERMINE OPTIMAL TIMING:

One of the initial challenges in this project was to attach some physical meaning to “optimal” timing in the context of preventive maintenance treatment applications. It could potentially mean to provide the smoothest ride for the least money, to prolong the need for rehabilitation, or to meet some other objective. While the concept of “optimal” timing seems closely linked to cost-effectiveness, the definition of cost-effectiveness also varies among managements of transport. Ultimately, a methodology very similar to the cost-effectiveness analyses used in pavement management systems was selected. Peshkin, D. G., T.E. Hoerner, K.A. Zimmerman, (2004[16]).

2-10 OVERVIEW OF THE ANALYSIS APPROACH:

The approach is built on a number of fundamental concepts. It assesses the effectiveness of a particular preventive maintenance application in terms of both the benefit it provides and the cost required to obtain that benefit. In this methodology, benefit is defined as the quantitative influence on pavement performance as measured by one or more condition indicators. Costs that may be included in the analysis include the following:

- The cost to construct the treatment,
- Work zone-related user delay costs,
- The cost of a rehabilitation activity that would be considered at the point when the preventive maintenance treatment is considered failed, and
- The cost of scheduled routine maintenance.

In the optimal timing methodology, the benefits associated with the use of a preventive maintenance treatment are evaluated in conjunction with its associated costs. The optimal

application of a preventive maintenance treatment occurs at the point at which the benefit per unit cost is greatest. Peshkin, D. G., T.E. Hoerner, K.A. Zimmerman, (2004[16]).

Pavement Performance:

The computation of the benefit associated with an applied preventive maintenance treatment requires knowledge of the anticipated performance of the pavement. The effect of a treatment on performance is determined by the change in condition indicators, such as International Roughness Index (IRI), present serviceability index (PSI), or other custom-defined measure of performance. Peshkin, D. G., T.E. Hoerner, K.A. Zimmerman, (2004[15])

Condition Indicators:

The ability of treatment to preserve pavement condition and retard future deterioration is measured by changes in the condition indicators that define pavement performance. Condition indicators used in the optimal timing methodology should have the following characteristics:

- Be measurable (able to be tracked over time),
- Indicate pavement performance (especially functional performance for preventive maintenance), and
- Change value following the application of a preventive maintenance treatment.

Condition monitoring data are needed for all condition indicators that are used in the analysis; the methodology permits the analysis of multiple condition indicators.

Do-Nothing Relationships:

The benefit associated with the application of a preventive maintenance treatment at any given time is based on the improvement in condition compared with that for the “do-nothing” alternative. The do-nothing alternative defines the performance over time

(in terms of the condition indicator) that would be expected if only minor routine maintenance were conducted. In a plot of pavement condition versus time, the baseline performance relationship is referred to as a do-nothing curve. If benefit is defined in terms of multiple distress types, a do-nothing performance curve is required for each relevant condition indicator. The best source for this information is existing pavement management systems, although the necessary relationships can also be approximated without the assistance of a pavement management database.

Post-Treatment Relationships

Determining optimal timing also requires an understanding of how performance is changed once the preventive maintenance treatment has been applied. A separate performance relationship (condition versus age) is needed for each unique combination of condition indicator and treatment application age; it is generally assumed that this relationship changes depending on when the treatment is applied. For example, if performance is measured by 3 indicators for a treatment applied at 5 ages, 15 (3×5) different performance relationships must be defined.

2-11 Main issues for the optimal timing analysis

According to NCHRP Report 523, several important parts for the optimal timing analysis includes:

- Define condition indicators
- Determine do-nothing pavement performance,
- Determine post-treatment performance,
- Identify the benefit brought by the preventive treatment, and
- Identify the cost of preventive maintenance.

2-11-1 Define condition indicators:

The computation of the benefit associated with an applied preventive maintenance treatment requires knowledge of the anticipated performance of the pavement. The effect of a treatment on performance is determined by the changes in pavement condition indicators, such as International Roughness Index (IRI), Present Serviceability Index (PSI), or other measures of performance. Condition indicators used in the decision trees should have the following characteristics:

- Measurability are (able to be reviewed over time) ,
- Reference to the performance of the pavement (especially for job performance Preventive maintenance),
- Change the value after the application of preventive maintenance treatments.
- Proper condition indicators should be selected through investigation on the regular and historical survey results of the agency. PMS is a good resource providing such time-related pavement performance data.

2-11-2 Determine do-nothing pavement performance relationship:

The benefit associated with the application of a preventive maintenance treatment at any given time is based on the improvement in condition compared with that for the “do-nothing” alternative. The do-nothing alternative defines the pavement performance over time (in terms of the condition indicator) that would be expected if only minor routine maintenance were conducted. The existing pavement management system (PMS) is the best source for this information.

2-11-3 Determine post-treatment pavement performance relationships:

How performance is improved with the application of one preventive maintenance treatment is also very important.

A separate performance relationship (condition versus age) is needed for each unique combination of condition indicator and treatment application age since this relationship changes depending on when the treatment is applied. Appropriate measures of performance for different treatments will be identified and tracked. The knowledge of current condition of the pavement and the condition changes with the application of preventive maintenance can be acquired by analyzing historical data from PMS.

2-11-4 Identify benefit of the treatments:

As shown in Figure 2-7, for a specific condition indicator, the benefit is determined by the difference in computed areas associated with the post-treatment condition indicator curve and the do-nothing curve. The overall benefit to one condition indicator can be calculated by the following equation. The individual benefit value and the corresponding benefit weighting factor for each treatment need to be identified first.

$$\text{Overall Benefit} = \text{Individual Benefit Value} \times \text{Benefit Weighting Factor}$$

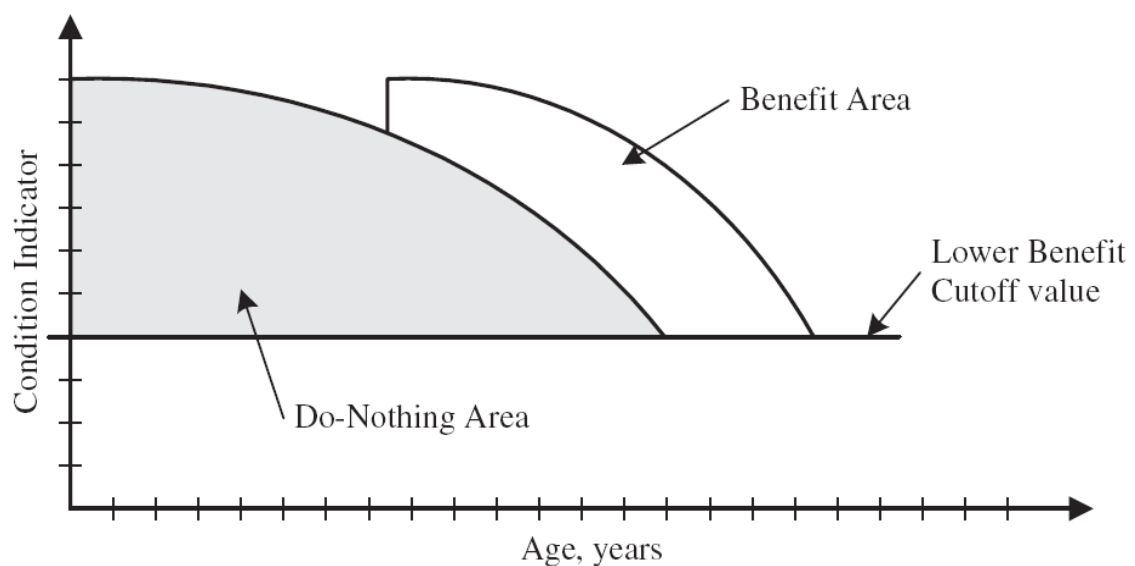


Figure 2-7 Conceptual Illustration of the Do-Nothing and Benefit Areas

2-11-5 Individual benefit values:

Benefit is the quantitative influence on condition indicators resulting from the application of a preventive maintenance treatment. The application of one preventive maintenance treatment may bring different types of benefit. For example, applying a chip seal could result in benefits in the form of improved friction, retarded oxidation, or reduced rutting. Individual benefit values for different condition indicators will be identified for each preventive maintenance treatment.

2-11-6 Benefit weighing factors:

There is probably more than one condition indicator included in the analysis. The individual benefit values associated with the different condition indicators need to be combined together. This is done by using benefit weighting factors and a normalization process. Benefit weighting factors are used to differentially weight the computed individual benefits associated with each included condition indicator. Each condition indicator is assigned an integer weighting factor between 0 and 100, where all the entered weighting factors must total 100 for a given analysis.

Normally, the selection of benefit weighting factors is a subjective process that requires engineering judgment, an investigation can be conducted to provide feedback on multiple condition indicators used in the analysis. Some general steps that can be followed to gather feedback for use in the factor selection process are described in this section.

- **Initial Selection of Benefit Weighting Factors:**

Engineering judgment is a good starting point in the process of selecting relative weights associated with each performance measure. The initially selected

weights represent attempts to quantify the relative purpose or benefit of applying the treatment.

- Analyze Each Condition Indicator Separately:

The initial selection of benefit weighting can be improved by investigating the sensitivity of the results. This can be accomplished by analyzing the effects of one condition indicator at a time (set the associated benefit weighting factor for one of the condition indicators to 100 and all other benefit weighting factors to 0). The effects on treatment timing can then be interpreted to identify the condition indicators that are relatively more important than others.

- Trials of Different Combinations of Benefit Weighting Factors:

Useful feedback may be obtained by conducting a series of analyses in which different combinations of weighting factors are investigated. For example, the selection of initial weighting factors as the baseline (e.g., 60 for rutting, 30 for cracking, and 10 for friction) indicates that controlling rutting appears to be the most important purpose of the treatment, and the overall optimal timing is thus likely to be closer to the age associated with the individual analysis in which only rutting was considered (i.e., 4 years) than to the ages associated with the other condition indicators (i.e., 2 or 7 years).

Related data will be collected first and then analyzed separately or by trials of different combinations to choose the appropriate benefit weighting factors.

2-11-7 Identify costs of the treatments:

Another fundamental aspect of the method is the inclusion of costs that are impacted by the application of preventive maintenance activities. The four main cost types are:

- Departments of transportation cost for the construction of the treatment,
- Costs relating to the scope of work for the road user delay,
- The cost of rehabilitation activities that will be seen in this case when the therapy is considered preventive maintenance failed, and
- The cost of routine maintenance scheduled. Each project, the costs need to be considered from four to during the investigation of historical records and related.

(Baoshan Huang and Dragon Vukosavljevic (October 2009[6]

CHAPTER III

(CASE STUDY)

3-1 INTRODUCTION:

Based on the title of the thesis (preventive maintenance for Flexible Pavement) has been chosen study area and in order to reach the pavement condition index where the study area is each of the following sectors:

- Wad Medani - Gedaref
- Gedaref- Kassala
- Kassala- Hayia

And have been divided each sector into parts, and identify pavement condition index according to the manual of the National Corporation for Roads (Sudan) and Bridges and PEVAR method by (Shaheen) also will be remembered later.

This thesis includes the required instructions for conducting the visual study for paved roads classified as primary or secondary.

These instructions provide a procedure for evaluating the surface condition of all paved roads in (case study).

This thesis will address two of the four major elements of deterioration contributes to pavement management systems, ride quality and distress, using visual inspection, the other components of PMS (Skid resistance and deflection or structural capacity and automated roughness measurements) can be included later.

3-2 Importance of pavement management system:

Pavement management system in its broad sense includes all the activities involved in the planning, design, construction, maintenance, and rehabilitation of pavement. A pavement management system (PMS) can provide an organized methodology to assist decision makers in finding optimum strategies for providing and

maintaining pavements in a serviceable condition over a given period of time. The function of PMS is to improve the efficiency of decision making, expand its scope, provide feedback on the consequences of decisions, and insure the consistency of decisions made at different management levels within the same organization.

The essential requirement of PMS includes:

- Basic inventory data including traffic and structure information.
- Ability to consider alternative maintenance and rehabilitation strategies.
- The ability to identify a prioritized or optimized set of alternative strategies.
- A feedback process to update system models as better information becomes available.

The basic functions of the PMS are to:

- Collect inventory, condition, and cost data.
- Assign strategies, identify needs, and arrange priorities.
- Project future needs and build long range programs.
- Provide management information.
- Support budgets.

3-3 Approach:

The road network (case study) shall be subdivided into links which are uniform in respect of traffic, environment, geometry, and pavement type and construction history. The links shall be subdivided into sections which are uniform in respect of pavement condition. For the purpose of project analysis the links, sections and unit samples shall be the same for every strategic analysis, then type and severity of pavement distress shall be assessed by visual inspection.

The distress data are used to calculate the PCI for each sample unit. The PCI of the pavement section is determined based on the PCI of the inspected sample units within the section.

The PCI is a numerical indicator that rates the surface condition of the pavement is adopted to measure the present condition of the pavement based on the distress observed on the surface of the surveyed sample units.

This procedure cannot measure structural capacity nor does it provide direct measurement of skid resistance or roughness. It provides an objective and rational basis for determining Maintenance and repair needs and priorities. Continuous monitoring of the PCI is used to establish the rate of pavement deterioration, which permits early identification of major rehabilitation needs. The PCI provides feedback on pavement performance for validation or improvement of current pavement design and maintenance procedures.

3-4 Terminology:

Definitions of Terms Specific to This thesis:

1. Additional sample: Non-representative sample unit inspected in addition to the random sample units to include in the determination of the pavement condition. This includes very poor or excellent samples that are not typical of the section sample units, containing unusual distress (e.g. utility cut). If a sample unit containing an unusual distress is chosen at random it should be counted as an additional sample unit and another random sample unit should be chosen. If every sample unit is surveyed, then there are no additional sample units.
2. Asphalt concrete (AC) surface: aggregate mixture with an asphalt cement binder. It includes all surfaces constructed with hot mix asphalt.

3. Pavement link: a link is an identifiable part of the pavement network that is a single entity and has a distinct function. For example, each roadway is a separate link.
4. Pavement condition index (PCI): a numerical rating of the Pavement condition that ranges from 0 to 100 with 0 being the worst possible condition and 100 being the best possible condition.
5. Pavement condition rating: a verbal description of pavement condition as a function of the PCI value that varies from “failed” to “excellent”.
6. Pavement distress: external indicators of pavement deterioration caused by loading, environmental factors, construction deficiencies, or a combination thereof. Typical distresses are cracks, rutting, and weathering of the pavement surface. Distress types and severity levels detailed in this thesis for AC pavements must be used to obtain an accurate PCI value.
7. Pavement sample unit: a subdivision of a pavement section that has a standard length of 5000 contiguous linear meter, if the unit lies at the end of pavement section, its length should be selected to accommodate field condition.
8. Pavement section: a contiguous pavement area having uniform construction, maintenance, usage history, and condition. A section should have the same traffic volume and load intensity.
9. Random sample: a sample unit of the pavement section selected for inspection by random sampling techniques, such as a random number table or systematic random procedure.
10. Palling: refers to further breaking of pavement or loss of materials around cracks and joints.

3-5 Tools:

- ✓ Data Sheets: or other field recording instruments that record at a minimum the following information, date, location, link, section, sample unit size, distress types, severity levels, quantities, and names of surveyors. Example data sheets for pavements are shown in Table 3.1.
- ✓ Hand Odometer: Wheel that reads to the nearest 30 mm.
- ✓ Straightedge 3 m
- ✓ Scale, 300 mm that reads to 3 mm or better
- ✓ Layout Plan, for network to be inspected.
- ✓ Digital camera.
- ✓ Safety tools.

3-6 Safety:

Traffic is a hazard as inspectors may walk on the pavement to perform the condition survey.

It is the responsibility of the researcher establish appropriate safety and health practices and determine the applicability of regulatory limitations prior to use.

3-7 Distress on Asphalt Pavement:

3-7-1 General:

During the field condition surveys and validation of the PCI, several questions are commonly asked about the identification and measurement of some of the distresses. The answers to these questions for each distress are included under the heading “How to Measure.” For convenience, however, the most frequently raised issues are addressed below:

1. If alligator cracking and rutting occur in the same area, each is recorded separately at its respective severity level.
2. If bleeding is counted, polished aggregate is not counted in the same area.
3. Palling as used herein is the further breaking of pavement or loss of materials around cracks or joints.
4. If a crack does not have the same severity level along its entire length, each portion of the crack having a different severity level should be recorded separately. If,
5. However, the different levels of severity in a portion of a crack cannot be easily divided, that portion should be rated at the highest severity level present.
6. If any distress, including cracking and potholes, is found in a patched area, it is not recorded, and however, its effect is considered in determining the severity level of the patch.
7. A significant amount of polished aggregate should be present before it is counted.
8. A distress is said to be reveled if the area surrounding the distress is broken (sometimes to the extent that pieces are removed).

The reader must be note that the items above are general issues and do not stand alone as inspection criteria. To properly measure each distress type, the inspector must be familiar with its individual measurement criteria.

Nineteen distress types for asphalt-surfaced pavements are listed alphabetically in this thesis and their severity and method of measurement is given in details in Table 3.1.

3-7-2 Ride Quality:

Ride quality must be evaluated in order to establish a severity level for the following distress types:

- Bumps.

- Corrugation.
- Railroad crossings.
- Shoving.

To determine the effect of these distresses on ride quality, the inspector should drive at the normal operating speed and use the following severity-level definitions of ride quality:

Low Severity (L): Vehicle vibrations, for example, from corrugation, are noticeable, but no reduction in speed is necessary for comfort or safety. Individual bumps or settlements, or both, cause the vehicle to bounce slightly, but create little discomfort.

Medium Severity (M): Vehicle vibrations are significant and some reduction in speed is necessary for safety and Comfort. Individual bumps or settlements, or both, cause the vehicle to bounce significantly, creating some discomfort.

High Severity (H): Vehicle vibrations are so excessive that speed must be reduced considerably for safety and comfort. Individual bumps or settlements, or both, cause the vehicle to bounce excessively, creating substantial discomfort, safety hazard, or high potential vehicle damage.

The inspector should drive a car at the normal speed in a representative section during normal traffic flow. Pavement sections near stop signs should be rated at a deceleration speed appropriate for the intersection.

3-7-3 Alligator Cracking (Fatigue):

Alligator or fatigue cracking is a series of interconnecting cracks caused by fatigue failure of the asphalt concrete surface under repeated traffic loading. Cracking begins at the bottom of the asphalt surface, or stabilized base, where tensile stress and strain are highest under a wheel load. The cracks propagate to the surface initially as a

series of parallel longitudinal cracks. After repeated traffic loading, the cracks connect, forming many sided, sharp-angled pieces that develop a pattern resembling chicken wire or the skin of an alligator. The pieces are generally less than 0.5 m on the longest side. Alligator cracking occurs only in areas subjected to repeated traffic loading, such as wheel paths. Pattern-type cracking that over an entire area not subjected to loading is called “block cracking,” which is not a load associated distress.

Figures 3.1 to Figure 3.3 shows the different severity levels for the fatigue cracking defined in Table 3.1 in this thesis.



Fig. 3.1: Low Severity Alligator Cracking

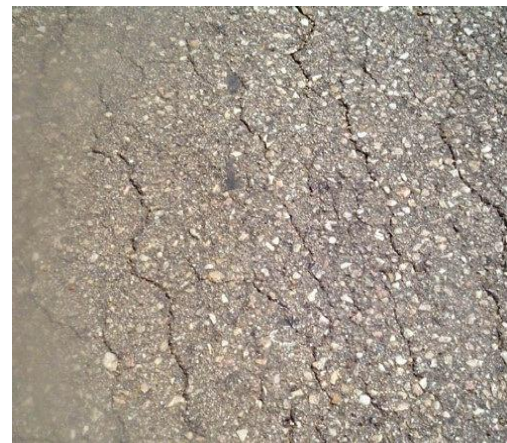


Fig. 3.2: Medium Severity Alligator Cracking



Fig. 3.3: High Severity Alligator Cracking

3-7-4 Bleeding:

Bleeding is a film of bituminous material on the pavement surface that creates a shiny, glasslike, reflecting surface that usually becomes quite sticky. Bleeding is caused by excessive amounts of asphalt cement or tars in the mix, excess application of a bituminous sealant, or low air void content, or a combination thereof. It occurs when asphalt fills the voids of the mix during hot weather and then expands onto the pavement surface. Since the bleeding process is not reversible during cold weather, asphalt will accumulate on the surface.

Figures 3.4 to Figure 3.6 shows the different severity levels for the bleeding defined in Table 3.1 in this thesis.



Fig. 3.4: Low Severity Bleeding



Fig. 3.5: Medium Severity Bleeding



Fig. 3.6: High Severity Bleeding

3-7-5 Block Cracking:

Block cracks are interconnected cracks that divide the pavement into approximately rectangular pieces. The blocks may range in size from approximately 0.3 by 0.3 m to 3 by 3 m. Block cracking is caused mainly by shrinkage of the asphalt concrete and daily temperature cycling, which results in daily stress/strain cycling.

It is not load-associated. Block cracking usually indicates that the asphalt has hardened significantly. Block cracking normally occurs over a large portion of the pavement area, but sometimes will occur only in non-traffic areas. This type of distress differs from alligator cracking in that alligator cracks form smaller, many sided pieces with sharp angles. Also, unlike block, alligator cracks are caused by repeated traffic loadings, and therefore, are found only in traffic areas, that is, wheel paths.

Figures 3.7 to Figure 3.9 shows the different severity levels for the Block Cracking defined in Table 3.1 in this thesis.



Fig. 3.7: Low Severity Block Cracking



Fig. 3.8: Medium Severity Block Cracking



Fig.3.9: High Severity Block Cracking

3-7-6 Upheaval and Settlements:

Upheavals are small, localized, upward displacements of the pavement surface. They are different from shoves in that shoves are caused by unstable pavement.

Bumps, on the other hand, can be caused by several factors, including:

Infiltration and buildup of material in a crack in combination with traffic loading (sometimes called “tenting”).

Settlements are small, abrupt, downward displacements of the pavement surface.

If bumps appear in a pattern perpendicular to traffic flow and are spaced at less than 3 m, the distress is called corrugation. Distortion and displacement that occur over large areas of the pavement surface, causing large or long dips, or both, in the pavement should be recorded as “swelling.”

Figures 3.10 to Figure 3.12 shows the different severity levels for the Upheavals and Settlements as defined in Table 3.1 in this thesis.



Fig. 3.10: Low Severity Upheavals and Settlements



Fig. 3.11: Medium Severity Upheavals and Settlements



Fig. 3.12: High Severity Upheavals and Settlements

3-7-7 Corrugation:

It is a series of closely spaced ridges and valleys (ripples) occurring at fairly regular intervals, usually less than 3 m along the pavement. The ridges are perpendicular to the traffic direction. This type of distress usually is caused by traffic action combined with an unstable pavement surface or base.

Figures 3.13 to Figure 3.15 shows the different severity levels for the Corrugation as defined in Table 3.1 in this thesis.



Fig. 3.13: Low Severity Corrugation



Fig. 3.14: Medium Severity Corrugation



Fig. 3.15: High Severity Corrugation

3-7-8 Depression:

Depressions are localized pavement surface areas with elevations slightly lower than those of the surrounding pavement. In many instances, light depressions are not noticeable until after a rain, when ponding water creates a “birdbath” area; on dry

pavement, depressions can be spotted by looking for stains caused by ponding water. Depressions are created by settlement of the foundation soil or are a result of improper construction. Depressions cause some roughness, and when deep enough or filled with water, can cause hydroplaning.

Figures 3.16 to Figure 3.18 shows the different severity levels for the Depression as defined in Table 3.1 in this thesis.



Fig. 3.16: Low Severity Depression

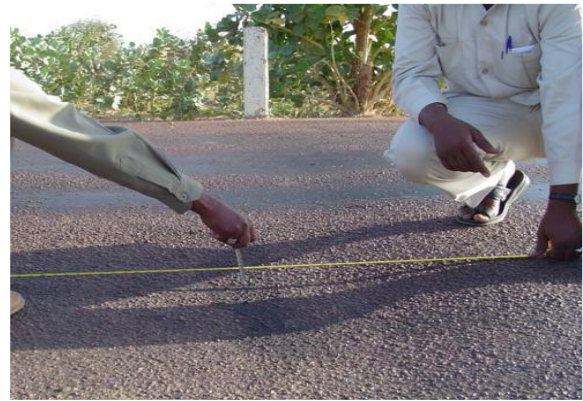


Fig. 3.17: Medium Severity Depression



Fig. 3.18: High Severity Depression

3-7-9 Edge Cracking:

Edge cracks are parallel to and usually within 0.3 to 0.5 m of the outer edge of the pavement. This distress is accelerated by traffic loading and can be caused by weak base or Subgrade near the edge of the pavement. The area between the crack and

pavement edge is classified as raveled if it is broken up (sometimes to the extent that pieces are removed).

Figures 3.19 to Figure 3.21 shows the different severity levels for the Edge Cracking as defined in Table 3.1 in this thesis.



Fig. 3.19: Low Severity Edge Cracking

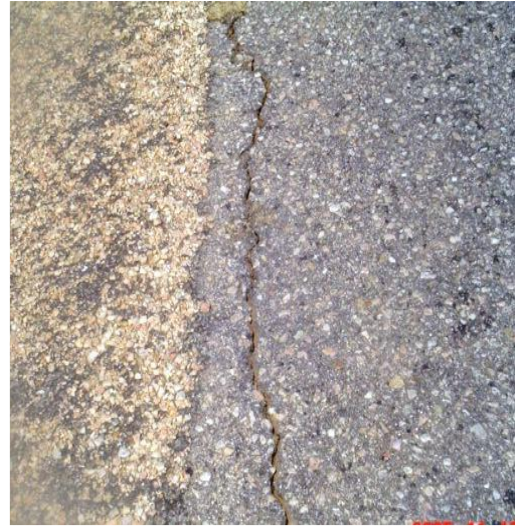


Fig. 3.20: Medium Severity Edge Cracking



Fig. 3.21: High Severity Edge Cracking

3-7-10 Lane/Shoulders Drop-off:

Lane/shoulder drop-off is a difference in elevation between the pavement edge and the shoulder. This distress is caused by shoulder erosion, shoulder settlement, or by building up the roadway without adjusting the shoulder level.

Figures 3.22 to Figure 3.24 shows the different severity levels for the Lane/Shoulder Drop-off as defined in Table 3.1 in this thesis.



Fig. 3.22: Low Severity Lane/Shoulder drop-off



Fig. 3.23: Medium Severity Lane/Shoulder Drop-off



Fig. 3.24: High Severity Lane/Shoulder Drop-off

3-7-11 Longitudinal and Transverse cracking:

Longitudinal cracks are parallel to the pavement's centerline or lay down direction. They may be caused by:

- A poorly constructed paving lane joint.

- Shrinkage of the AC surface due to low temperatures or hardening of the asphalt, or daily temperature cycling, or both.
- Transverse cracks extend across the pavement at approximately right angles to the pavement centerline or direction of lay down. These types of cracks are not usually load-associated.

Figures 3.25 to Figure 3.27 shows the different severity levels for the Longitudinal and Transverse cracking as defined in Table 3.1 in this thesis.



Fig. 3.25: Low Severity Longitudinal and Transverse Cracking



Fig. 3.26: Medium Severity Longitudinal and Transverse Cracking



Fig. 3.27: High Severity Longitudinal and Transverse Cracking

3-7-12 Patching:

A patch is an area of pavement that has been replaced with new material to repair the existing pavement. A patch is considered a defect no matter how well it is performing (a patched area or adjacent area usually does not perform as well as an original pavement section). Generally, some roughness is associated with this distress.

Figures 3.28 to Figure 3.30 shows the different severity levels for the Patching as defined in Table 3.1 in this thesis.



Fig. 3.28: Low Severity Patching



Fig.3.29: Medium Severity Patching



Fig. 3.30: High Severity Patching

3-7-13 Polishing:

This distress is caused by repeated traffic applications. Polished aggregate is present when close examination of a pavement reveals that the portion of aggregate extending above the asphalt is either very small, or there are no rough or angular aggregate particles to provide good skid resistance. When the aggregate in the surface becomes smooth to the touch, adhesion with vehicle tires is considerably reduced. When the portion of aggregate extending above the surface is small, the pavement texture does not significantly contribute to reducing vehicle speed.

Polished aggregate should be counted when close examination reveals that the aggregate extending above the asphalt is negligible, and the surface aggregate is smooth to the touch. This type of distress is indicated when the number on a skid resistance test is low or has dropped significantly from a previous rating.

No degrees of severity are defined; however, the degree of polishing should be clearly evident in the sample unit in that the aggregate surface should be smooth to the touch figures 3.31 shows polished aggregate texture.



Figure 3.31 Polished Aggregate Textures

3-7-14 Potholes:

Potholes are small - usually less than 750 mm in diameter - bowl-shaped depressions in the pavement surface. They generally have sharp edges and vertical sides near the top of the hole. When holes are created by high-severity alligator cracking, they should be identified as potholes, not as weathering.

Figures 3.32 to Figure 3.34 shows the different severity levels for the Potholes as defined in Table 3.1 in this thesis.



Figure 3.32 Low Severity Potholes



Figure 3.33 Medium Severity Potholes

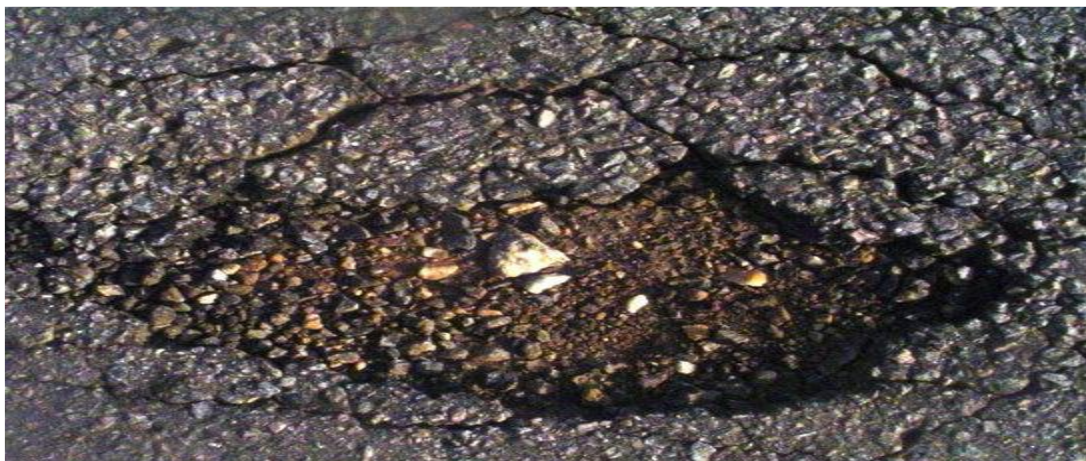


Figure 3.34 High Severity Pothole

3-7-15 Railroad Crossings:

Railroad crossing defects are depressions or bumps around, or between tracks, or both. Table 3.1 in this Manual shows degree of severities and how to measure this type of distress.

3-7-16 Raveling:

Weathering and raveling are the wearing away of the pavement surface due to a loss of asphalt or tar binder and dislodged aggregate particles. These distresses indicate that either the asphalt binder has hardened appreciably or that a poor quality mixture is present. In addition, raveling may be caused by certain types of traffic, for example, tracked vehicles. Softening of the surface and dislodging of the aggregates due to oil spillage also are included under raveling.

Figures 3.35 to Figure 3.37 shows the different severity levels for the Raveling as defined in Table 3.1 in this thesis.



Figure 3.35 Low Severity Raveling



Figure 3.36 Medium Severity Raveling



Figure 3.37 High Severity Raveling

3-7-17 Reflection Cracks:

This distress occurs only on asphalt surfaced pavements that have been laid over a PCC slab and include reflection cracks from any other type of base, that is, cement- or lime-stabilized; these cracks are caused mainly by thermal- or moisture induced movement of the pavement layer beneath the AC surface. This distress is not load-related; however, traffic loading may cause a breakdown of the AC surface near the crack. If the pavement is fragmented along a crack, the crack is said to be palled.

Figures 3.38 to Figure 3.40 shows the different severity levels for the Reflection cracks as defined in Table 3.1 in this thesis.



Figure 3.38 low Severity reflection cracks



Figure 3.39 medium Severity reflection cracks



Figure 3.40 High Severity reflection cracks

3-7-18 Rutting:

A rut is a surface depression in the wheel paths. Pavement uplift may occur along the sides of the rut, but, in many instances, ruts are noticeable only after a rainfall when the paths are filled with water.

Rutting stems from a permanent deformation, in any of the pavement layers or Subgrade, usually, caused by consolidated or lateral movement of the materials due to traffic load. Figures 3.41 to Figure 3.43 shows the different severity levels for the Rutting as defined in Table 3.1 in this thesis.



Figure 3.41 low Severity Rutting



Figure 3.42 Medium Severity Rutting



Figure 3.43 High Severity Rutting

3-7-19 Shoving:

Shoving is a permanent, longitudinal displacement of a localized area of the pavement surface caused by traffic loading. When traffic pushes against the pavement, it produces a short, abrupt wave in the pavement surface. This distress normally occurs only in unstable liquid asphalt mix (cutback or emulsion) pavements.

Figures 3.44 to Figure 3.46 shows the different severity levels for the Shoving as defined in Table 3.1 in this thesis.



Figure 3.44 Low Severity shoving



Figure 3.45 Medium Severity shoving



Figure 3.46 high Severity shoving

3-7-20 Slippage Cracks:

Slippage cracks are crescent or half- moon shaped cracks, usually transverse to the direction of travel. They are produced when braking or turning wheels cause the pavement surface to slide or deform. This distress usually occurs in overlaps when there is a poor bond between the surface and the next layer of the pavement structure.

Figures 3.47 to Figure 3.49 shows the different severity levels for the Slippage Cracks as defined in Table 3.1 in this Manual.

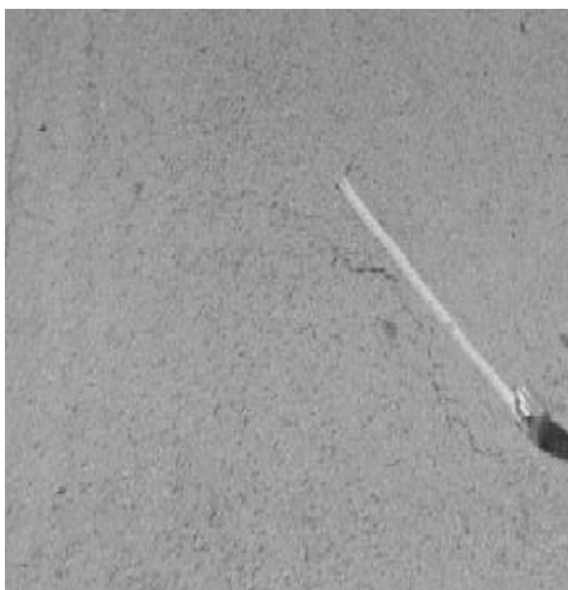


Figure 3.47 Low Severity Slippage Cracks

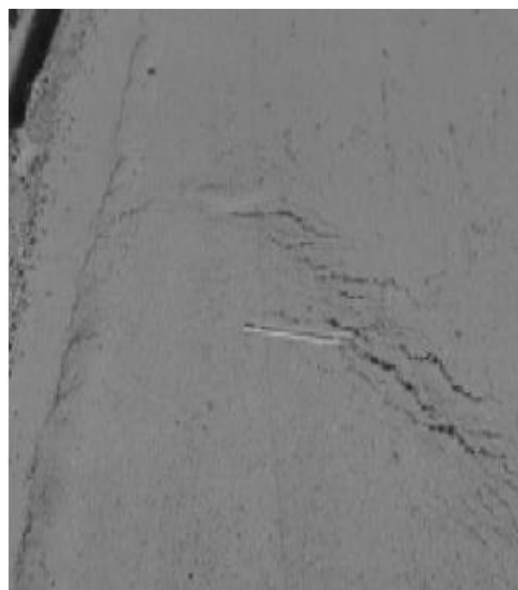


Figure 3.48 Medium Severity Slippage Cracks

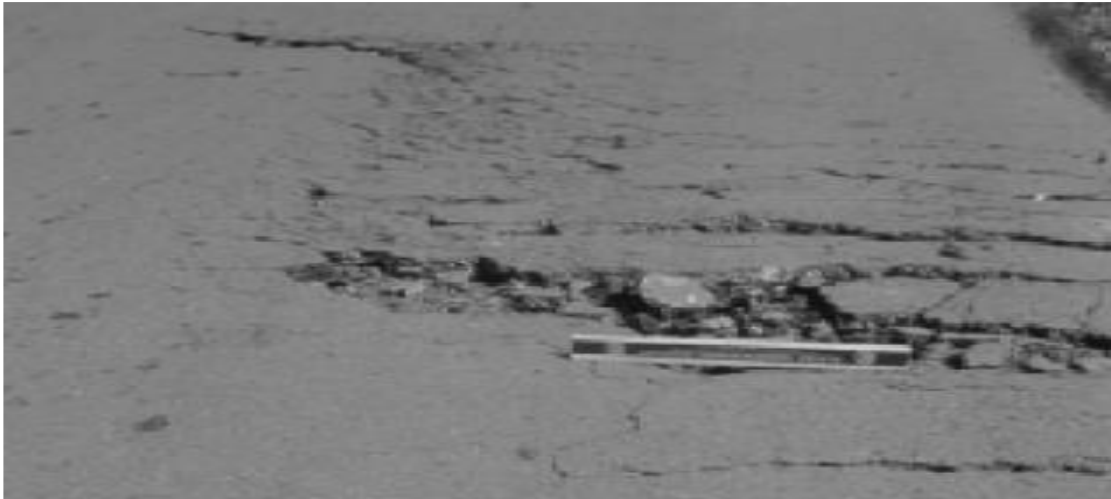


Figure 3.49 High Severity Slippage Cracks

3-7-21 Swell:

Swell is characterized by an upward bulge in the pavement's surface, a long, gradual wave more than 3 m long. Swelling can be accompanied by surface cracking.

This distress usually is caused by frost action in the Subgrade or by swelling soil.

Table 3-1 shows severity levels and method of measurement for the distress.

Table 3:1 level of severity and method of measurement					
No.	Type	severity levels			How to measure
		low(L)	Medium(M)	High (H0)	
1	Alligator cracking	Fine, longitudinal hairline cracks running parallel to each other with no, or only a few interconnecting cracks. The cracks are not spalled	further development of light alligator cracks into a pattern or network of cracks that may be lightly spalled	network or pattern cracking has progressed so that the pieces are well defined and spalled at the edge, some of the pieces may rock under traffic	Alligator cracking is measured in square meters of surface area. If these portions can be easily distinguished from each other, they should be measured and recorded separately, however, if the different levels of severity cannot be divided easily, the entire area should be rated at the highest severity present, if alligator cracking and rutting occur in the same area, each is recorded separately at its respective severity level.
2	Bleeding	Bleeding only has occurred to a very slight degree and is noticeable only during some part of the year, asphalt does not stick to shoes and vehicles.	Bleeding has occurred to the extent that asphalt sticks to shoes and vehicles during only a few weeks of the year.	Bleeding has occurred extensively and considerable asphalt sticks to shoes and vehicles during at least several weeks of the year.	Bleeding is measured in square meters of surface area. If bleeding is counted, polished aggregate should be not counted.
3	Block cracking	If unfilled cracks ≤ 13 mm, or filled cracks of any width with the filler in satisfactory condition. No faulting exists.	One of the following conditions exists: unfilled crack with a width > 13 mm and ≤ 50 mm, unfilled crack of any width ≤ 50 mm with a faulting < 10 mm, or filled crack of any width with faulting < 10 mm.	One of the following conditions exists: unfilled crack with width > 50 mm, or filled or unfilled of any width with faulting > 10 mm.	Block cracking is measured in square meters of surface area. If usually occurs at one severity level in a given pavement section; however, if areas of different severity level can be distinguished easily from one another, they should be measured and recorded separately.
4	Upheaval & settlements	causes low- severity ride quality.	causes medium- severity ride quality.	causes high- severity ride quality.	Measured in linear meters. If bump occurs in combination with crack, crack is also recorded.
5	Corrugation	corrugation produces low- severity ride quality.	corrugation produces medium- severity ride quality.	corrugation produces high- severity ride quality.	corrugation is measured in square meters of surface area.
6	Depression	13 to 25 mm	25 to 50 mm	More than 50 mm	Depressions are measured in square meters of surface area.
7	Edge cracking	Low or medium cracking with no breakup and raveling	Medium cracks with some breakup and raveling	Considerable breakup or raveling along the edge.	Edge cracking is measured in linear meters.
8	Lane / Shoulder Drop-off	The difference in elevation between the pavement edge and shoulder is > 25 mm and < 50 mm.	The difference in elevation between the pavement edge and shoulder is > 50 mm and < 100 mm.	The difference in elevation between the pavement edge and shoulder is > 25 mm and < 100 mm.	Lane / shoulder drop-off is measured in linear meters.
9	Longitudinal / transverse cracking	One of the following conditions exists: unfilled crack width is less than 10 mm, or filled crack of any width (filler in satisfactory condition)	One of the following conditions exists: unfilled crack width is greater than or equal to 10 mm and less than 75 mm, non-filled crack is less than or equal to 75 mm surrounded by light and medium	One of the following conditions exists: any crack filled or unfilled surrounded by medium or- high severity random cracking; unfilled crack greater than 75 mm; or, a crack of any width where approximately 100 mm of pavement around the crack is severity block.	Longitudinal / transverse cracks are measured in linear meters. The length and severity level of each crack should be recorded. If the crack does not have same severity level along the section length, each portion of the crack having a different severity level should be recorded separately.

Table 3:1 level of severity and method of measurement																								
No.	Type	severity levels			How to measure																			
		low(L)	Medium(M)	High (H0)																				
10	Patching	Patch is in good condition and satisfactory. Ride quality is rated as low severity or better.	Patch is moderately deteriorated, or ride quality is rated as medium severity, or both.	patch is badly deteriorated, or ride quality is rated as high severity, or both; needs replacement so as.	Patching is rated in square meters of surface area, however, if a single patch area has accurs a differing severity, these areas should be measured and recorded separately. For example, 2.5 m2 patch may have 1 m2 of medium severity and 1.5 m2 of low severity.																			
11	Polishing	No degrees severity of defined, however, the degree of polishing should be clearly without in the sample unit in that the aggregate surface should be smooth to the touch (Fig X 1.34)			Polished aggregate is measured in square meters of surface area. If bleeding is counted, polished aggregate should not be counted.																			
12	Potholes	The level of severity for pothole less than 750 mm in diameter are based on both the diameter and the depth of the pothole, according to the following: If the potholes is more than 750 mm in diameter, the areas should be determined in square meter and divided by 0.5 m2 find the equivelant number of hole. If the depth is 25 mm or less, the holes are considered medium-severity. If the depth more than 25 mm, they are considered high-severity. <table><tr><th rowspan="2">max. depth of pothole</th><th colspan="3">Average diameter</th></tr><tr><th>100 to 200 mm</th><th>200 to 450 mm</th><th>450 to 750 mm</th></tr><tr><td>13 to ≤ 25 mm</td><td>L</td><td>L</td><td>M</td></tr><tr><td>> 25 and ≤ 50 mm</td><td>L</td><td>M</td><td>H</td></tr><tr><td>> 50 mm</td><td>M</td><td>M</td><td>H</td></tr></table>			max. depth of pothole	Average diameter			100 to 200 mm	200 to 450 mm	450 to 750 mm	13 to ≤ 25 mm	L	L	M	> 25 and ≤ 50 mm	L	M	H	> 50 mm	M	M	H	Potholes are measured by counting the number that are low; medium; and high-severity and recording them separately.
max. depth of pothole	Average diameter																							
	100 to 200 mm	200 to 450 mm	450 to 750 mm																					
13 to ≤ 25 mm	L	L	M																					
> 25 and ≤ 50 mm	L	M	H																					
> 50 mm	M	M	H																					
13	Rail - Road cracking	Railroad crossing causes low-severity ride quality	Railroad crossing causes medium-severity ride quality	Railroad crossing causes high-severity ride quality	The area of the crossing is measured in square meters (feet) of surface area. If the crossing does not affect ride quality, it should not be counted. Any large bump created by the tracks should be counted as part of the crossing.																			
14	Raveling	Aggregate or binder has started to wear away. In some areas, the surface is starting to pit (Figure 19a). In the case of oil spillage, the oil stain can be seen, but the surface is hard and cannot be penetrated with a coin.	Aggregate or binder has worn away. The surface texture is moderately rough and pitted (Figure 19b). In the case of oil spillage, the surface is soft and can be penetrated with a coin.	Aggregate or binder has been worn away considerably. The surface texture is very rough and severely pitted. The pitted areas are less than 10 mm (4 in.) in diameter and less than 13 mm (1/2 in.) deep (Figure 19c); pitted areas larger than this are counted as potholes. In the case of oil spillage, the asphalt binder has lost its binding effect and the aggregate has become loose.	Weathering and raveling are measured in square meters (feet) of surface area.																			

Table 3:1 level of severity and method of measurement					
No.	Type	severity levels			How to measure
		low(L)	Medium(M)	High (H0)	
15	Reflection cracks	One of the following conditions exists (Figure 8a): (1) Non-filled crack width is less than 10mm (3/8 in.), or (2) filled crack of any width (filler in satisfactory condition).	One of the following conditions exists (Figure 8b): (1) Non-filled crack width is greater than or equal to 10 mm (3/8 in.) and less than 75 mm (3 in.); (2) non-filled crack less than or equal to 75 mm (3 in.) surrounded by light secondary cracking, or (3) filled crack of any width surrounded by light secondary cracking.	One of the following conditions exists (Figure 8c): (1) Any crack filled or non-filled surrounded by medium or high severity secondary cracking; (2) non-filled cracks greater than 75 mm (3 in.), or (3) A crack of any width where approximately 100 mm (4 in.) of pavement around the crack are severely raveled or broken.	Joint reflection cracking is measured in linear meters (feet). The length and severity level of each crack should be identified and recorded separately. For example, a crack that is 15 m (50ft) long may have 3 m (10 ft) of high severity cracks; these are all recorded separately. If a bump occurs at the reflection crack, it is also recorded.
16	Rutting	6 to 13 mm (1/4 to 1/2 in.)	>13 to 25 mm (>1/2 to 1 in.)	>25 mm (>1 in.)	Rutting is measured in square meters (feet) of surface area and its severity is determined by the mean depth of the rut (see above). The mean rut depth is calculated by laying a straight edge across the rut, measuring its depth, then using measurements taken along the length of the rut to compute its mean depth in millimeters.
17	Shoving	Shove causes low-severity ride quality	Shove causes medium-severity ride quality	Shove causes high-severity ride quality	Shoves are measured in square meters (feet) of surface area. Shoves occurring in patches are considered in rating the patch, not as a separate distress.
18	Slippage cracks	Average crack width is < 10 mm (3/8 in.)	One of the following conditions exists : (1) average crack width is > 10 and < 40 mm (> 3/8 and < 1-1/2 in.); (2) the area around the crack is moderately spalled and/or surrounded with secondary cracks..	One of the following conditions exists : (1) the average crack width is > 40 mm (1-1/2 in.), or (2) the area around the crack is broken into easily removed pieces.	The area associated with a given slippage crack is measured in square meters (feet) and rated according to the highest level of severity in the area.
19	Swelling	Swell causes low-severity ride quality. Low-severity swells are not always easy to see, but can be detected by driving at the speed limit over the pavement section. An upward motion will occur at the swell if it is present.	Swell causes medium-severity ride quality.	Swell causes high-severity ride quality.	The surface area of the swell is measured in square meters (feet).

CHAPTER IV

ANALYSIS AND RESULT

4-1 Introduction:

After data collection we will analyze and discuss the results in this section, and performed calculations to determine the pavement condition index by manual method and computerize method, as well as the use of computerize method because many data collected and difficult to analyzed manually and to reach the average pavement condition index for each sector, and from the average of pavement condition index identify the type of surface treatments for appropriate preventive maintenance.

4-2 Sampling and Sample Units:

The following procedure shall be followed in order to identify branches of the pavement with different uses such as roadways on the network layout plan.

Divide each branch into sections based on the pavements design, construction history, traffic, condition and according to network coding and numbering system.

Divide the pavement sections into sample units. Individual sample units to be inspected should be marked or identified in a manner to allow inspectors and quality control personnel to easily locate them on the pavement surface. Paint marks along the edge and sketches with locations connected to physical pavement features are acceptable. It is necessary to be able to accurately relocate the sample units to allow verification of current distress data, to examine changes in condition with time of a particular sample unit, and to enable future inspections of the same sample unit if desired.

Select the sample units to be inspected. The number of sample units to be inspected may vary from the following: all of the sample units in the section, a number of sample units that provides a 95 % confidence level, or a lesser number.

All sample units in the section may be inspected to determine the average PCI of the section. This is usually precluded for routine management purposes by available manpower, funds, and time. Total sampling, however, is desirable for project analysis to help estimate maintenance and repair quantities.

The minimum number of sample units (n) that must be surveyed within a given section to obtain a statistically adequate estimate (95 % confidence) of the PCI of the section is calculated using the following formula and rounding n to the next highest whole number (see equation Eq. 1 below).

$$n = NS^2/(e^2/4)((N - 1) + S^2) \quad \dots \dots \dots (1)$$

Where,

e = acceptable error in estimating the section PCI; commonly, e = ±5 PCI points;

s = standard deviation of the PCI from one sample unit to another within the section.

When performing the initial inspection the standard deviation is assumed to be ten for AC pavements. This assumption should be checked as described below after PCI values are determined. For subsequent inspections, the standard deviation from the preceding inspection should be used to determine n; and,

N = total number of sample units in the section.

If obtaining the 95 % confidence level is critical, the adequacy of the number of sample units surveyed must be confirmed.

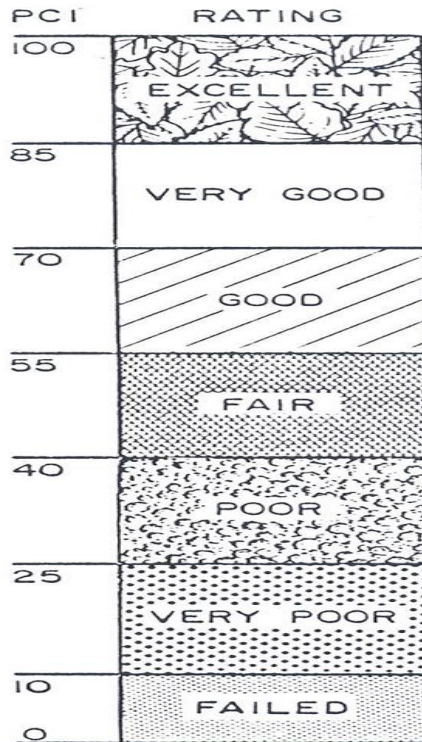


Figure 8 . PCI scale and condition rating.

FIG. 4-1 Pavement Condition Index (PCI) and Rating Scale

The number of sample units was estimated based on an assumed standard deviation.

Calculate the actual standard Deviation as follows (see equation Eq. 2 below):

$$S = (\sum_{i=1}^n (PCI_i - PCI_s)^2 / (n - 1))^{1/2} \dots\dots\dots (2)$$

Where:

PCI_i = PCI of surveyed sample units i ,

PCI_s = PCI of section (mean PCI of surveyed sample units), and n = total number of sample units surveyed.

Calculate the revised minimum number of sample units (Eq. 1) to be surveyed using the calculated standard deviation (Eq. 2).

If the revised number of sample units to be surveyed is greater than the number of sample units already surveyed, select and survey additional random sample units.

These sample units should be spaced evenly across the section. Repeat the process of checking the revised number of sample units and surveying additional random sample units until the total number of sample units surveyed equals or exceeds the minimum required sample units (n) in Eq. 1, using the actual total sample standard deviation.

4-3 Inspection Procedure:

The definitions and guidelines for quantifying distresses for PCI determination are given here after, Using of this method, inspectors should identify distress types accurately 95 % of the time. Linear measurements should be considered accurate when they are within 10 % if re-measured, and area measurements should be considered accurate when they are within 20 % if re-measured.

Individually inspect each sample unit chosen. Sketch the sample unit, including orientation.

Record the branch and section number and the number and type of the sample unit (random or additional). Record the sample unit size measured with the hand odometer.

Once the number of sample units to be inspected has been determined, compute the spacing interval of the units using systematic random sampling. Samples are spaced equally throughout the section with the first sample selected at random.

The spacing interval (I) of the units to be sampled is calculated by the following formula rounded to the next lowest whole number:

$$I = N/n \dots\dots\dots (3)$$

Where:

N = total number of sample units in the section, and

n = number of sample units to be inspected.

The first sample unit to be inspected is selected at random from sample units 1 through I . The sample units within a section that are successive increments of the interval I after the first randomly selected unit also are inspected.

A lesser sampling rate than the above mentioned 95 % Confidence level can be used based on the condition survey Objective. As an example, one agency uses the following table for selecting the number of sample units to be inspected for strategy or programming analysis purposes rather than project analysis:

Given Survey:

- 1 to 5 sample units 1 sample unit
- 6 to 10 sample units 2 sample units
- 11 to 15 sample units 3 sample units
- 16 to 40 sample units 4 sample units
- Over 40 sample units > 10 %.

Additional sample units only are to be inspected when no representative distresses are observed as defined before. These sample units are selected by the user.

We conduct the distress inspection by walking over the sidewalk/shoulder of the sample unit being surveyed, we have measured the quantity of each severity level of every distress type present, and recorded the data. Each distress must correspond in type and severity to that described in this thesis the method of measurement is included with each distress description. Repeated this procedure for each sample unit to be inspected. A copy of a Blank Flexible Pavement Condition Survey Data Sheet for Sample Unit is included in Table 4.1. Eq.3.

Table 4-1: Condition Survey Data Sheet for Sample Unit

[illegible]

4-4 Calculation of PCI:

1. Add up the total quantity of each distress type at each severity level, and record them in the “Total Severities” section. For example, Table 3.2 shows five entries for the Distress Type alligator cracking, edge cracking, patching, potholes and rutting with different severities. The distress at each severity level is summed and entered in the “Total Severity” of low severity or medium severity or high severities. The units for the quantities shall be in

square meters, linear meters, or number of occurrences, depending on the distress type.

2. Divide the total quantity of each distress type at each severity level as determined above by the total area of the sample unit and multiply by 100 to obtain the percent density of each distress type and severity.
3. Determine the deduct value (DV) for each distress type and severity level combination from the distress deduct value curves in Appendix.
4. Determine the maximum corrected deduct value (CDV) according to the following procedure.
 - If none or only one individual deduct value is greater than two, the total value is used in place of the maximum CDV in determining the PCI; otherwise, maximum CDV must be determined using the procedure described in the following.
 - List the individual deducts values in descending order. For example, in Table 4-3 this will be 12, 11, 11 and 4.
 - Determine the allowable number of deducts, m , using the following formula
(See Eq. 4):

$$m = 1 + (9/98)(100 - HDV) \leq 10 \dots \dots \dots (4)$$

Where:

m = allowable number of deducts including fractions (must be less than or equal to ten), and

HDV = highest individual deduct value. (For example in Table 4-3, $m = 1 + (9/98)$

$(100-12) = 9.01$).

The number of the individual deduct values is reduced to the m largest deduct values, including the fractional part. For example in Table 4-3, the values are 12, 11, 11 and 4 (the number of deduct values available in this example is less than m deduct values, in this case use all of the deduct values without a reduction of the last deduct value (EX.1). The reduction shall be calculated in the second case as follows: reduce the last value by multiplying it with the difference between calculated m value and the number of deduct values less than the allowable ones. (See EX.2).

- Determine total deduct value by summing individual deduct values. The total deduct value is obtained by adding the individual deduct values in this example is 38.
- Determine q as the number of deducts with a value greater than 2.0. For example, in Fig. 20 (appendix), $q = 7$ for the first row.
- Determine the CDV from total deduct value and q by looking up the appropriate correction curve for AC pavements in Fig. 20 in the appendix in this thesis.
- Reduce the smallest individual deduct value greater than 2.0 to 2.0 and repeat the last three steps until $q = 1$.
- Maximum CDV is the largest of the CDVs.
- Calculate PCI by subtracting the maximum CDV from 100: $PCI = 100 - \text{max CDV}$.

4- 5 Determination of Section PCI:

If all surveyed sample units are selected randomly or if every sample unit is surveyed then the PCI of the section is the average of the PCIs of the sample units.

If additional sample units, as defined in before, are surveyed then a weighted average is used as follows:

$$PCI_S = (N - A) \left(\frac{PCI_R}{N} \right) + \frac{A(PCI_A)}{N} \dots\dots\dots (5)$$

Where:

- PCI_S = weighted PCI of the section,
- N = total number of sample units in the section,
- A = number of additional sample units,
- PCI_R = mean PCI of randomly selected sample units, and
- PCI_A = mean PCI of additional selected sample units.

Determine the overall condition rating of the section by using the section PCI and the condition rating scale in Fig. 1.

A summary report shall be developed for each section. The summary shall lists all section location, size, total number of sample units, the sample units inspected, the PCIs obtained, the average PCI for the section, and the section condition rating these data shall be stored on the available data base.

Table 4-2: Example of Flexible Pavement Condition Survey Data Sheet

ASPHALT PAVED ROADS CONDITION SURVEY DATA SHEET													SKETCH:		
LINK: 14E (MADANI- EL-GADARIF)		SECTION:(14E/2)...(MADANI- EL-FAU).....					SAMPLE UNIT:... (Km0 -----Km5).....								
SURVEYED BY:.....		DATE:.....					SAMPLE AREA (M):...35000.....								
1-ALLIGATOR CRACKING		6- DEPRESSION					11-PATCHING								
2-BLEEDING		7- EDGE CRACKING					12-POLISHED AGG.						16-SHOVING		
3-BLOCK CRACKING		8-JT-REFLECTION CR.					13-POTHOLE						17-SLIPPAGE CRACKING		
4-BUMPS & SAGS		9-LANE SH. DROP					14-RAILROAD CROSSING						18-SWELL		
5-CORRUGATION		10-LOG.-TR.CR					15-RUTTING						19-WEATHER&RAVELING		
DISTRESS SEVERITY		QUANTITY											TOTAL	DENSITY%	DUDACT VALUE
16 L	43	25	100	62	55	77.5							362.5	1.04	4
10 M	48												48	0.14	11
6 M	175	35											210	0.60	12
16 M	46	38	125	50	22.5	77.5							359	1.03	11
12 H	3												3	0.01	0
14 H	20												20	0.06	0
16 H	23	55											78	0.22	0
16 M	20	100	70										190	0.54	1
16 L	10	15	40										65	0.19	0
6 M	2												2	0.01	0

Table 4-3: Calculation of Corrected Deduct Values

Link ID:	14E				Section ID:	14E/2				
Link Name:	MEDANI- GEDARIF				Section Name:	MEDANI-EL-FAU				
No. of sample U. surv.:	16				Sample unit:	km 0-km5				
No.	Deduct Values							Total	q	CDV
1	12	11	11	4				38	4	18
2	12	11	11	2				36	3	20
3	12	11	2	2				27	2	20
4	12	2	2	2				18	1	19
5										
6										
7										
8										
9										
10										
$m = 1 + (9/98)(100-HDV)$					9.01 ALLOWABLE NUMBER OF DEDUCT VALUE					
MAX CDV =		20								
PCI = 100-MAX CDV =		80								
RATING =		VERY GOOD								
<u>COMMENTS:</u>										
THE (m) VALUE IS 9.01 WHICH IS LESS THAN 10, USE ALL DEDUCT VALUE WITHOUT REDUCTION OF THE LAST VALUE BECAUSE THE NUMBER OF D.V THE M VALUE IS 9.01 WHICH IS LESS THAN 10, USE ALL DEDUCT VALUE										

Table 4-4: Calculation of Corrected Deduct Values

$m = 1 + (9/98)(100 - \text{max DV})$
 use highest 8 deducts and
 multiply the nine deduct with
 diff. of $(8.35 - 8) = 0.35 \times 3 = 1.05$

Link ID:	14E	Section ID:	14E/2
Link Name:	MEDANI- GEDARIF	Section Name:	MEDANI-EL-FAU
No. of sample U. surv	16	Sample unit:	km 49 - km54

No.	Deduct Values									Total	q	CDV
1	20	12	11	10	10	6	3	3	1.05	76	8	37
2	20	12	11	10	10	6	3	3	2	77	8	37
3	20	12	11	10	10	6	3	2	2	76	7	37
4	20	12	11	10	10	6	2	2	2	75	6	35
5	20	12	11	10	10	2	2	2	2	71	5	37
6	20	12	11	10	2	2	2	2	2	63	4	35
7	20	12	11	2	2	2	2	2	2	55	3	35
8	20	12	2	2	2	2	2	2	2	46	2	34
9	20	2	2	2	2	2	2	2	2	36	1	36
10												

$m = 1 + (9/98)(100 - \text{HDV})$	<u>8.35</u> ALLOWABLE NUMBER OF DEDUCT VALUE
MAX CDV =	37
PCI = 100-MAX CDV =	63
RATING =	<u>GOOD</u>
<u>COMMENTS:</u>	
THE (m) VALUE IS 8.35 WHICH IS LESS THAN 9, USE HIGHEST 8 D. V. WITH A REDUCTION OF THE LAST VALUE TO BE $0.35 \times 3 = 1.05$	

Table 4-5: Input Data for Paver Software

PCI:S NETWORK-14E-14E/2

Summary data at time of inspection

Branch Use: ROADWAY Section Surface Type: AAC Section True Area: 35,000. SqM
 Section Length: 5000 M Section Width: 7 M

Inspection Date: 1/1/2014 Edit Inspections Detailed Inspection Comments

Sample Unit: 16 Edit Sample Units Calculate Conditions

Sample Unit Size: 35000.00 SqM No distresses found during inspection.

Distress Type

☐ 01 ALLIGATOR CR ☐ 06 DEPRESSION ☐ 11 PATCH/UT CUT ☐ 16 SHOVING
☐ 02 BLEEDING ☐ 07 EDGE CR ☐ 12 POLISHED AG ☐ 17 SLIPPAGE CR
☐ 03 BLOCK CR ☐ 08 JT REF. CR ☐ 13 POTHOLE ☐ 18 SWELL
☐ 04 BUMPS/SAGS ☐ 09 LANE SH DROP ☐ 14 RR CROSSING ☐ 19 WEATH/RAVEL
☐ 05 CORRUGATION ☐ 10 L_T CR ☒ 15 RUTTING

Distress Severity ☐ Low ☐ Medium ☒ High ☐ N/A

Distress Quantity 78.00 SqM

Distress	Description	Severity	Quantity	Units
15	RUTTING	H	78.	SqM

Add Distress
 Delete Distress
 Replace Distress

Previous Sample Unit Next Sample Unit

Images (0) Close

Table 4-6: Output Data for Paver Software to calculate (PCI)

Assessment Results

Network ID: S NETWORK

Branch ID: 14E Branch Name: MADANI-FAU Section Area: 35,000. SqM

Section ID: 14E/2 Section Length: 5,000. M Section Width: 7. M

Index: PCI Date: 1/1/2014 Condition: 88 Good Std Dev.: 8.11

Condition Indices Sample Distresses Sample Conditions Section Extrapolated Distresses

Condition Index	Condition Value
PCI	88.

Print Close

To discuss the results of the study were first mentioned road network division (case study) to the three links and also links to the division of the sectors are as follows:

1- LINK (MEDANI – GEDARIF) has been divided into two sectors:

- MEDANI – FAO, which is 110 km in length.
- FAO – GEDARIF, which is 117 km in length.

2- LINK (GEDARIF – KASSALA) has been divided into two sectors:

- GEDARIF - KHASHM EL GIRBA, which is 128 km in length.
- KHASHM EL GIRBA – KASSALA, which is 75 km in length.

3- LINK (KASSALA-HAYIA) has been divided into five sectors:

- KASSALA-UPARRAK, which is 70 km in length.
- UPARRAK – UMADAM, which is 50 km in length.
- UMADAM-DURDAIB, which is 130 km in length.
- DURDAIB – ADROUT, which is 35 km in length.
- ADROUT – HAYIA, which is 65 km in length.

The links was conducted subdivided based on several factors are: they are uniform in respect of traffic, environment, geometry, and pavement type and construction history. The links was subdivided into sections which are uniform in respect of pavement condition. For the purpose of project analysis the links, sections and unit samples was be the same for every strategic analysis, then type and severity of pavement distress was assessed by visual inspection.

The distress data are used to calculate the PCI for each sample unit. The PCI of the pavement section was determined based on the PCI of the inspected sample units within the section.

The study was conducted the random samplings based on the distance longitudinal 5 km and width 7 m and also calculate the distance interval between each sample and which the followed 2 km, unless there are distress in this interval, and this is noted in data tables pavement condition index each section.

Table 4-7: Mean Value of PCI for Section (MEDANI-FAU)

Link ID	14E	Section ID	14E/2	
Link Name	MEDANI -GEDARIF	Section Name	MEDANI-FAU	
Total No.of Sample Units (N)	22	Surveyed sample units	16	
No. of Random Sample	16	No. of Additional Sample	0	
TOTAL LENGTH = 110 Km				
Sample Unit	UNIT LOCATION	PCI of Rand. Sample	PCI of Add. Sample	Notes
1	KM 0-KM 5	80	0	
2	KM7-KM 12	90	0	
3	KM 14-KM19	62	0	
4	KM 21-KM 26	61	0	
5	KM 28-KM 33	46	0	
6	KM 35-KM 40	67	0	
7	KM 42-KM 47	32	0	
8	KM 49-KM 54	63	0	
9	KM 56-KM 61	35	0	
10	KM 63-KM 68	18	0	
11	KM 70-KM 75	90	0	
12	KM 77-KM 82	100	0	
13	KM 84-KM 89	65	0	
14	KM 91-KM 96	67	0	
15	KM 98-KM 103	70	0	
16	KM 105-KM 110	70	0	
MEAN VALUE		63.5	0	

CALCULATION PCI OF SECTION			
PCIs= (N - A)(PCI r)/N+A(PCI a)/N			
MEAN PCI RAND	MEAN PCI ADD.	PCI OF SECTION	
63.5	0	64	
RATING OF SECTI		GOOD	
SIGN	.....		
NAME	.....		

Table 4-8: Mean Value of PCI for Section (FAU - GEDARIF)

Link ID	14E		Section ID	14E/1
Link Name	MEDANI -GEDARIF		Section Name	FAU-GEDARIF
Total No.of Sample Units (N)		23	Surveyed sample units	16
No. of Random Sample		16	No. of Additional Sample	0
TOTAL LENGTH = 117 Km				
Sample Unit	UNIT LOCATION	PCI of Rand. Sample	PCI of Add. Sample	Notes
1	KM 2-KM 7	99	0	
2	KM 9-KM 14	80	0	
3	KM 16-KM 21	89	0	
4	KM 23-KM 28	81	0	
5	KM 30-KM 35	67	0	
6	KM 37-KM 42	68	0	
7	KM 44-KM 49	49	0	
8	KM 51-KM 56	56	0	
9	KM 58-KM63	80	0	
10	KM 65-KM 70	74	0	
11	KM 72-KM 77	96	0	
12	KM 79-KM 84	93	0	
13	KM 86-KM 91	46	0	
14	KM 93-KM 98	82	0	
15	KM 100-KM 105	77	0	
16	KM 107-KM 112	18		
MEAN VALUE		72.2	0	
CALCULATION PCI OF SECTION				
PCIs= (N - A)(PCI r)/N+A(PCI a)/N				
MEAN PCI RAND		MEAN PCI ADD.	PCI OF SECTION	
72.2		0	72	
RATING OF SECTI		V.GOOD		
SIGN	.....			
NAME	.....			

Table 4-9: Mean Value of PCI for Section (GEDARIF – KHASHM ELGIRBA)

Link ID	03S1		Section ID	03S1/2
Link Name	GEDARIF - KASSALA		Section Name	EL GEDARIF-KHASM EL GIRBA
Total No. of Sample Units (N)	25		Surveyed sample units	16
No. of Random Sample	16		No. of Additional Sample	0
TOTAL LENGTH = 128 Km				
Sample Unit	UNIT LOCATION	PCI of Rand. Sample	PCI of Add. Sample	Notes
1	KM 3-KM8	19	0	
2	KM 11-KM 16	82	0	
3	KM 19-KM 24	28	0	
4	KM 27-KM 32	70	0	
5	KM 35-KM 40	84	0	
6	KM 43-KM 48	60	0	
7	KM 51-KM 56	48	0	
8	KM 59-KM 64	73	0	
9	KM 67-KM72	90	0	
10	KM 75-KM80	60	0	
11	KM 83-KM88	60	0	
12	KM 91-KM 96	56	0	
13	KM 99-KM 104	5	0	
14	KM 107-KM 112	23	0	
15	KM 115-KM 120	18	0	
16	KM 123-KM 128	19	0	
MEAN VALUE		49.7	0	
<u>CALCULATION PCI OF SECTION</u>				
$PCI_s = (N - A)(PCI_r)/N + A(PCI_a)/N$				
MEAN PCI RAND		MEAN PCI ADD.	PCI OF SECTION	
49.7		0	50	
<u>RATING OF SECTI</u>		FAIR		
SIGN	.....			
NAME	.....			

Table 4-10: Mean Value of PCI for Section (KHASHM ELGIRBA - KASSALA)

Link ID	03S1	Section ID	03S1/1			
Link Name	GEDARIF - KASSALA	Section Name	KHASHM EL GIRBA - KASSALA			
Total No. of Sample Units (N)	15	Surveyed sample units	10			
No. of Random Sample	10	No. of Additional Sample	0			
TOTAL LENGTH = 75 Km						
Sample Unit	UNIT LOCATION	PCI of Rand. Sample	PCI of Add. Sample	Notes		
1	KM 4-KM9	32	0			
2	KM11-KM 16	39	0			
3	KM 18-KM23	20	0			
4	KM 25-KM 30	85	0			
5	KM 32-KM 37	72	0			
6	KM 39-KM 44	48	0			
7	KM 46-KM 51	36	0			
8	KM 53-KM 58	62	0			
9	KM 60-KM 65	71	0			
10	KM 67-KM 72	72	0			
MEAN VALUE		53.7	0			
CALCULATION PCI OF SECTION						
$PCI_s = (N - A)(PCI_r)/N + A(PCI_a)/N$						
MEAN PCI RAND		MEAN PCI ADD.	PCI OF SECTION			
53.7		0	54			
RATING OF SECTI						
FAIR						
SIGN	.....					
NAME	.....					

Table 4-11: Mean Value of PCI for Section (KASSALA - UPARRAK)

Link ID	03N2		Section ID	03N2/1
Link Name	KASSALA - HAYIA		Section Name	KASSALA - UPARRAK
Total No.of Sample Units (N)		14	Surveyed sample units	10
No. of Random Sample		10	No. of Additional Sample	0
TOTAL LENGTH = 70 Km				
Sample Unit	UNIT LOCATION	PCI of Rand. Sample	PCI of Add. Sample	Notes
1	KM 2-KM 7	82	0	
2	KM 9-KM 14	58	0	
3	KM 16-KM 21	70	0	
4	KM 23-KM 28	87	0	
5	KM 30-KM 35	68	0	
6	KM 37-KM42	71	0	
7	KM44-KM49	88	0	
8	KM 51-KM56	52	0	
9	KM 58-KM 63	60	0	
10	KM 65-KM 70	68	0	
MEAN VALUE		70.4	0	
CALCULATION PCI OF SECTION				
PCI _s = (N - A)(PCI _r)/N+A(PCI _a)/N				
MEAN PCI RAND		MEAN PCI ADD.	PCI OF SECTION	
70.4		0	70	
RATING OF SECTI		GOOD		
SIGN	.....			
NAME	.....			

Table 4-12: Mean Value of PCI for Section (UPARRAK - UMADAM)

Link ID	03N2	Section ID	03N2/2	
Link Name	KASSALA - HAYIA	Section Name	UPARRAK - UMADAM	
Total No. of Sample Units (N)	10	Surveyed sample units	7	
No. of Random Sample	7	No. of Additional Sample	0	
TOTAL LENGTH = 50 Km				
Sample Unit	UNIT LOCATION	PCI of Rand. Sample	PCI of Add. Sample	Notes
1	KM 1-KM 6	38	0	
2	KM 8-KM 13	41	0	
3	KM 15-KM20	48	0	
4	KM 22-KM 27	80	0	
5	KM 29-KM 34	70	0	
6	KM 36-KM 41	36	0	
7	KM 43-KM 47	32	0	
MEAN VALUE		49.3	0	
CALCULATION PCI OF SECTION				
$PCI_s = (N - A)(PCI_r)/N + A(PCI_a)/N$				
MEAN PCI RAND		MEAN PCI ADD.	PCI OF SECTION	
49.3		0	49	
RATING OF SECTI		FAIR		
SIGN	.....			
NAME	.....			

Table 4-13: Mean Value of PCI for Section (UMADAM - DURDAIB)

Link ID	03N2		Section ID	03N2/3
Link Name	KASSALA - HAYIA		Section Name	UMADAM - DURDAIB
Total No.of Sample Units (N)		26	Surveyed sample units	16
No. of Random Sample		16	No. of Additional Sample	0
TOTAL LENGTH = 130 Km				
Sample Unit	UNIT LOCATION	PCI of Rand. Sample	PCI of Add. Sample	Notes
1	KM 6-KM 11	16	0	
2	KM 14-KM 19	43	0	
3	KM 22-KM27	69	0	
4	KM 30-KM 35	77	0	
5	KM 38-KM 43	80	0	
6	KM 46-KM 51	58	0	
7	KM 54-KM 59	60	0	
8	KM 62-KM 67	78	0	
9	KM70-KM 75	62	0	
10	KM 78-KM 83	17	0	
11	KM 86-KM 91	38	0	
12	KM 94-KM 99	18	0	
13	KM 102-KM 107	20	0	
14	KM 110-KM 115	12	0	
15	KM 118-KM 123	36	0	
16	KM125-KM130	19	0	
MEAN VALUE		43.9	0	
CALCULATION PCI OF SECTION				
PCIs= (N - A)(PCI r)/N+A(PCI a)/N				
MEAN PCI RAND		MEAN PCI ADD.	PCI OF SECTION	
43.9		0	44	
RATING OF SECTI		FAIR		
SIGN	.....			
NAME	.....			

Table 4-14: Mean Value of PCI for Section (DURDAIB - ADROUT)

Link ID	03N2	Section ID	03N2/4			
Link Name	KASSALA - HAYIA	Section Name	DURDAIB - ADROUT			
Total No. of Sample Units (N)	7	Surveyed sample units	6			
No. of Random Sample	6	No. of Additional Sample	0			
TOTAL LENGTH = 35 Km						
Sample Unit	UNIT LOCATION	PCI of Rand. Sample	PCI of Add. Sample	Notes		
1	KM 0-KM 5	50	0			
2	KM 6-KM 11	52	0			
3	KM 12-KM 17	59	0			
4	KM 18-KM 23	65	0			
5	KM 24-KM 29	60	0			
6	KM 30-KM 35	57	0			
MEAN VALUE		57.2	0			
CALCULATION PCI OF SECTION						
$PCIs = (N - A)(PCI\ r)/N + A(PCI\ a)/N$						
MEAN PCI RAND		MEAN PCI ADD.	PCI OF SECTION			
57.2		0	57			
RATING OF SECTI						
GOOD						
SIGN	.....					
NAME	.....					

Table 4-15: Mean Value of PCI for Section (ADROUT - HAYIA)

Link ID	03N2		Section ID	03N2/5
Link Name	KASSALA - HAYIA		Section Name	ADROUT - HAYIA
Total No.of Sample Units (N)		13	Surveyed sample units	8
No. of Random Sample		8	No. of Additional Sample	0
TOTAL LENGTH = 65 Km				
Sample Unit	UNIT LOCATION	PCI of Rand. Sample	PCI of Add. Sample	Notes
1	KM 10-KM 15	87	0	
2	KM17-KM 22	66	0	
3	KM 24-KM 29	60	0	
4	KM 31-KM 36	53	0	
5	KM 38-KM 43	52	0	
6	KM 45-KM 50	62	0	
7	KM 52-KM 57	49	0	
8	KM 59-KM 64	52	0	
MEAN VALUE		60.1	0	

<u>CALCULATION PCI OF SECTION</u>				
PCIs= (N - A)(PCI r)/N+A(PCI a)/N				
MEAN PCI RAND		MEAN PCI ADD.	PCI OF SECTION	
60.1		0	60	
<u>RATING OF SECTI</u>		GOOD		
SIGN	.....			
NAME	.....			

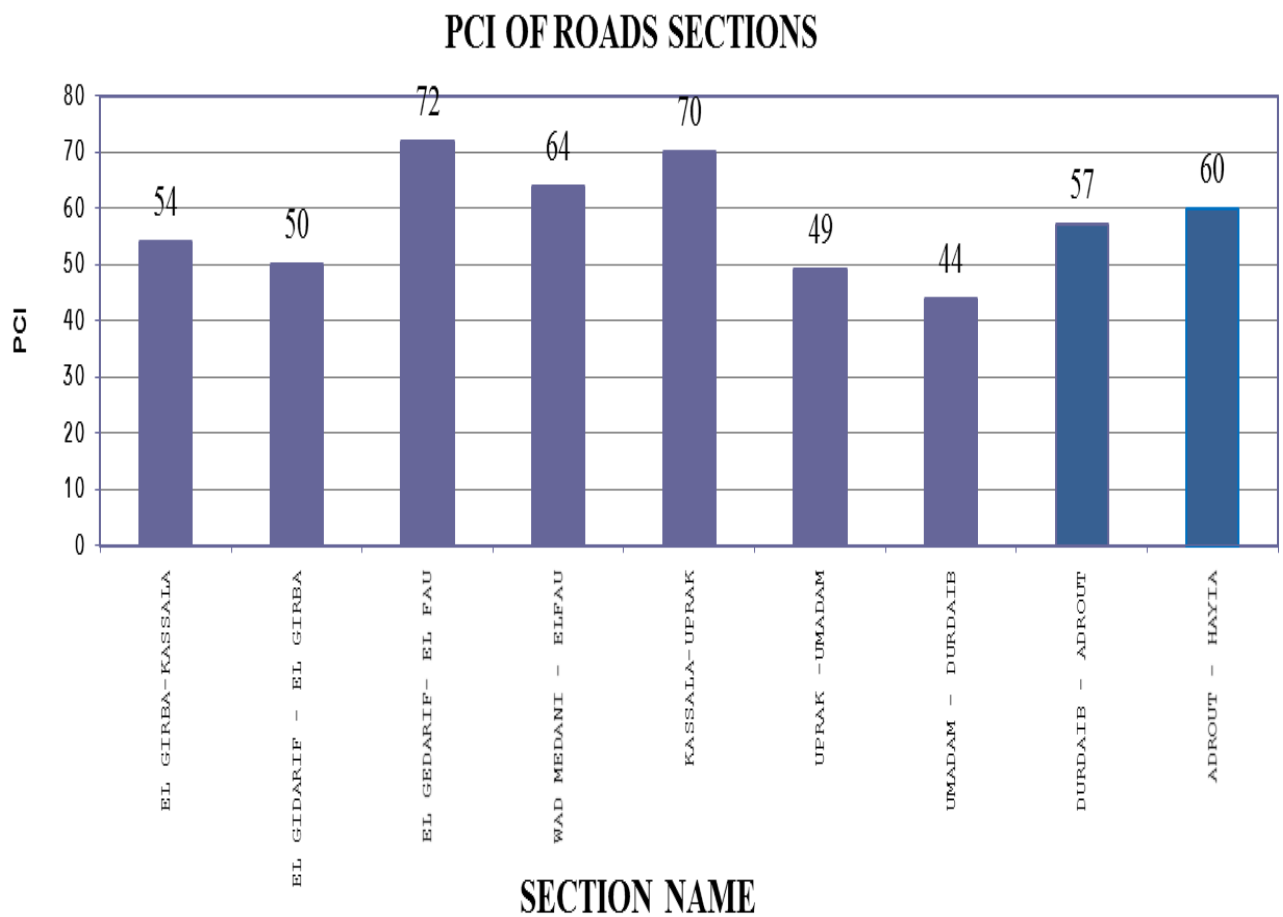
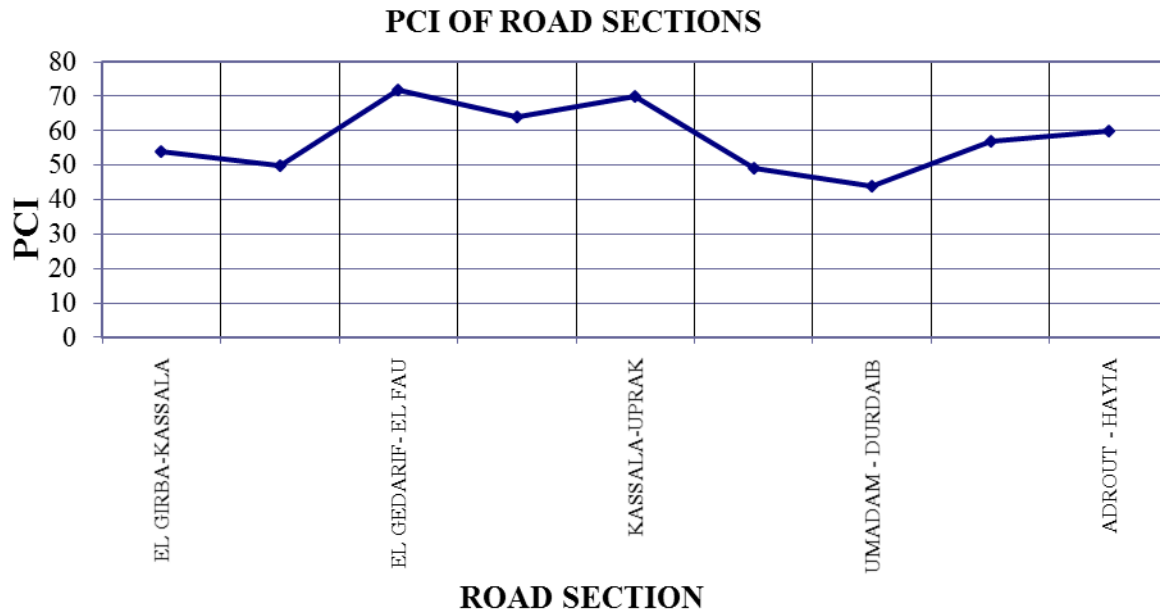


Fig. 4-2: Illustrate PCI vs. Roads Section

After identify the pavement condition index for each sector, we can apply surface treatments appropriate for preventive maintenance, and so in order to reach to The Right treatment, to the Right road at the Right time.

It chart following and to maintain the pavement well, and the application of appropriate preventive maintenance at the optimum time must not less than the pavement condition Index 70.

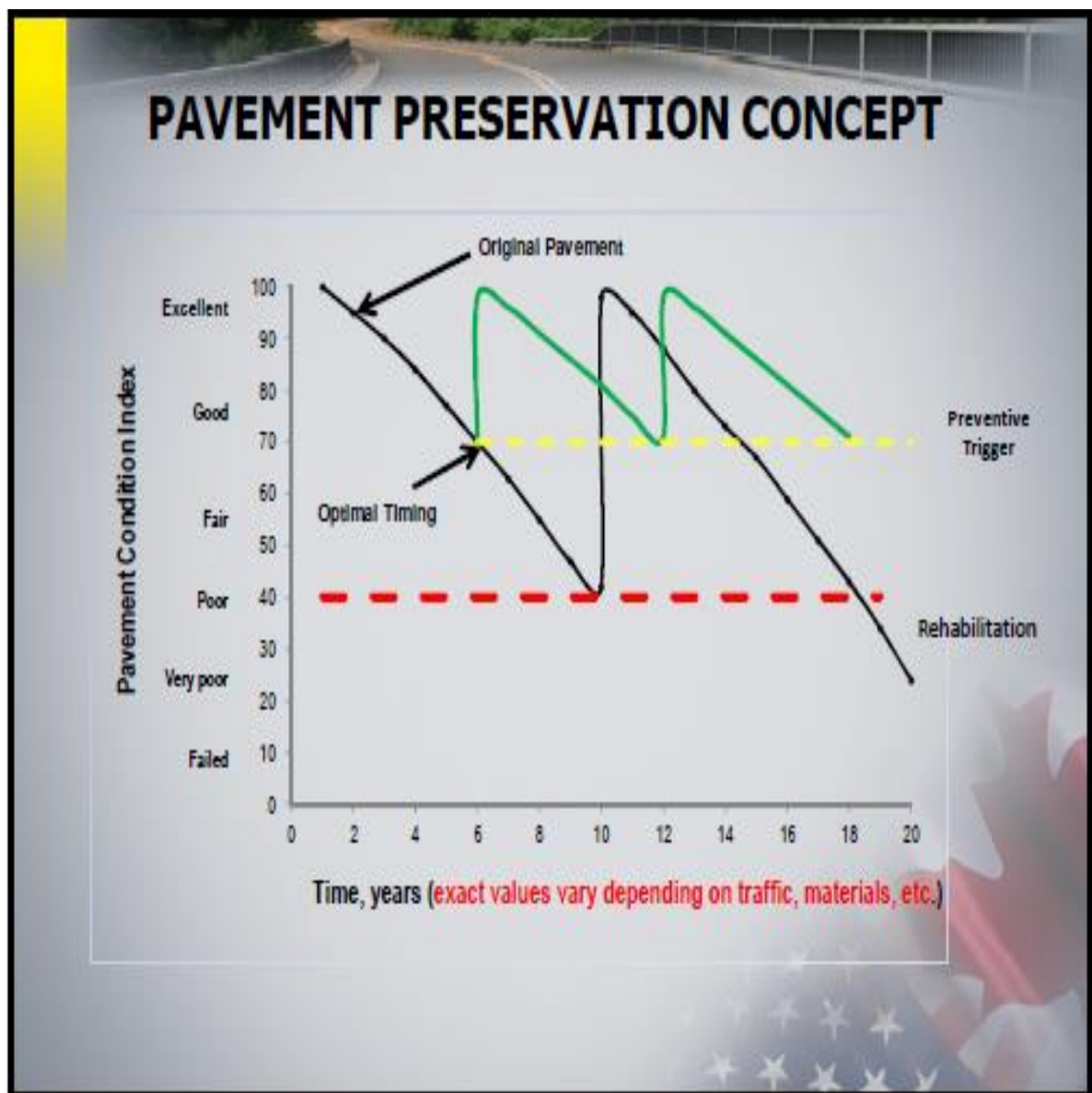


Fig 4-3: Pavement Preservation Concept

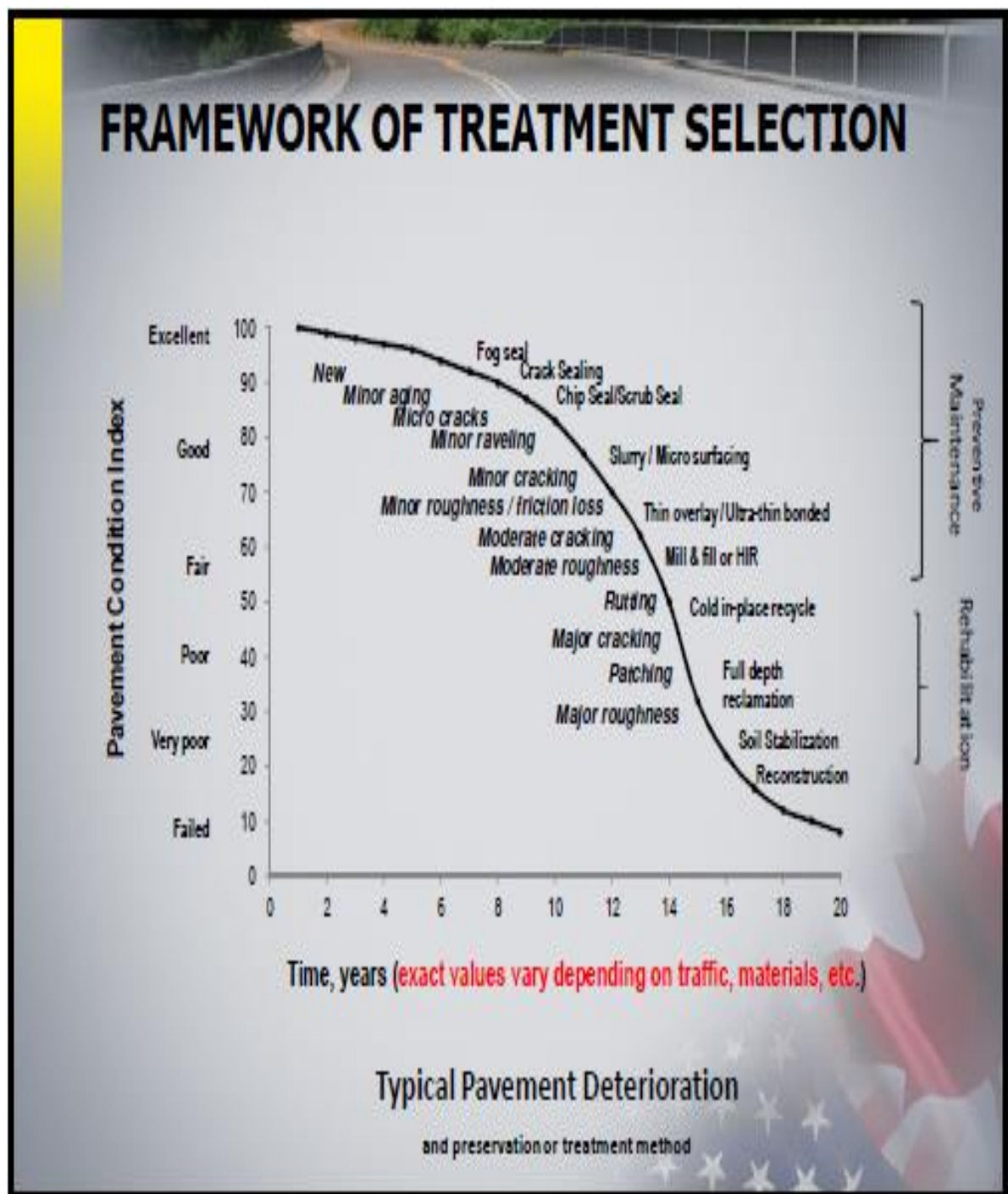


Fig 4-4: Framework of Treatment Selection

CHAPTER V

CONCLUSION AND RECOMMENDATIONS

5-1 CONCLUSION:

It has clearly demonstrated, that a visual survey to find a pavement condition index and any information of the pavement, he realizes a large part of the target and is maintaining the pavement, and provides information enables us to classify each sector on the existing network road, as well as stored ease of information by use the software, and easy retrieval information and studies on pavement, such as information about the data sectors, tools and materials pavement and maintenance history.

In order to check the pavement condition index, three links were selected is part of the national network of roads of Sudan are:

- (Wad MEDANI - GEDARIF)
- (GEDARIF - KASSALA)
- (KASSALA - HAYIA)

And visually surveyed, and then put the data collected in manual calculation equations, as well as the use of software (micro PAVER), and then extract the rate of pavement condition index for each sample have been selected, and then find the average of pavement condition index for each sector,

And then placed in the tables, in order to determine which are in critical condition and can be applied to surface treatments for preventive maintenance.

And reached that the pavement condition index for each sector should be not less than 70, in order to be treatment at the optimal time and cost effective, and choosing the right pavement.

And that each sector, the rate of pavement condition index less than 40, in this case ,it would conduct Rehabilitation for this section , and use preventive maintenance is not benefit , but here means an increase in cost and time.

SECTION NAME	SECTION ID	T. U. SAMPLE	S. U. SAMPLES	LENGTH km	MEAN PCI	RATING
EL GIRBA-KASSALA	03S1/1	15	10	75	54	FAIR
EL GIDARIF - EL GIRBA	03S1/2	25	16	128	50	FAIR
EL GEDARIF- EL FAU	14E/1	23	16	117	72	V.GOOD
WAD MEDANI - ELFAU	14E/2	22	16	110	64	GOOD
KASSALA-UPRAK	03N2/1	14	10	70	70	V.GOOD
UPRAK -UMADAM	03N2/2	10	7	50	49	FAIR
UMADAM - DURDAIB	03N2/3	26	16	130	44	FAIR
DURDAIB - ADROUT	03N2/4	7	6	35	57	GOOD
ADROUT - HAYIA	03N2/5	13	8	65	60	GOOD
STANDARD DEVIATION OF PCI					9.601794	
AVERAGE PCI					52.96018	
TOTAL LENGTH, KM				780		

And through the table above, we conclude that all the links and sectors (case study) showed that the pavement condition index in some sectors, the sector come out of the process of preventive maintenance to find pavement condition index less than 55.

And so we refer to the following sectors that through the visual surveying, the more distress were as follows, and therefore require the following preventive maintenance treatments: -

- 1- EL GEDARIF- EL FAU the pavement condition index that (72) very good, and the distress was survey shoving and depression, and must be apply the preventive maintenance treatment micro-surfacing, cape seal.
- 2- WAD MEDANI – ELFAU pavement condition index that (64) good, and the distress was survey shoving and bumps & sags, and must be apply the preventive maintenance treatment thin HMA overlay.
- 3- KASSALA-UPRAK the pavement condition index that (70) very good, and the distress was survey shoving and swell, and must be apply the preventive maintenance treatment micro-surfacing.
- 4- DURDAIB – ADROUT the pavement condition index that (57) good, and the distress was survey polished and alligator, and must be apply the preventive maintenance treatment fog seal , micro-surfacing, cape seal, mill & grind.
- 5- ADROUT – HAYIA the pavement condition index that (60) good, and the distress was survey lane shoulder drop and block cracking , and must be apply the preventive maintenance crack sealing , treatment micro-surfacing, cape seal, slurry seal,

5-2 RECOMMENDATIONS:

This study is the cornerstone in the establishment of research and studies in the field of all kinds of the maintenance of the road network in Sudan.

And the results obtained from the study is the tip of the iceberg of the data required in the field of road maintenance, where she was the study of preventive maintenance and how to collect data visually and determine the pavement condition index, and then determine the type of treatment appropriate, this is part of a national network of roads in Sudan it was mentioned previously.

So that should the researchers to continue research in order to collect all the required data and it placed in the data base to make road maintenance by method scientific away from the chaos and random, so that the roads must be in good condition and provide of safety and comfort for its users.

Among the recommendations, which were based on the results obtained from this study as follows:

- 5-2-a** It should establish a maintenance department of each sector for the network roads in the Sudan, and the maintenance department conduct the necessary surveys and routine, and save the data collected and prioritize maintenance by coordination with the National Authority for Roads, and creating software and interest funding.
- 5-2-b** The manual should be revised and developed, it followed the National Authority for Roads, and it interest maintenance and how to perform a visual survey, and set up sessions and workshops for all those interested in maintenance and training them on how data collection and analysis, as well as an annual conference to discuss maintenance issues and Preservation on the pavement.
- 5-2-b** The study also included the pavement condition Index without consider to other factors to pavement management system, such as the structure capacity and should be conduct extensive studies on these factors and the effect of loads on the road section and find solutions for it.
- 5-2-a** Should the National Authority for Roads supply the equipment needed to conduct visual surveys on pavement distress, as well as supply the devices to measure permanent deformations in the pavement and measure the roughness and structural capacity for the pavement.

5-2-b Studies should be conducted to incorporate skid resistance into the pavement as one of the pillars of the pavement management system, as well as a comparison between the skid resistance and the design mix by (Marshall & Super-pave System).

Finally, the interest in preventive maintenance and applied at the right time, and the right pavement, and right treatment it has provided us the default long life, also the cost effective and the cost for maintenance less compared with the rehabilitation, and therefore Preservation on the pavement and thus realize the comfort and the safety of users.

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APPENDICES

Data Collection for Link (MADANI – ELGADARIF)

ASPHALT PAVED ROADS CONDATON SURVEY DATA SHEET													SKETCH:		
LINK ID: 14E		SECTION ID(14E/2)...(MADANI- EL-FAU).....					SAMPLE UNIT:... (Km 0 -----Km 5).....								
LINK NAME: (MADANI- EL-GADARIF).....							SECTION NAME: ... (MADANI- EL-FAU).....								
SURVEYED BY:.....		DATE:.....					SAMPLE AREA (M)35000.....			SHEET NO.:...(I).....					
1-ALLIGATOR CRAKING		6- DEPRESSION			11-PATCHING			16-SHOVING							
2-BLEEDING		7- EDGE CRACKING			12-POLISHEDE AGG.			17-SLIPPAGE CRACKING							
3-BLOCK CRACKING		8-JT-REFLECTION CR.			13-POTHOLE			18-SWELL							
4-BUMPS & SAGS		9-LANE SH. DROP			14-RAILROAD CROSSING			19-WEATHER&RAVELING							
5-CORRUGATION		10-LOG.-TR.CR			15-RUTTING										
DISTRESS		SEVERITY	QUANTITY										TOTAL	DENSITY%	DUDACT VALUE
16		L	43	25	100	62	55	77.5					362.5	1.04	4
10		M	48										48	0.14	11
6		M	175	35									210	0.60	12
16		M	46	37.5	125	49.5	22.5	77.5					358	1.02	11
12		H	3										3	0.01	0
14		H	20										20	0.06	0
16		H	23	55									78	0.22	0
16		M	20	100	70								190	0.54	1
16		L	10	15	40								65	0.19	0
6		M	2										2	0.01	0

ASPHALT PAVED ROADS CONDATON SURVEY DATA SHEET													SKETCH:			
LINK ID: 14E	SECTION ID(14E/2)....(MADANI- EL-FAU).....							SAMPLE UNIT:... (Km 7 -----Km 12).....								
LINK NAME: (MADANI- EL-GADARIF).....							SECTION NAME: ... (MADANI- EL-FAU).....									
SURVEYED BY:.....	DATE:.....							SAMPLE AREA (M):35000.....			SHEET NO ....(2).....					
1-ALLIGATOR CRAKING	6- DEPRESSION				11-PATCHING				16-SHOVING							
2-BLEEDING	7- EDGE CRACKING				12-POLISHEDE AGG.				17-SLIPPAGE CRACKING							
3-BLOCK CRACKING	8-JT-REFLECTION CR.				13-POTHOLE				18-SWELL							
4-BUMPS & SAGS	9-LANE SH. DROP				14-RAILROAD CROSSING				19-WEATHER&RAVELING							
5-CORRUGATION	10-LOG.-TR.CR				15-RUTTING											
DISTRESS	SEVERITY	QUANTITY											TOTAL	DENSITY%	DUDACT VALUE	
16	M	46	126	15	85	17.5	15						304.5	0.87	3	
16	L	35	77	90	32.5	37.5	96						368	1.05	0	
16	L	42	21.5	11	6								80.5	0.23	0	
16	M	4	60	2	5	7.5	6						84.5	0.24	0	
12	H	1	3										4	0.01	0	
10	M	2	3	1.6	1.8	0.6	8						17	0.05	0	
9	M	4	3	4	7	20	14	5					57	0.16	0	
3	H	10	40	60	90	30	35						265	0.76	5	
14	H	2	3	6									11	0.03	0	
14	M	4	20										24	0.07	0	
16	M	20	9										29	0.08	0	
16	H	15											15	0.04	0	
4	M	25	7										32	0.09	5	
10	M	18	10	2									30	0.09	4	

ASPHALT PAVED ROADS CONDTION SURVEY DATA SHEET														SKETCH:		
LINK ID: 14E	SECTION ID(14E/2)...(MADANI- EL-FAU).....						SAMPLE UNIT:.. (Km 14 -----Km 19).....									
LINK NAME: .....( MADANI- EL-GADARIF).....						SECTION NAME: ...(MADANI- EL-FAU).....										
SURVEYED BY:.....		DATE:.....				SAMPLE AREA (M)35000.....				SHEET NO:...(3).....						
1-ALLIGATOR CRAKING		6- DEPRESSTION				11-PATCHING				16-SHOVING						
2-BLEEDING		7- EDGE CRACKING				12-POLISHEDE AGG.				17-SLIPPAGE CRACKING						
3-BLOCK CRACKING		8-JT-REFLECTION CR.				13-POTHOLE				18-SWELL						
4-BUMPS & SAGS		9-LANE SH. DROP				14-RAILROAD CROSSING				19-WEATHER&RAVELING						
5-CORRUGATION		10-LOG.-TR.CR				15-RUTTING										
DISTRESS	SEVERITY	QUANTITY												TOTAL	DENSITY%	DUDACT VALUE
9	M	10	14	9	6	10	12	6	0	0	0	0	67	0.19	0	
3	M	9	6	10	10.5	14	8	0	0	0	0	0	57.5	0.16	0	
14	H	2	35	4	26	16	50	0	0	0	0	0	133	0.38	18	
10	M	28	3	8	2	6	0	0	0	0	0	0	47	0.13	3	
16	M	5	0	0	0	0	0	0	0	0	0	0	5	0.01	0	
3	L	6	0	0	0	0	0	0	0	0	0	0	6	0.02	0	
12	H	4	2	1	8	3	4	9	8	4	6	0	49	0.14	20	
14	L	24	0	0	0	0	0	0	0	0	0	0	24	0.07	0	
4	M	8	25	40	30	20	35	25	35	50	60	40	368	1.05	13	
9	H	8	2	2	6	2	0	0	0	0	0	0	20	0.06	0	
1	M	3.6	4.8	0	0	0	0	0	0	0	0	0	8.4	0.02	0	
3	M	24	3	20	0	0	0	0	0	0	0	0	47	0.13	0	
3	H	12	10.5	35	7.5	17.5	0	0	0	0	0	0	82.5	0.24	2	
14	M	10.5	7.5	0	0	0	0	0	0	0	0	0	18	0.05	0	
5	M	15	0	0	0	0	0	0	0	0	0	0	15	0.04	0	
14	H	24	63	0	0	0	0	0	0	0	0	0	87	0.25	13	
4	L	40	0	0	0	0	0	0	0	0	0	0	40	0.11	0	

ASPHALT PAVED ROADS CONDTION SURVEY DATA SHEET														SKETCH:		
LINK ID: 14E	SECTION ID:(14E/2)...(MADANI- EL-FAU).....							SAMPLE UNIT:... (Km 21 -----Km 26).....								
LINK NAME: .....( MADANI- EL-GADARIF).....							SECTION NAME: ...(MADANI- EL-FAU).....									
SURVEYED BY:.....		DATE:.....					SAMPLE AREA (M)35000.....				SHEET NO :...(4).....					
1-ALLIGATOR CRAKING		6- DEPRESSTION				11-PATCHING				16-SHOVING						
2-BLEEDING		7- EDGE CRACKING				12-POLISHEDE AGG.				17-SLIPPAGE CRACKING						
3-BLOCK CRACKING		8-JT-REFLECTION CR.				13-POTHOLE				18-SWELL						
4-BUMPS & SAGS		9-LANE SH. DROP				14-RAILROAD CROSSING				19-WEATHER&RAVELING						
5-CORRUGATION		10-LOG.-TR.CR				15-RUTTING										
DISTRESS		SEVERITY	QUANTITY											TOTAL	DENSITY%	DUDACT VALUE
9	M	4	5	7	6	0	0	0	0	0	0	0	22	0.06	0	
4	M	58	68	89	50	70	25	40	35	45	0	0	480	1.37	10	
1	L	18.6	0	0	0	0	0	0	0	0	0	0	18.6	0.05	3	
16	M	5	0	0	0	0	0	0	0	0	0	0	5	0.01	0	
12	H	3	5	7	4	4	0	0	0	0	0	0	23	0.07	20	
14	H	10.5	2	16	6	24.5	52.5	0	0	0	0	0	111.5	0.32	10	
3	H	0.24	18	0	0	0	0	0	0	0	0	0	18	0.05	0	
10	M	2	10	4	2	2	0	0	0	0	0	0	20	0.06	3	
9	H	2	0	0	0	0	0	0	0	0	0	0	2	0.01	0	
3	L	10	0	0	0	0	0	0	0	0	0	0	10	0.03	0	
3	H	84	30	20	0	0	0	0	0	0	0	0	134	0.38	3	
5	M	70	60	15	36	30	45	0	0	0	0	0	256	0.73	11	
1	H	6	0	0	0	0	0	0	0	0	0	0	6	0.02	0	
6	M	14	0	0	0	0	0	0	0	0	0	0	14	0.04	0	
19	M	20	0	0	0	0	0	0	0	0	0	0	20	0.06	0	
14	H	36	2	6	15	91	0	0	0	0	0	0	150	0.43	11	
10	L	2	1.8	0	0	0	0	0	0	0	0	0	3.8	0.01	0	

ASPHALT PAVED ROADS CONDATION SURVEY DATA SHEET													SKETCH:			
LINK ID: 14E		SECTION ID:(14E/2)...(MADANI- EL-FAU).....						SAMPLE UNIT... (Km28 -----Km33).....								
LINK NAME: .....(MADANI- EL-GADARIF).....								SECTION NAME: ...(MADANI- EL-FAU).....								
SURVEYED BY:.....		DATE:.....				SAMPLE AREA (M)35000.....				SHEET NO :...(5).....						
1-ALLIGATOR CRAKING		6- DEPRESSTION				11-PATCHING				16-SHOVING						
2-BLEEDING		7- EDGE CRACKING				12-POLISHEDE AGG.				17-SLIPPAGE CRACKING						
3-BLOCK CRACKING		8-JT-REFLECTION CR.				13-POTHOLE				18-SWELL						
4-BUMPS & SAGS		9-LANE SH. DROP				14-RAILROAD CROSSING				19-WEATHER&RAVELING						
5-CORRUGATION		10-LOG.-TR.CR				15-RUTTING										
DISTRESS		SEVERITY	QUANTITY										TOTAL	DENSITY%	DUDACT VALUE	
9		H	7	7	7	10	5	5	7	0	0	0	0	48	0.14	0
14		H	1	17.5	28	15	21	6	0	0	0	0	0	88.5	0.25	16
3		H	10	24	30	16	54	12	0	0	0	0	0	146	0.42	3
4		M	70	25	25	65	140	95	64	65	40	20	15	624	1.78	18
5		M	15	54	10	25	45	0	0	0	0	0	0	149	0.43	9
14		M	12	0	0	0	0	0	0	0	0	0	0	12	0.03	0
10		M	0.7	1	2	6	16	8	0	0	0	0	0	33.7	0.10	5
3		H	16	18	24.5	30	36	15	0	0	0	0	0	139.5	0.40	3
12		H	3	7	11	4	27	17	22	25	0	0	0	116	0.33	30
3		M	28	0	0	0	0	0	0	0	0	0	0	28	0.08	0
10		M	4	4.5	2	4.5	2	0.81	0	0	0	0	0	17.81	0.05	3
16		H	0.5	0	0	0	0	0	0	0	0	0	0	0.5	0.00	0
3		H	35	70	10.5	10.5	10	75	0	0	0	0	0	211	0.60	4
16		M	4	15	0	0	0	0	0	0	0	0	0	19	0.05	0
14		H	20	30	70	9	0	0	0	0	0	0	0	129	0.37	19
6		H	24	0	0	0	0	0	0	0	0	0	0	24	0.07	11
10		M	2	1	0	0	0	0	0	0	0	0	0	3	0.01	0
9		M	7	14	0	0	0	0	0	0	0	0	0	21	0.06	0

ASPHALT PAVED ROADS CONDATION SURVEY DATA SHEET													SKETCH:		
LINK ID: 14E	SECTION ID(14E/2)...(MADANI- EL-FAU).....						SAMPLE UNIT:.... (Km 35 -----Km 40).....								
LINK NAME: (MADANI- EL-GADARIF).....							SECTION NAME: ... (MADANI- EL-FAU).....								
SURVEYED BY:.....		DATE:.....				SAMPLE AREA (M)35000.....				SHEET NO.:...(6).....					
1-ALLIGATOR CRAKING		6- DEPRESSTION				11-PATCHING				16-SHOVING					
2-BLEEDING		7- EDGE CRACKING				12-POLISHEDE AGG.				17-SLIPPAGE CRACKING					
3-BLOCK CRACKING		8-JT-REFLECTION CR.				13-POTHOLE				18-SWELL					
4-BUMPS & SAGS		9-LANE SH. DROP				14-RAILROAD CROSSING				19-WEATHER&RAVELING					
5-CORRUGATION		10-LOG.-TR.CR				15-RUTTING									
DISTRESS	SEVERITY	QUANTITY											TOTAL	DENSITY%	DUDACT VALUE
3	H	84	27	14	6	6	35	0	0	0	0	0	172	0.49	3
10	M	3	3.75	3	1.2	8	3	0	0	0	0	0	21.95	0.06	3
9	M	5	3	2	3	2	3	7	3	4	6	7	45	0.13	0
4	M	54	150	70	10	26	25	12	24	10	40	45	466	1.33	14
12	H	1	6	3	37	4	2	1	4	0	0	0	58	0.17	20
3	M	30	36	42	10	21	52.5	0	0	0	0	0	191.5	0.55	0
3	H	9	34	5	70	105	15	0	0	0	0	0	238	0.68	5
5	M	13	0	0	0	0	0	0	0	0	0	0	13	0.04	0
9	H	5	15	20	9	2	2	10	3	0	0	0	66	0.19	0
11	O	150	120	210	0	0	0	0	0	0	0	0	480	1.37	0
3	M	70	75	21	0	0	0	0	0	0	0	0	166	0.47	0
14	H	54	24	0	0	0	0	0	0	0	0	0	78	0.22	11
3	H	24	10.5	8	30	15	54	0	0	0	0	0	141.5	0.40	2
10	M	2	0.7	1.4	0	0	0	0	0	0	0	0	4.1	0.01	0
4	M	30	0	0	0	0	0	0	0	0	0	0	30	0.09	0
9	M	7	0	0	0	0	0	0	0	0	0	0	7	0.02	0
3	H	16	0	0	0	0	0	0	0	0	0	0	16	0.05	0

ASPHALT PAVED ROADS CONDTION SURVEY DATA SHEET													SKETCH:			
LINK ID: 14E	SECTION ID(14E/2)...(MADANI- EL-FAU).....						SAMPLE UNIT:... (Km 42 -----Km 47).....									
LINK NAME: (MADANI- EL-GADARIF).....							SECTION NAME: ... (MADANI- EL-FAU).....									
SURVEYED BY:.....		DATE:.....				SAMPLE AREA (M)35000.....				SHEET NO:...(7).....						
1-ALLIGATOR CRAKING		6- DEPRESSION				11-PATCHING				16-SHOVING						
2-BLEEDING		7- EDGE CRACKING				12-POLISHEDE AGG.				17-SLIPPAGE CRACKING						
3-BLOCK CRACKING		8-JT-REFLECTION CR.				13-POTHOLE				18-SWELL						
4-BUMPS & SAGS		9-LANE SH. DROP				14-RAILROAD CROSSING				19-WEATHER&RAVELING						
5-CORRUGATION		10-LOG.-TR.CR				15-RUTTING										
DISTRESS	SEVERITY	QUANTITY											TOTAL	DENSITY%	DUDACT VALUE	
3	H	8	2	48	35	16	12	0	0	0	0	0	121	0.35	3	
11	0	154	28	100	0	0	0	0	0	0	0	0	282	0.81	0	
12	H	7	5	6	4	5	2	2	16	6	5	3	61	0.17	22	
14	H	14	4	28	12	10.5	22	0	0	0	0	0	90.5	0.26	15	
10	M	9	28	0	0	0	0	0	0	0	0	0	37	0.11	3	
9	M	4	3	7	2	4	7	7	4	6	8	0	52	0.15	0	
14	H	1	8	4	1	13	15	0	0	0	0	0	42	0.12	7	
9	H	4	3	3.5	3	4	8	8	5	3	21	0	62.5	0.18	0	
3	H	12	18	12	3	14	70	0	0	0	0	0	129	0.37	3	
3	H	15	52.5	14	10.5	36	70	0	0	0	0	0	198	0.57	4	
14	H	3	8	40	2	7.5	0	0	0	0	0	0	60.5	0.17	11	
5	M	30	30	30	20	60	70	0	0	0	0	0	240	0.69	10	
3	M	30	17.5	30	0	0	0	0	0	0	0	0	77.5	0.22	0	
4	M	10	15	12	190	0	0	0	0	0	0	0	227	0.65	10	
3	H	30	192.5	10	45	36	0	0	0	0	0	0	313.5	0.90	6	
5	H	340	0	0	0	0	0	0	0	0	0	0	340	0.97	34	
4	H	90	0	0	0	0	0	0	0	0	0	0	90	0.26	20	
5	M	420	0	0	0	0	0	0	0	0	0	0	420	1.20	17	

ASPHALT PAVED ROADS CONDTION SURVEY DATA SHEET													SKETCH:		
LINK ID: 14E	SECTION ID(14E/2)...(MADANI- EL-FAU).....					SAMPLE UNIT:...(Km 49 -----Km 54).....									
LINK NAME: .....( MADANI- EL-GADARIF).....						SECTION NAME: ...(MADANI- EL-FAU).....									
SURVEYED BY:.....		DATE:.....				SAMPLE AREA (M)35000.....				SHEET NO:...(8).....					
1-ALLIGATOR CRAKING		6- DEPRESSION				11-PATCHING				16-SHOVING					
2-BLEEDING		7- EDGE CRACKING				12-POLISHEDE AGG.				17-SLIPPAGE CRACKING					
3-BLOCK CRACKING		8-JT-REFLECTION CR.				13-POTHOLE				18-SWELL					
4-BUMPS & SAGS		9-LANE SH. DROP				14-RAILROAD CROSSING				19-WEATHER&RAVELING					
5-CORRUGATION		10-LOG.-TR.CR				15-RUTTING									
DISTRESS	SEVERITY	QUANTITY											TOTAL	DENSITY%	DUDACT VALUE
19	L	8	6	0	0	0	0	0	0	0	0	0	14	0.04	0
9	L	2	0	0	0	0	0	0	0	0	0	0	2	0.01	0
9	H	6	7	7	8	17	8	4	3	7	4	9	80	0.23	0
12	H	1	1	0	0	0	0	0	0	0	0	0	2	0.01	0
9	M	7	6	7	4	6	7	3.5	7	4	8	0	59.5	0.17	0
5	M	9	117	40	40	75	20	0	0	0	0	0	301	0.86	11
4	M	5	56	14	32	31	20	60	0	0	0	0	218	0.62	10
3	H	4	6	21	3	10	84	0	0	0	0	0	128	0.37	3
3	H	28	6	28	12	35	30	0	0	0	0	0	139	0.40	3
14	H	24	28	0	0	0	0	0	0	0	0	0	52	0.15	10
12	H	9	13	2	1	4	0	0	0	0	0	0	29	0.08	20
3	M	6	10	45.5	0	0	0	0	0	0	0	0	61.5	0.18	0
3	H	10	10.5	63	92.5	5	16	0	0	0	0	0	197	0.56	3
9	H	3.5	6	7	6	13	17	15	7	3.5	6	0	84	0.24	0
3	H	20	2	4.5	75	5	22.5	0	0	0	0	0	129	0.37	2
5	M	20	60	60	70	30	30	0	0	0	0	0	270	0.77	12
19	M	2	0	0	0	0	0	0	0	0	0	0	2	0.01	0
3	H	70	122.5	112	0	0	0	0	0	0	0	0	304.5	0.87	6

ASPHALT PAVED ROADS CONDATON SURVEY DATA SHEET														SKETCH:		
LINK ID: 14E		SECTION ID:(14E/2)...(MADANI- EL-FAU).....						SAMPLE UNIT... (Km 56 -----Km 61).....								
LINK NAME: (MADANI- EL-GADARIF).....								SECTION NAME: ... (MADANI- EL-FAU).....								
SURVEYED BY:.....		DATE:.....						SAMPLE AREA (M)35000.....				SHEET NO.:...(9).....				
1-ALLIGATOR CRAKING		6- DEPRESSTION				11-PATCHING				16-SHOVING						
2-BLEEDING		7- EDGE CRACKING				12-POLISHEDE AGG.				17-SLIPPAGE CRACKING						
3-BLOCK CRACKING		8-JT-REFLECTION CR.				13-POTHOLE				18-SWELL						
4-BUMPS & SAGS		9-LANE SH. DROP				14-RAILROAD CROSSING				19-WEATHER&RAVELING						
5-CORRUGATION		10-LOG.-TR.CR				15-RUTTING										
DISTRESS		SEVERITY	QUANTITY											TOTAL	DENSITY%	DUDACT VALUE
3		M	5	10	0	0	0	0	0	0	0	0	0	15	0.04	0
19		M	6	0	0	0	0	0	0	0	0	0	0	6	0.02	0
5		L	60	60	0	0	0	0	0	0	0	0	0	120	0.34	0
14		H	2	10	20	14	10	4.5	0	0	0	0	0	60.5	0.17	10
5		M	150	80	60	0	0	0	0	0	0	0	0	290	0.83	12
9		H	5	4	0	0	0	0	0	0	0	0	0	9	0.03	0
3		M	7	0	0	0	0	0	0	0	0	0	0	7	0.02	0
5		H	140	270	40	0	0	0	0	0	0	0	0	450	1.29	35
3		H	59.5	14	52.5	70	87.5	70	0	0	0	0	0	353.5	1.01	7
4		M	30	70	0	0	0	0	0	0	0	0	0	100	0.29	7
9		M	7	7	3	15	0	0	0	0	0	0	0	32	0.09	0
3		H	63	30	91	77	77	105	0	0	0	0	0	443	1.27	7
1		H	16	0	0	0	0	0	0	0	0	0	0	16	0.05	12
14		H	7.5	30	140	6	28	3	0	0	0	0	0	214.5	0.61	21
12		H	9	3	4	2	5	7	5	14	0	0	0	49	0.14	20
3		H	122.5	70	80.5	245	420	119	0	0	0	0	0	1057	3.02	16
14		H	8	70	14	12	4	12	0	0	0	0	0	120	0.34	16
10		M	27	56	8	0	0	0	0	0	0	0	0	91	0.26	5
3		H	59.5	91	140	147	132	12	0	0	0	0	0	581.5	1.66	11
3		H	140	175	14	4.5	22.5	0	0	0	0	0	0	356	1.02	7
14		H	2	0	0	0	0	0	0	0	0	0	0	2	0.01	0
3		M	70	63	0	0	0	0	0	0	0	0	0	133	0.38	0

ASPHALT PAVED ROADS CONDATON SURVEY DATA SHEET														SKETCH:		
LINK ID: 14E	SECTION ID:(14E/2)... (MADANI- EL-FAU).....					SAMPLE UNIT:.... (Km 63 -----Km 68).....										
LINK NAME: (MADANI- EL-GADARIF).....						SECTION NAME: ... (MADANI- EL-FAU).....										
SURVEYED BY:.....		DATE:.....				SAMPLE AREA (M)35000.....				SHEET NO:...(10).....						
1-ALLIGATOR CRAKING		6- DEPRESSTION			11-PATCHING				16-SHOVING							
2-BLEEDING		7- EDGE CRACKING			12-POLISHEDE AGG.				17-SLIPPAGE CRACKING							
3-BLOCK CRACKING		8-JT-REFLECTION CR.			13-POTHOLE				18-SWELL							
4-BUMPS & SAGS		9-LANE SH. DROP			14-RAILROAD CROSSING				19-WEATHER&RAVELING							
5-CORRUGATION		10-LOG.-TR.CR			15-RUTTING											
DISTRESS		SEVERITY	QUANTITY											TOTAL	DENSITY%	DUDACT VALUE
9	M	2	7	6	3	4	9	4	5	4	0	0	44	0.13	0	
3	M	56	175	70	25	35	30	0	0	0	0	0	391	1.12	3	
3	H	35	49	35	4	133	0	0	0	0	0	0	256	0.73	4	
9	H	11	7	7	10	7	7	0	0	0	0	0	49	0.14	0	
3	H	28	28	17.5	35	49	21	0	0	0	0	0	178.5	0.51	3	
3	H	49	56	105	245	175	560	0	0	0	0	0	1190	3.40	17	
10	M	6	45	0	0	0	0	0	0	0	0	0	51	0.15	3	
3	H	140	70	371	490	119	231	0	0	0	0	0	1421	4.06	18	
12	H	6	23	30	14	9	3	2	26	12	14	27	166	0.47	40	
14	H	161	154	90	10	5	0	0	0	0	0	0	420	1.20	28	
19	M	32	0	0	0	0	0	0	0	0	0	0	32	0.09	0	
3	H	798	336	497	819	700	0	0	0	0	0	0	3150	9.00	28	
12	H	14	50	24	13	5	3	1	0	0	0	0	110	0.31	30	
6	H	70	0	0	0	0	0	0	0	0	0	0	70	0.20	13	
3	H	1050	840	525	35	630	105	0	0	0	0	0	3185	9.10	28	
6	M	30	10	0	0	0	0	0	0	0	0	0	40	0.11	9	
4	M	35	105	200	150	70	0	0	0	0	0	0	560	1.60	15	
5	M	110	120	60	0	0	0	0	0	0	0	0	290	0.83	12	
14	H	210	10	75	15	0.25	0	0	0	0	0	0	310.25	0.89	18	
3	H	147.5	70	105	40	0	0	0	0	0	0	0	362.5	1.04	7	
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0	
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0	

ASPHALT PAVED ROADS CONDATION SURVEY DATA SHEET														SKETCH:		
LINK ID: 14E		SECTION ID(14E/2)...(MADANI- EL-FAU).....						SAMPLE UNIT:... (Km 70 -----Km 75).....								
LINK NAME: .....( MADANI- EL-GADARIF).....								SECTION NAME: ...(MADANI- EL-FAU).....								
SURVEYED BY:.....		DATE:.....						SAMPLE AREA (M)35000....				SHEET NO.:...(11).....				
1-ALLIGATOR CRAKING 6- DEPRESSION 11-PATCHING 16-SHOVING 2-BLEEDING 7- EDGE CRACKING 12-POLISHEDE AGG. 17-SLIPPAGE CRACKING 3-BLOCK CRACKING 8-JT-REFLECTION CR. 13-POTHOLE 18-SWELL 4-BUMPS & SAGS 9-LANE SH. DROP 14-RAILROAD CROSSING 19-WEATHER&RAVELING 5-CORRUGATION 10-LOG.-TR.CR 15-RUTTING																
DISTRESS		SEVERITY	QUANTITY											TOTAL	DENSITY%	DUDACT VALUE
16		L	6.5	15	12.5	18.5	24	34.5	0	0	0	0	0	111	0.32	0
16		M	3	24	15	17	10	0	0	0	0	0	0	69	0.20	0
16		L	37.5	11	9.5	2.5	2	10	0	0	0	0	0	72.5	0.21	0
9		L	2	4	0	0	0	0	0	0	0	0	0	6	0.02	0
16		H	1.5	6	22.5	5	0	0	0	0	0	0	0	35	0.10	0
16		L	6	10	0	0	0	0	0	0	0	0	0	16	0.05	0
12		H	5	0	0	0	0	0	0	0	0	0	0	5	0.01	0
16		M	2.5	5	7.5	7.5	4	0	0	0	0	0	0	26.5	0.08	0
19		M	24	12	0	0	0	0	0	0	0	0	0	36	0.10	0
10		M	0.6	0.56	1.5	28	1.5	3	0	0	0	0	0	35.16	0.10	3
5		M	30	0	0	0	0	0	0	0	0	0	0	30	0.09	5
4		M	13	10	15	17	0	0	0	0	0	0	0	55	0.16	0
5		L	12	0	0	0	0	0	0	0	0	0	0	12	0.03	0
6		M	7	7	0	0	0	0	0	0	0	0	0	14	0.04	0
0		0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0

ASPHALT PAVED ROADS CONDATION SURVEY DATA SHEET														SKETCH:		
LINK ID: 14E		SECTION ID(14E/2)...(MADANI- EL-FAU).....						SAMPLE UNIT:... (Km 77 -----Km 82).....								
LINK NAME: .....( MADANI- EL-GADARIF).....								SECTION NAME: ...(MADANI- EL-FAU).....								
SURVEYED BY:.....		DATE:.....				SAMPLE AREA (M)35000.....				SHEET NO:...(12).....						
1-ALLIGATOR CRAKING		6- DEPRESSTION				11-PATCHING				16-SHOVING						
2-BLEEDING		7- EDGE CRACKING				12-POLISHEDE AGG.				17-SLIPPAGE CRACKING						
3-BLOCK CRACKING		8-JT-REFLECTION CR.				13-POTHOLE				18-SWELL						
4-BUMPS & SAGS		9-LANE SH. DROP				14-RAILROAD CROSSING				19-WEATHER&RAVELING						
5-CORRUGATION		10-LOG.-TR.CR				15-RUTTING										
DISTRESS		SEVERITY	QUANTITY											TOTAL	DENSITY%	DUDACT VALUE
16		M	7.5	24	21.5	11	9	0	0	0	0	0	0	73	0.21	0
16		L	7	63	14	7.5	40	14.5	0	0	0	0	0	146	0.42	0
16		H	13	2.5	4	9	35	0	0	0	0	0	0	63.5	0.18	0
9		L	7	7	6	9	3.5	8	0	0	0	0	0	40.5	0.12	0
10		M	9	0	0	0	0	0	0	0	0	0	0	9	0.03	0
16		M	32.5	15	27.5	15	0	0	0	0	0	0	0	90	0.26	0
16		L	15	10	6	62.5	30	10	0	0	0	0	0	133.5	0.38	0
0		0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0

ASPHALT PAVED ROADS CONDATON SURVEY DATA SHEET													SKETCH:			
LINK ID: 14E	SECTION ID(14E2)...(MADANI- EL-FAU).....						SAMPLE UNIT:.. (Km 84 -----Km 89).....									
LINK NAME: .....( MADANI- EL-GADARIF).....						SECTION NAME: ..(MADANI- EL-FAU).....										
SURVEYED BY:.....		DATE:.....				SAMPLE AREA (M)35000.....				SHEET NO.:...(13).....						
1-ALLIGATOR CRAKING		6- DEPRESSTION				11-PATCHING				16-SHOVING						
2-BLEEDING		7- EDGE CRACKING				12-POLISHEDE AGG.				17-SLIPPAGE CRACKING						
3-BLOCK CRACKING		8-JT-REFLECTION CR.				13-POTHOLE				18-SWELL						
4-BUMPS & SAGS		9-LANE SH. DROP				14-RAILROAD CROSSING				19-WEATHER&RAVELING						
5-CORRUGATION		10-LOG.-TR.CR				15-RUTTING										
DISTRESS	SEVERITY	QUANTITY											TOTAL	DENSITY%	DUDACT VALUE	
14	H	5	11.2	9	2	2	18	0	0	0	0	0	47.2	0.13	7	
6	M	5	7	15	35	0	0	0	0	0	0	0	62	0.18	9	
16	H	7	7.5	7.5	15	17.5	0	0	0	0	0	0	54.5	0.16	0	
6	H	7.5	30	1.4	0	0	0	0	0	0	0	0	38.9	0.11	10	
10	M	42	42	0	0	0	0	0	0	0	0	0	84	0.24	3	
10	H	49	0	0	0	0	0	0	0	0	0	0	49	0.14	6	
16	M	5	0	0	0	0	0	0	0	0	0	0	5	0.01	0	
16	H	6.5	4	4.5	5.5	32	2.5	0	0	0	0	0	55	0.16	4	
16	M	8.5	10	8.5	20	20	10	0	0	0	0	0	77	0.22	0	
9	H	2	3	0	0	0	0	0	0	0	0	0	5	0.01	0	
14	H	9	0.16	4	12	14.4	0	0	0	0	0	0	39.56	0.11	7	
10	M	91	77	224	112	42	42	0	0	0	0	0	588	1.68	11	
3	H	12	0.5	0	0	0	0	0	0	0	0	0	12.5	0.04	0	
3	M	3	4	3	0	0	0	0	0	0	0	0	10	0.03	0	
10	L	6	0	0	0	0	0	0	0	0	0	0	6	0.02	0	
6	L	6	0	0	0	0	0	0	0	0	0	0	6	0.02	0	
12	H	12	9	4	5	7	9	3	0	0	0	0	49	0.14	20	
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0	

ASPHALT PAVED ROADS CONDATON SURVEY DATA SHEET													SKETCH:			
LINK ID: 14E	SECTION ID(14E2)...(MADANI- EL-FAU).....						SAMPLE UNIT:.. (Km 91 -----Km 96).....									
LINK NAME: ....( MADANI- EL-GADARIF).....						SECTION NAME: ..(MADANI- EL-FAU).....										
SURVEYED BY:.....		DATE:.....				SAMPLE AREA (M)35000.....				SHEET NO.:...(14).....						
1-ALLIGATOR CRAKING		6- DEPRESSTION				11-PATCHING				16-SHOVING						
2-BLEEDING		7- EDGE CRACKING				12-POLISHEDE AGG.				17-SLIPPAGE CRACKING						
3-BLOCK CRACKING		8-JT-REFLECTION CR.				13-POTHOLE				18-SWELL						
4-BUMPS & SAGS		9-LANE SH. DROP				14-RAILROAD CROSSING				19-WEATHER&RAVELING						
5-CORRUGATION		10-LOG.-TR.CR				15-RUTTING										
DISTRESS		SEVERITY	QUANTITY										TOTAL	DENSITY%	DUDACT VALUE	
16		H	7.5	10.2	31	1.5	7.5	6	0	0	0	0	63.7	0.18	0	
12		H	1	8	9	7	10	4	6	12	3	5	78	0.22	17	
10		M	2	63	14	12	20	4	0	0	0	0	115	0.33	5	
16		M	30	9.5	9.5	58	15	3	0	0	0	0	125	0.36	0	
6		M	10.5	9	7	10	13	2	0	0	0	0	51.5	0.15	9	
6		H	3	0	0	0	0	0	0	0	0	0	3	0.01	0	
16		L	15	4	3.5	13.5	0	0	0	0	0	0	36	0.10	0	
14		H	2	3	0.42	3	2	0	0	0	0	0	10.42	0.03	0	
6		L	10	5.6	11	15	21	17	0	0	0	0	79.6	0.23	4	
16		M	23	6.5	11	2.5	15	8	0	0	0	0	66	0.19	0	
12		H	1	2	4	7	1	14	8	18	3	0	58	0.17	13	
10		M	30	20	20	42	38.5	6	0	0	0	0	156.5	0.45	6	
6		M	18	6	14	20	10	15	0	0	0	0	83	0.24	9	
16		H	5	3.5	2	5	5	7.5	0	0	0	0	28	0.08	0	
10		M	42	42	42	42	42	0	0	0	0	0	210	0.60	7	
14		M	2.1	4	6	0	0	0	0	0	0	0	12.1	0.03	0	
16		M	11.5	20	25	20	5	1.5	0	0	0	0	83	0.24	0	
10		M	63	35	0	0	0	0	0	0	0	0	98	0.28	5	
3		M	2	0	0	0	0	0	0	0	0	0	2	0.01	0	
6		M	3	6	0	0	0	0	0	0	0	0	9	0.03	0	
0		0	0	0	0	0	0	0	0	0	0	0	0	0.00	0	

ASPHALT PAVED ROADS CONDATON SURVEY DATA SHEET														SKETCH:		
LINK ID: 14E	SECTION ID(14E2)...(MADANI- EL-FAU).....							SAMPLE UNIT:... (Km 98 -----Km 103).....								
LINK NAME: (MADANI- EL-GADARIF).....							SECTION NAME: ... (MADANI- EL-FAU).....									
SURVEYED BY:.....	DATE:.....						SAMPLE AREA (M):35000.....				SHEET NO.... (15).....					
1-ALLIGATOR CRAKING		6- DEPRESSTION				11-PATCHING				16-SHOVING						
2-BLEEDING		7- EDGE CRACKING				12-POLISHEDE AGG.				17-SLIPPAGE CRACKING						
3-BLOCK CRACKING		8-JT-REFLECTION CR.				13-POTHOLE				18-SWELL						
4-BUMPS & SAGS		9-LANE SH. DROP				14-RAILROAD CROSSING				19-WEATHER&RAVELING						
5-CORRUGATION		10-LOG.-TR.CR				15-RUTTING										
DISTRESS	SEVERITY	QUANTITY												TOTAL	DENSITY%	DUDACT VALUE
6	M	28	6	17	4	4	9.6	0	0	0	0	0	68.6	0.20	9	
16	H	5	3	9.5	80	38	10.5	0	0	0	0	0	146	0.42	3	
16	M	2.5	20	29.5	11	40	20	0	0	0	0	0	123	0.35	0	
12	H	2	6	2	3	3	6	8	8	5	19	12	74	0.21	17	
14	M	9	10	2	3	0	0	0	0	0	0	0	24	0.07	4	
10	M	6	155	6	155	52.5	84	0	0	0	0	0	458.5	1.31	11	
16	H	3	4.5	3	15.75	12	2.5	0	0	0	0	0	40.75	0.12	0	
14	H	3.5	8	0	0	0	0	0	0	0	0	0	11.5	0.03	0	
16	M	9.5	3.5	15	6	10	3.5	0	0	0	0	0	47.5	0.14	0	
16	H	3.5	9.5	17.5	4.5	2.5	17.5	0	0	0	0	0	55	0.16	0	
10	M	35	2	8	3	35	3	0	0	0	0	0	86	0.25	4	
16	L	7.5	10	0	0	0	0	0	0	0	0	0	17.5	0.05	0	
6	M	35	5	3	7	4	2	0	0	0	0	0	56	0.16	9	
10	M	35	42	7	8	4.5	0	0	0	0	0	0	96.5	0.28	4	
16	H	19	5	2.5	0	0	0	0	0	0	0	0	26.5	0.08	0	
16	M	17.5	10	0	0	0	0	0	0	0	0	0	27.5	0.08	0	
6	M	3	3	2	0	0	0	0	0	0	0	0	8	0.02	0	
12	H	7	0	0	0	0	0	0	0	0	0	0	7	0.02	0	
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0	

ASPHALT PAVED ROADS CONDATON SURVEY DATA SHEET														SKETCH:		
LINK ID: 14E	SECTION ID(14E2)...(MADANI- EL-FAU).....					SAMPLE UNIT:... (Km 105 -----Km 110).....										
LINK NAME: .....(MADANI- EL-GADARIF).....						SECTION NAME: ... (MADANI- EL-FAU).....										
SURVEYED BY:.....		DATE:.....				SAMPLE AREA (M)35000.....				SHEET NO.:...(16).....						
1-ALLIGATOR CRAKING		6- DEPRESSTION				11-PATCHING				16-SHOVING						
2-BLEEDING		7- EDGE CRACKING				12-POLISHEDE AGG.				17-SLIPPAGE CRACKING						
3-BLOCK CRACKING		8-JT-REFLECTION CR.				13-POTHOLE				18-SWELL						
4-BUMPS & SAGS		9-LANE SH. DROP				14-RAILROAD CROSSING				19-WEATHER&RAVELING						
5-CORRUGATION		10-LOG.-TR.CR				15-RUTTING										
DISTRESS	SEVERITY	QUANTITY												TOTAL	DENSITY%	DUDACT VALUE
16	L	12	5	5	5	2.5	40	0	0	0	0	0	69.5	0.20	0	
16	M	20	30	40	25	20	12	0	0	0	0	0	147	0.42	0	
14	H	3	1.5	14	0	0	0	0	0	0	0	0	18.5	0.05	7	
14	M	2	0	0	0	0	0	0	0	0	0	0	2	0.01	0	
9	M	3	2	5	0	0	0	0	0	0	0	0	10	0.03	0	
16	H	4	4	3	12.5	17.5	2.5	0	0	0	0	0	43.5	0.12	0	
10	M	98	2	119	28	35	6	0	0	0	0	0	288	0.82	9	
6	M	4	4.9	15	9	63	7	0	0	0	0	0	102.9	0.29	9	
16	M	5	28	12.5	3.5	9	2.5	0	0	0	0	0	60.5	0.17	0	
3	L	1.5	0	0	0	0	0	0	0	0	0	0	1.5	0.00	0	
3	M	16	0	0	0	0	0	0	0	0	0	0	16	0.05	0	
2	H	3	0	0	0	0	0	0	0	0	0	0	3	0.01	0	
3	H	4	0	0	0	0	0	0	0	0	0	0	4	0.01	0	
3	M	10	0	0	0	0	0	0	0	0	0	0	10	0.03	0	
6	M	7.2	35	5	30	4.2	3	0	0	0	0	0	84.4	0.24	0	
16	M	22.5	13.5	28	80	9	0	0	0	0	0	0	153	0.44	0	
10	L	2	0.63	1	0.8	0.7	0	0	0	0	0	0	5.13	0.01	0	
6	L	17	12	16	0	0	0	0	0	0	0	0	45	0.13	3	
6	H	12	0	0	0	0	0	0	0	0	0	0	12	0.03	0	
12	H	2	1	2	3	6	2	0	0	0	0	0	16	0.05	20	
1	M	7.2	0	0	0	0	0	0	0	0	0	0	7.2	0.02	0	
10	M	2	0	0	0	0	0	0	0	0	0	0	2	0.01	0	
16	H	5	3	6	1	0	0	0	0	0	0	0	15	0.04	0	
6	M	12	5.6	3	0	0	0	0	0	0	0	0	20.6	0.06	9	
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0	

ASPHALT PAVED ROADS CONDATON SURVEY DATA SHEET													SKETCH:		
LINK ID: 14E		SECTION ID: ....(14E/1).....					SAMPLE UNIT:... (Km 2 -----Km 7).....								
LINK NAME: .....( MADANI- EL-GADARIF).....							SECTION NAME: ... (EL FAU -ELGEDARIF).....								
SURVEYED BY:.....		DATE:.....					SAMPLE AREA (M)35000.....			SHEET NO.:...(1).....					
1-ALLIGATOR CRAKING		6- DEPRESSTION			11-PATCHING			16-SHOVING							
2-BLEEDING		7- EDGE CRACKING			12-POLISHEDE AGG.			17-SLIPPAGE CRACKING							
3-BLOCK CRACKING		8-JT-REFLECTION CR.			13-POTHOLE			18-SWELL							
4-BUMPS & SAGS		9-LANE SH. DROP			14-RAILROAD CROSSING			19-WEATHER&RAVELING							
5-CORRUGATION		10-LOG.-TR.CR			15-RUTTING										
DISTRESS	SEVERITY	QUANTITY											TOTAL	DENSITY%	DUDACT VALUE
16	L	55	30	15	25	200	50	0	0	0	0	0	375	1.07	0
16	M	11	40	62	10	9	34	0	0	0	0	0	166	0.47	0
16	L	80	35	20	35	30	30	0	0	0	0	0	230	0.66	0
16	M	30	12.5	17.5	17.5	28	20	22	0	0	0	0	147.5	0.42	1
6	H	28	0	0	0	0	0	0	0	0	0	0	28	0.08	0
6	M	7	5	3	6	0	0	0	0	0	0	0	21	0.06	0
16	M	5	17	61.5	25	12.5	10	0	0	0	0	0	131	0.37	0
16	L	16	25	7.5	10	0	0	0	0	0	0	0	58.5	0.17	0
16	H	6.5	40	12.5	2.5	0	0	0	0	0	0	0	61.5	0.18	0
6	L	6	6	0	0	0	0	0	0	0	0	0	12	0.03	0
16	M	15	0	0	0	0	0	0	0	0	0	0	15	0.04	0
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0

ASPHALT PAVED ROADS CONDATON SURVEY DATA SHEET													SKETCH:		
LINK ID: 14E		SECTION ID: ....(14E/1).....					SAMPLE UNIT:... (Km 9 -----Km 14).....								
LINK NAME: .....( MADANI- EL-GADARIF).....							SECTION NAME: ... (EL FAU -ELGEDARIF).....								
SURVEYED BY:.....		DATE:.....					SAMPLE AREA (M)35000.....			SHEET NO.:...(2).....					
1-ALLIGATOR CRAKING		6- DEPRESSTION			11-PATCHING			16-SHOVING							
2-BLEEDING		7- EDGE CRACKING			12-POLISHEDE AGG.			17-SLIPPAGE CRACKING							
3-BLOCK CRACKING		8-JT-REFLECTION CR.			13-POTHOLE			18-SWELL							
4-BUMPS & SAGS		9-LANE SH. DROP			14-RAILROAD CROSSING			19-WEATHER&RAVELING							
5-CORRUGATION		10-LOG.-TR.CR			15-RUTTING										
DISTRESS	SEVERITY	QUANTITY											TOTAL	DENSITY%	DUDACT VALUE
6	L	9.3	10	10.5	0	0	0	0	0	0	0	0	29.8	0.1	4
16	M	70	21	9	38.5	15	20	0	0	0	0	0	173.5	0.5	1
6	L	26	7.5	10	7	4	1.8	0	0	0	0	0	56.3	0.2	5
16	H	2.5	29	23	22.5	5	6	0	0	0	0	0	88	0.3	2
16	L	35	8.5	25	70	35	24	0	0	0	0	0	197.5	0.6	0
16	M	7.5	4	6	5	13	7	0	0	0	0	0	42.5	0.1	0
16	M	7.5	6.5	7.5	59	5	46	0	0	0	0	0	131.5	0.4	0
16	L	26	5	25	62	25	7	0	0	0	0	0	150	0.4	0
6	H	55	0	0	0	0	0	0	0	0	0	0	55	0.2	13
16	H	17.5	10	5	12.5	5	0	0	0	0	0	0	50	0.1	0
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.0	0

ASPHALT PAVED ROADS CONDATON SURVEY DATA SHEET													SKETCH:			
LINK ID: 14E		SECTION ID:.....(14E/1).....					SAMPLE UNIT:.. (Km 16-----Km 21).....									
LINK NAME: .....( MADANI- EL-GADARIF).....							SECTION NAME: ...(EL FAU -ELGEDARIF).....									
SURVEYED BY:.....		DATE:.....					SAMPLE AREA (M)35000.....			SHEET NO.:...(3).....						
1-ALLIGATOR CRAKING		6- DEPRESSTION			11-PATCHING			16-SHOVING								
2-BLEEDING		7- EDGE CRACKING			12-POLISHEDE AGG.			17-SLIPPAGE CRACKING								
3-BLOCK CRACKING		8-JT-REFLECTION CR.			13-POTHOLE			18-SWELL								
4-BUMPS & SAGS		9-LANE SH. DROP			14-RAILROAD CROSSING			19-WEATHER&RAVELING								
5-CORRUGATION		10-LOG.-TR.CR			15-RUTTING											
DISTRESS		SEVERITY	QUANTITY										TOTAL	DENSITY%	DUDACT VALUE	
6		M	42	112	60	3	7	9.6	0	0	0	0	0	233.6	0.7	9
16		L	11	10	17	14	30	2.5	0	0	0	0	0	84.5	0.2	0
16		M	18	5	11	9	11.5	10	0	0	0	0	0	64.5	0.2	0
14		M	1	0	0	0	0	0	0	0	0	0	0	1	0.0	0
16		H	22	7.5	5	5	7.5	0	0	0	0	0	0	47	0.1	0
16		L	21	46	32.5	38	30	40	0	0	0	0	0	207.5	0.6	0
16		M	21	18	8.5	25	7.5	26	0	0	0	0	0	106	0.3	0
6		L	42	0	0	0	0	0	0	0	0	0	0	42	0.1	4
16		L	30	27.5	12.5	37	22.5	15	0	0	0	0	0	144.5	0.4	0
10		M	2	0	0	0	0	0	0	0	0	0	0	2	0.0	0
6		M	3	0	0	0	0	0	0	0	0	0	0	3	0.0	0
16		M	20	7.5	7.5	0	0	0	0	0	0	0	0	35	0.1	0
16		L	10	20	5	10	0	0	0	0	0	0	0	45	0.1	0
0		0	0	0	0	0	0	0	0	0	0	0	0	0	0.0	0

ASPHALT PAVED ROADS CONDATON SURVEY DATA SHEET													SKETCH:		
LINK ID: 14E		SECTION ID:.....(14E/1).....					SAMPLE UNIT... (Km 23-----Km 28).....								
LINK NAME: .....( MADANI- EL-GADARIF).....							SECTION NAME: ...(EL FAU -ELGEDARIF).....								
SURVEYED BY:.....		DATE:.....					SAMPLE AREA (M)35000.....			SHEET NO.:...(4).....					
1-ALLIGATOR CRAKING	6- DEPRESSTION				11-PATCHING				16-SHOVING						
2-BLEEDING	7- EDGE CRACKING				12-POLISHEDE AGG.				17-SLIPPAGE CRACKING						
3-BLOCK CRACKING	8-JT-REFLECTION CR.				13-POTHOLE				18-SWELL						
4-BUMPS & SAGS	9-LANE SH. DROP				14-RAILROAD CROSSING				19-WEATHER&RAVELING						
5-CORRUGATION	10-LOG.-TR.CR				15-RUTTING										
DISTRESS		SEVERITY	QUANTITY										TOTAL	DENSITY%	DUDACT VALUE
16	L	9	7.5	9.5	10	42.5	13	0	0	0	0	0	91.5	0.3	0
16	H	17.5	8	8.5	16	23	22	0	0	0	0	0	95	0.3	2
16	M	10	10	1.5	3.5	8	10	0	0	0	0	0	43	0.1	0
10	M	2	0	0	0	0	0	0	0	0	0	0	2	0.0	0
14	H	1.3	0	0	0	0	0	0	0	0	0	0	1.3	0.0	0
12	H	1	0	0	0	0	0	0	0	0	0	0	1	0.0	0
16	H	6	35	4	6.5	8.4	11	0	0	0	0	0	70.9	0.2	0
16	M	2.5	16.8	13	23	22.5	67.5	0	0	0	0	0	145.3	0.4	0
16	H	6	12	12	22.5	20	15	0	0	0	0	0	87.5	0.3	2
6	L	12.5	10.5	1.2	7	10.5	0	0	0	0	0	0	41.7	0.1	4
16	L	15	22.5	8	7.5	0	0	0	0	0	0	0	53	0.2	0
6	H	28	4.2	0	0	0	0	0	0	0	0	0	32.2	0.1	12
6	M	15	6	40	4	24	5.6	0	0	0	0	0	94.6	0.3	4
16	M	77.5	22.5	5	17.5	22.5	13	0	0	0	0	0	158	0.5	1
6	M	10	0	0	0	0	0	0	0	0	0	0	10	0.0	0
16	H	5	10	0	0	0	0	0	0	0	0	0	15	0.0	0
12	M	1	0	0	0	0	0	0	0	0	0	0	1	0.0	0
16	M	10	0	0	0	0	0	0	0	0	0	0	10	0.0	0
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.0	0

ASPHALT PAVED ROADS CONDATON SURVEY DATA SHEET													SKETCH:		
LINK ID: 14E		SECTION ID:.....(14E/1).....					SAMPLE UNIT:.. (Km 30-----Km 35).....								
LINK NAME: (MADANI- EL-GADARIF).....							SECTION NAME: ... (EL FAU -ELGEDARIF).....								
SURVEYED BY:.....		DATE:.....					SAMPLE AREA (M)35000.....				SHEET NO :...(5).....				
1-ALLIGATOR CRAKING	6- DEPRESSTION				11-PATCHING				16-SHOVING						
2-BLEEDING	7- EDGE CRACKING				12-POLISHEDE AGG.				17-SLIPPAGE CRACKING						
3-BLOCK CRACKING	8-JT-REFLECTION CR.				13-POTHOLE				18-SWELL						
4-BUMPS & SAGS	9-LANE SH. DROP				14-RAILROAD CROSSING				19-WEATHER&RAVELING						
5-CORRUGATION	10-LOG.-TR.CR				15-RUTTING										
DISTRESS	SEVERITY	QUANTITY											TOTAL	DENSITY%	DUDACT VALUE
16	H	4.5	7	6.5	6.5	5	4	0	0	0	0	0	33.5	0.1	0
16	L	19	11	5	10.5	6	12	0	0	0	0	0	63.5	0.2	0
10	M	1.2	5	14	6	2	2	0	0	0	0	0	30.2	0.1	3
12	H	2	1	3	0	0	0	0	0	0	0	0	6	0.0	0
16	M	20	12.5	7.5	2.5	17	7.5	0	0	0	0	0	67	0.2	0
6	M	14.4	15	4	74	10	8	0	0	0	0	0	125.4	0.4	9
16	M	32.5	11	4	22.5	40	27.5	0	0	0	0	0	137.5	0.4	0
6	L	7	9	9.8	12	0	0	0	0	0	0	0	37.8	0.1	0
16	H	30	7	7	35	12.5	6.5	0	0	0	0	0	98	0.3	2
11	0	20	0	0	0	0	0	0	0	0	0	0	20	0.1	0
6	L	9	11.2	28.8	21	10	0	0	0	0	0	0	80	0.2	4
10	M	14	6	6	3	6	6	0	0	0	0	0	41	0.1	3
6	H	90	224	33	18	25.2	8	0	0	0	0	0	398.2	1.1	17
1	L	10.8	6	0	0	0	0	0	0	0	0	0	16.8	0.0	0
1	H	30	9	0	0	0	0	0	0	0	0	0	39	0.1	12
16	H	25	17.5	22	17.5	2.5	9	0	0	0	0	0	93.5	0.3	2
1	M	22.5	9	0	0	0	0	0	0	0	0	0	31.5	0.1	7
6	H	7	7	5	7	10	0	0	0	0	0	0	36	0.1	12
6	M	8	40	5	0	0	0	0	0	0	0	0	53	0.2	8
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.0	0

ASPHALT PAVED ROADS CONDATON SURVEY DATA SHEET													SKETCH:		
LINK ID: 14E	SECTION ID:.....(14E/1).....					SAMPLE UNIT:.. (Km 37 -----Km 42).....									
LINK NAME: .....( MADANI- EL-GADARIF).....						SECTION NAME: ... (EL FAU -ELGEDARIF).....									
SURVEYED BY:.....	DATE:.....					SAMPLE AREA (M)35000.....				SHEET NO :...(6).....					
1-ALLIGATOR CRAKING	6- DEPRESSTION				11-PATCHING				16-SHOVING						
2-BLEEDING	7- EDGE CRACKING				12-POLISHEDE AGG.				17-SLIPPAGE CRACKING						
3-BLOCK CRACKING	8-JT-REFLECTION CR.				13-POTHOLE				18-SWELL						
4-BUMPS & SAGS	9-LANE SH. DROP				14-RAILROAD CROSSING				19-WEATHER&RAVELING						
5-CORRUGATION	10-LOG.-TR.CR				15-RUTTING										
DISTRESS	SEVERITY	QUANTITY											TOTAL	DENSITY%	DUDAC VALUE
16	M	8.5	6	12.5	7.5	22	7.5	0	0	0	0	0	64	0.2	0
16	L	5	14.5	2.5	10	0	0	0	0	0	0	0	32	0.1	0
1	L	2.4	4.2	4.8	0	0	0	0	0	0	0	0	11.4	0.0	0
16	H	16.5	10	7.5	5	10	12.5	0	0	0	0	0	61.5	0.2	0
10	M	12	2.25	6	1.5	6	0.6	0	0	0	0	0	28.35	0.1	3
9	L	11	2	5	0	0	0	0	0	0	0	0	18	0.1	0
6	H	5	15	17	4	12	10	0	0	0	0	0	63	0.2	13
1	M	2.4	0	0	0	0	0	0	0	0	0	0	2.4	0.0	0
6	M	9	8	4	18	39	30	0	0	0	0	0	108	0.3	8
16	M	6	13.5	15	6	2.5	10	0	0	0	0	0	53	0.2	0
9	H	7	0	0	0	0	0	0	0	0	0	0	7	0.0	0
9	M	4	6	0	0	0	0	0	0	0	0	0	10	0.0	0
10	M	10	35	3	3	21	1.5	0	0	0	0	0	73.5	0.2	4
6	H	35	16	18	3	6	8	0	0	0	0	0	86	0.2	13
6	M	7	16	6	17	60	6	0	0	0	0	0	112	0.3	8
16	M	5	7.5	22.5	5	45	80	0	0	0	0	0	165	0.5	1
10	M	2	2	0.96	0	0	0	0	0	0	0	0	4.96	0.0	0
6	H	12	9	30	5	4	0	0	0	0	0	0	60	0.2	13
12	H	1	0	0	0	0	0	0	0	0	0	0	1	0.0	0
6	M	6	20	4.5	0	0	0	0	0	0	0	0	30.5	0.1	8
16	M	80	10	0	0	0	0	0	0	0	0	0	90	0.3	0
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.0	0

ASPHALT PAVED ROADS CONDATON SURVEY DATA SHEET														SKETCH:		
LINK ID: 14E	SECTION ID:.....(14E/1).....					SAMPLE UNIT:.. (Km 44 -----Km 49).....										
LINK NAME: (MADANI- EL-GADARIF).....						SECTION NAME: ... (EL FAU -ELGEDARIF).....										
SURVEYED BY:.....		DATE:.....				SAMPLE AREA (M)35000.....				SHEET NO:...(7).....						
1-ALLIGATOR CRAKING		6- DEPRESSTION				11-PATCHING				16-SHOVING						
2-BLEEDING		7- EDGE CRACKING				12-POLISHEDE AGG.				17-SLIPPAGE CRACKING						
3-BLOCK CRACKING		8-JT-REFLECTION CR.				13-POTHOLE				18-SWELL						
4-BUMPS & SAGS		9-LANE SH. DROP				14-RAILROAD CROSSING				19-WEATHER&RAVELING						
5-CORRUGATION		10-LOG.-TR.CR				15-RUTTING										
DISTRESS	SEVERITY	QUANTITY												TOTAL	DENSITY%	DUDACT VALUE
6	H	38	54	40	39	18	12	0	0	0	0	0	201	0.57	17	
12	M	1	0	0	0	0	0	0	0	0	0	0	1	0.00	0	
3	M	52.5	16	14	7	10	7.5	0	0	0	0	0	107	0.31	0	
6	M	15	1	20	3	5	8	0	0	0	0	0	52	0.15	8	
1	M	16.2	0	0	0	0	0	0	0	0	0	0	16.2	0.05	0	
16	M	11.5	15	27.5	27.5	11.5	12.5	0	0	0	0	0	105.5	0.30	0	
9	M	3	11	7	14	11	6	3	11	7	4	10	87	0.25	0	
10	M	3.25	1	1	4	70	1.5	0	0	0	0	0	80.75	0.23	4	
1	M	12	4.2	3	9	10.8	3.6	0	0	0	0	0	42.6	0.12	7	
6	L	45	24	14	0	0	0	0	0	0	0	0	83	0.24	5	
6	M	8.8	99	9	7	18	25	0	0	0	0	0	166.8	0.48	9	
6	H	16	50	6	6	14	12	0	0	0	0	0	104	0.30	15	
16	L	6	8	6.5	0	0	0	0	0	0	0	0	20.5	0.06	0	
6	M	16	6	4	19.5	27	20	20	0	0	0	0	112.5	0.32	9	
14	M	0.15	0	0	0	0	0	0	0	0	0	0	0.15	0.00	0	
1	M	12.6	22.5	5.4	54	48	32.5	0	0	0	0	0	175	0.50	15	
12	H	3	2	1	0	0	0	0	0	0	0	0	6	0.02	0	
6	M	40	7	40	3	15.6	15	0	0	0	0	0	120.6	0.34	9	
6	H	24	12	20	20	7	14	0	0	0	0	0	97	0.28	15	
16	H	12	10	20	9	10	90	0	0	0	0	0	151	0.43	3	
10	M	2	4.5	21	0	0	0	0	0	0	0	0	27.5	0.08	3	
1	M	15	21	9	1.2	0	0	0	0	0	0	0	46.2	0.13	7	
6	H	5	20	10.5	10	0	0	0	0	0	0	0	45.5	0.13	12	
16	M	7.5	62.5	36	0	0	0	0	0	0	0	0	106	0.30	0	
6	M	15	8	7	0	0	0	0	0	0	0	0	30	0.09	9	

ASPHALT PAVED ROADS CONDATON SURVEY DATA SHEET														SKETCH:		
LINK ID: 14E	SECTION ID:.....(14E/1).....						SAMPLE UNIT:.. (Km 51 -----Km 56).....									
LINK NAME: (MADANI- EL-GADARIF).....							SECTION NAME: ... (EL FAU -ELGEDARIF).....									
SURVEYED BY:.....			DATE:.....			SAMPLE AREA (M)35000.....				SHEET NO:...(8).....						
1-ALLIGATOR CRAKING		6- DEPRESSTION				11-PATCHING				16-SHOVING						
2-BLEEDING		7- EDGE CRACKING				12-POLISHEDE AGG.				17-SLIPPAGE CRACKING						
3-BLOCK CRACKING		8-JT-REFLECTION CR.				13-POTHOLE				18-SWELL						
4-BUMPS & SAGS		9-LANE SH. DROP				14-RAILROAD CROSSING				19-WEATHER&RAVELING						
5-CORRUGATION		10-LOG.-TR.CR				15-RUTTING										
DISTRESS	SEVERITY	QUANTITY												TOTAL	DENSITY%	DUDACT VALUE
6	M	25	7	15	5	27	12	0	0	0	0	0	91	0.3	9	
9	M	13	5	8	3	4	15	20	2	2	13	10	95	0.3	0	
9	L	5	4	5	3	13	5	4	3	13	2	3	60	0.2	0	
16	M	23	21	8	2.5	9	8.5	0	0	0	0	0	72	0.2	0	
1	H	14	9	39	0	0	0	0	0	0	0	0	62	0.2	17	
3	L	42	1.5	0	0	0	0	0	0	0	0	0	43.5	0.1	0	
3	M	1.5	14	0	0	0	0	0	0	0	0	0	15.5	0.0	0	
1	M	6	6	6	15	4.8	12	0	0	0	0	0	49.8	0.1	7	
16	M	22.5	15	15	12.5	15	17.5	0	0	0	0	0	97.5	0.3	0	
16	L	4.5	6	6.5	25	0	0	0	0	0	0	0	42	0.1	0	
6	M	6	7.5	28	11.9	3	9.1	0	0	0	0	0	65.5	0.2	9	
6	H	18	52	2.4	2	0	0	0	0	0	0	0	74.4	0.2	14	
9	L	1	15	3	0	0	0	0	0	0	0	0	19	0.1	0	
6	M	24	0	0	0	0	0	0	0	0	0	0	24	0.1	8	
16	M	15	38.5	45	11	27.5	47.5	0	0	0	0	0	184.5	0.5	1	
10	M	28	35	12	49	0	0	0	0	0	0	0	124	0.4	7	
6	M	10	7	3	3	0	0	0	0	0	0	0	23	0.1	9	
6	H	3	0	0	0	0	0	0	0	0	0	0	3	0.0	0	
1	M	10	13.2	49.8	10.2	21	39	0	0	0	0	0	143.2	0.4	14	
16	H	9	5	0	0	0	0	0	0	0	0	0	14	0.0	0	
14	M	35	0	0	0	0	0	0	0	0	0	0	35	0.1	4	
9	M	17	15	5	0	0	0	0	0	0	0	0	37	0.1	0	
9	H	10	0	0	0	0	0	0	0	0	0	0	10	0.0	0	
12	M	3	2	0	0	0	0	0	0	0	0	0	5	0.0	0	
16	M	20	22.5	25	10	15	0	0	0	0	0	0	92.5	0.3	0	
1	M	6	0	0	0	0	0	0	0	0	0	0	6	0.0	0	

ASPHALT PAVED ROADS CONDATION SURVEY DATA SHEET														SKETCH:		
LINK ID: 14E		SECTION ID:.....(14E/1).....						SAMPLE UNIT:... (Km 58 -----Km 63).....								
LINK NAME: .....( MADANI- EL-GADARIF).....								SECTION NAME: ...(EL FAU -ELGEDARIF).....								
SURVEYED BY:.....		DATE:.....				SAMPLE AREA (M)35000....				SHEET NO :...(9).....						
1-ALLIGATOR CRAKING		6- DEPRESSTION				11-PATCHING				16-SHOVING						
2-BLEEDING		7- EDGE CRACKING				12-POLISHEDE AGG.				17-SLIPPAGE CRACKING						
3-BLOCK CRACKING		8-JT-REFLECTION CR.				13-POTHOLE				18-SWELL						
4-BUMPS & SAGS		9-LANE SH. DROP				14-RAILROAD CROSSING				19-WEATHER&RAVELING						
5-CORRUGATION		10-LOG.-TR.CR				15-RUTTING										
DISTRESS		SEVERITY	QUANTITY											TOTAL	DENSITY%	DUDACT VALUE
1		H	25.5	0	0	0	0	0	0	0	0	0	25.5	0.1	12	
16		H	7	5	10	10	8.5	0	0	0	0	0	40.5	0.1	0	
9		M	15	5	0	0	0	0	0	0	0	0	20	0.1	0	
16		M	95	115	25	17.5	17	6.5	0	0	0	0	276	0.8	2	
2		M	8	0	0	0	0	0	0	0	0	0	8	0.0	0	
6		M	3	14	0	0	0	0	0	0	0	0	17	0.0	0	
16		M	10	38.5	13.5	12.5	8.5	25	0	0	0	0	108	0.3	0	
9		L	105	126	42	35	49	0	0	0	0	0	357	1.0	0	
6		M	2	4	3	28	5	5	0	0	0	0	47	0.1	9	
16		L	10	4.5	10	10	3.5	20	0	0	0	0	58	0.2	0	
14		L	3	0	0	0	0	0	0	0	0	0	3	0.0	0	
16		M	22.5	34	20	16.5	13.5	6	0	0	0	0	112.5	0.3	0	
16		L	3.5	10	17.5	20	15	0	0	0	0	0	66	0.2	0	
1		M	28	0	0	0	0	0	0	0	0	0	28	0.1	7	
16		M	3	50	45	17.5	40.5	20	0	0	0	0	176	0.5	2	
0		0	0	0	0	0	0	0	0	0	0	0	0	0.0	0	

ASPHALT PAVED ROADS CONDATION SURVEY DATA SHEET													SKETCH:			
LINK ID: 14E		SECTION ID:.....(14E/1).....					SAMPLE UNIT:.. (Km 65 -----Km 70).....									
LINK NAME: .....( MADANI- EL-GADARIF).....							SECTION NAME: ...(EL FAU -ELGEDARIF).....									
SURVEYED BY:.....		DATE:.....					SAMPLE AREA (M)35000.....				SHEET NO :...(10).....					
1-ALLIGATOR CRAKING		6- DEPRESSION				11-PATCHING				16-SHOVING						
2-BLEEDING		7- EDGE CRACKING				12-POLISHEDE AGG.				17-SLIPPAGE CRACKING						
3-BLOCK CRACKING		8-JT-REFLECTION CR.				13-POTHOLE				18-SWELL						
4-BUMPS & SAGS		9-LANE SH. DROP				14-RAILROAD CROSSING				19-WEATHER&RAVELING						
5-CORRUGATION		10-LOG.-TR.CR				15-RUTTING										
DISTRESS		SEVERITY	QUANTITY										TOTAL	DENSITY%	DUDACT VALUE	
3		M	2	0	0	0	0	0	0	0	0	0	2	0.0	0	
3		L	5	0	0	0	0	0	0	0	0	0	5	0.0	0	
16		M	55	22	7.5	45	50	25	0	0	0	0	204.5	0.6	1	
16		H	80	22	16	15.4	11	15	0	0	0	0	159.4	0.5	3	
16		L	6	5	7.5	7.5	3.5	0	0	0	0	0	29.5	0.1	0	
16		M	7.5	96	49	34	68	22.5	0	0	0	0	277	0.8	2	
9		L	3	25	4	0	0	0	0	0	0	0	32	0.1	0	
16		M	36	40	10	25	75	23	0	0	0	0	209	0.6	1	
9		M	3	12	35	5	7	35	5	0	0	0	102	0.3	0	
16		M	10	140	15	22	100	43.5	0	0	0	0	330.5	0.9	2	
16		M	10	91	6	63	0	0	0	0	0	0	170	0.5	1	
16		H	14.5	7.5	3.5	0	0	0	0	0	0	0	25.5	0.1	0	
16		M	50	22	16.5	65	25	100	0	0	0	0	278.5	0.8	2	
6		M	2.8	30	21	3	22	8	0	0	0	0	86.8	0.2	9	
1		M	18	30	6	21	18	0	0	0	0	0	93	0.3	12	
16		M	35	7.5	70	35	0	0	0	0	0	0	147.5	0.4	0	
6		M	90	0	0	0	0	0	0	0	0	0	90	0.3	9	
6		H	50	0	0	0	0	0	0	0	0	0	50	0.1	0	
0		0	0	0	0	0	0	0	0	0	0	0	0	0.0	0	

ASPHALT PAVED ROADS CONDATON SURVEY DATA SHEET													SKETCH:		
LINK ID: 14E	SECTION ID:.....(14E/1).....					SAMPLE UNIT:.. (Km 72 -----Km 77).....									
LINK NAME: (MADANI- EL-GADARIF).....						SECTION NAME: ... (EL FAU -ELGEDARIF).....									
SURVEYED BY:.....	DATE:.....					SAMPLE AREA (M)35000.....				SHEET NO.:...(11).....					
1-ALLIGATOR CRAKING	6- DEPRESSTION				11-PATCHING				16-SHOVING						
2-BLEEDING	7- EDGE CRACKING				12-POLISHEDE AGG.				17-SLIPPAGE CRACKING						
3-BLOCK CRACKING	8-JT-REFLECTION CR.				13-POTHOLE				18-SWELL						
4-BUMPS & SAGS	9-LANE SH. DROP				14-RAILROAD CROSSING				19-WEATHER&RAVELING						
5-CORRUGATION	10-LOG.-TR.CR				15-RUTTING										
DISTRESS	SEVERITY	QUANTITY											TOTAL	DENSITY%	DUDACT VALUE
9	M	8	8	8	25	8	0	0	0	0	0	0	57	0.2	0
16	M	15	14	10	22.5	5	7.5	0	0	0	0	0	74	0.2	0
16	L	11	4	0	0	0	0	0	0	0	0	0	15	0.0	0
16	M	21	10	9.5	7.5	115	24	0	0	0	0	0	187	0.5	1
16	H	9	30	5	0	0	0	0	0	0	0	0	44	0.1	0
6	M	9	10	0	0	0	0	0	0	0	0	0	19	0.1	0
16	M	50	65	60	75	90	100	0	0	0	0	0	440	1.3	3
1	M	15	0	0	0	0	0	0	0	0	0	0	15	0.04	0
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0

ASPHALT PAVED ROADS CONDATON SURVEY DATA SHEET													SKETCH:		
LINK ID: 14E	SECTION ID:.....(14E/1).....						SAMPLE UNIT:.. (Km 79 -----Km 84).....								
LINK NAME: (MADANI- EL-GADARIF).....						SECTION NAME: ... (EL FAU -ELGEDARIF).....									
SURVEYED BY:.....		DATE:.....				SAMPLE AREA (M)35000.....				SHEET NO.:...(12).....					
1-ALLIGATOR CRAKING	6- DEPRESSTION				11-PATCHING				16-SHOVING						
2-BLEEDING	7- EDGE CRACKING				12-POLISHEDE AGG.				17-SLIPPAGE CRACKING						
3-BLOCK CRACKING	8-JT-REFLECTION CR.				13-POTHOLE				18-SWELL						
4-BUMPS & SAGS	9-LANE SH. DROP				14-RAILROAD CROSSING				19-WEATHER&RAVELING						
5-CORRUGATION	10-LOG.-TR.CR				15-RUTTING										
DISTRESS	SEVERITY	QUANTITY											TOTAL	DENSITY%	DUDACT VALUE
16	M	15	20	11.5	7.5	18	4	0	0	0	0	0	76	0.22	0
3	L	3.5	0	0	0	0	0	0	0	0	0	0	3.5	0.01	0
9	L	11	4	4.5	3	6	10	6	10	6	10	9	79.5	0.23	0
9	M	21	20	0	0	0	0	0	0	0	0	0	41	0.12	0
16	M	10	13.5	16.5	9.5	9	10	0	0	0	0	0	68.5	0.20	0
16	M	4	7.5	15	35	40	20	0	0	0	0	0	121.5	0.35	0
16	L	8	0	0	0	0	0	0	0	0	0	0	8	0.02	0
10	M	10	2	1.2	0	0	0	0	0	0	0	0	13.2	0.04	0
1	H	9	0	0	0	0	0	0	0	0	0	0	9	0.03	0
1	M	12	6	9	0	0	0	0	0	0	0	0	27	0.08	7
6	M	3	0	0	0	0	0	0	0	0	0	0	3	0.01	0
3	M	4	0	0	0	0	0	0	0	0	0	0	4	0.01	0
16	H	2	0	0	0	0	0	0	0	0	0	0	2	0.01	0
16	M	20	35	15	0	0	0	0	0	0	0	0	70	0.20	0
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0

ASPHALT PAVED ROADS CONDATON SURVEY DATA SHEET														SKETCH:		
LINK ID: 14E	SECTION ID:.....(14E/1).....					SAMPLE UNIT:.. (Km 86 -----Km 91).....										
LINK NAME: .....( MADANI- EL-GADARIF).....						SECTION NAME: ..(EL FAU -ELGEDARIF).....										
SURVEYED BY:.....	DATE:.....					SAMPLE AREA (M)35000....				SHEET NO:..(13).....						
1-ALLIGATOR CRAKING 2-BLEEDING 3-BLOCK CRACKING 4-BUMPS & SAGS 5-CORRUGATION	6- DEPRESSTION 7- EDGE CRACKING 8-JT-REFLECTION CR. 9-LANE SH. DROP 10-LOG.-TR.CR					11-PATCHING 12-POLISHEDE AGG. 13-POTHOLE 14-RAILROAD CROSSING 15-RUTTING				16-SHOVING 17-SLIPPAGE CRACKING 18-SWELL 19-WEATHER&RAVELING						
DISTRESS	SEVERITY	QUANTITY												TOTAL	DENSITY%	DUDACT VALUE
1	M	4.8	3.6	2.4	3	6	10.2	0	0	0	0	0	30	0.09	7	
3	M	35	2	28	12	21	3	0	0	0	0	0	101	0.29	0	
9	M	3	5	1	5	3	4	9	15	5	11	20	81	0.23	0	
6	M	4	8	2.5	3	3	3	0	0	0	0	0	23.5	0.07	9	
3	M	1.5	6	49	7	6	35	0	0	0	0	0	104.5	0.30	0	
9	L	5	0	0	0	0	0	0	0	0	0	0	5	0.01	0	
14	M	4	4	2	14	3	2	0	0	0	0	0	29	0.08	5	
3	L	1.5	0.54	0	0	0	0	0	0	0	0	0	2.04	0.01	0	
1	H	10	8	32	56	18	1.8	0	0	0	0	0	125.8	0.36	20	
3	M	7.5	24	2	36	4	0	0	0	0	0	0	73.5	0.21	0	
16	M	10	5	0	0	0	0	0	0	0	0	0	15	0.04	0	
14	H	76	1	0	0	0	0	0	0	0	0	0	77	0.22	13	
16	L	6.5	0	0	0	0	0	0	0	0	0	0	6.5	0.02	0	
1	M	54	3	30	84	48	30	0	0	0	0	0	249	0.71	19	
6	H	8	12	12	0	0	0	0	0	0	0	0	32	0.09	12	
11	O	2	0	0	0	0	0	0	0	0	0	0	2	0.01	0	
12	H	1	2	3	0	0	0	0	0	0	0	0	6	0.02	0	
6	M	30	10	8	3	14	5	0	0	0	0	0	70	0.20	1	
10	M	12	12	12	6	6	8	0	0	0	0	0	56	0.16	3	
1	M	28	27	3	15	45	15	0	0	0	0	0	133	0.38	14	
1	H	10	7	0	0	0	0	0	0	0	0	0	17	0.05	12	
3	M	7.5	0	0	0	0	0	0	0	0	0	0	7.5	0.02	0	
10	L	2	1.36	1.5	0.28	0	0	0	0	0	0	0	5.14	0.01	0	
9	M	3	0	0	0	0	0	0	0	0	0	0	3	0.01	0	
10	M	3	1.8	0	0	0	0	0	0	0	0	0	4.8	0.01	0	
6	M	17.5	0	0	0	0	0	0	0	0	0	0	17.5	0.05	9	

ASPHALT PAVED ROADS CONDATON SURVEY DATA SHEET														SKETCH:		
LINK ID: 14E	SECTION ID:.....(14E/1).....					SAMPLE UNIT:.. (Km 93 -----Km 98).....										
LINK NAME: (MADANI- EL-GADARIF).....						SECTION NAME: ..(EL FAU -ELGEDARIF).....										
SURVEYED BY:.....		DATE:.....				SAMPLE AREA (M)35000....				SHEET NO.:...(14).....						
1-ALLIGATOR CRAKING		6- DEPRESSTION				11-PATCHING				16-SHOVING						
2-BLEEDING		7- EDGE CRACKING				12-POLISHEDE AGG.				17-SLIPPAGE CRACKING						
3-BLOCK CRACKING		8-JT-REFLECTION CR.				13-POTHOLE				18-SWELL						
4-BUMPS & SAGS		9-LANE SH. DROP				14-RAILROAD CROSSING				19-WEATHER&RAVELING						
5-CORRUGATION		10-LOG.-TR.CR				15-RUTTING										
DISTRESS	SEVERITY	QUANTITY												TOTAL	DENSITY%	DUDACT VALUE
14	H	10	1	0	0	0	0	0	0	0	0	0	0	11	0.03	0
16	M	12.5	5	37.5	25	12.5	0	0	0	0	0	0	0	92.5	0.26	0
10	M	20	10	10	6	3	12	0	0	0	0	0	0	61	0.17	4
6	M	16	1	10	14	2	24	0	0	0	0	0	0	67	0.19	9
14	M	30	2	0.5	24	0	0	0	0	0	0	0	0	56.5	0.16	8
11	O	6	17.5	0	0	0	0	0	0	0	0	0	0	23.5	0.07	0
12	H	2	1	0	0	0	0	0	0	0	0	0	0	3	0.01	0
3	M	2	21	0	0	0	0	0	0	0	0	0	0	23	0.07	0
6	M	3	10	14	3	8	0	0	0	0	0	0	0	38	0.11	9
10	M	4.5	8	0	0	0	0	0	0	0	0	0	0	12.5	0.04	0
6	M	15	5	15	35	14	16	0	0	0	0	0	0	100	0.29	9
16	M	8.5	9	17.5	10	9.5	19	0	0	0	0	0	0	73.5	0.21	0
6	L	10	0	0	0	0	0	0	0	0	0	0	0	10	0.03	0
16	H	13	0	0	0	0	0	0	0	0	0	0	0	13	0.04	0
16	M	42	4	18	25.5	25	10	0	0	0	0	0	0	124.5	0.36	0
3	M	6	0.3	9	35	4.5	6	0	0	0	0	0	0	60.8	0.17	0
1	M	10	0	0	0	0	0	0	0	0	0	0	0	10	0.03	0
16	M	15	10	7.5	6.5	7	7.5	0	0	0	0	0	0	53.5	0.15	0
3	M	1	5	0.64	15	1.5	2	0	0	0	0	0	0	25.14	0.07	0
0	O	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0

ASPHALT PAVED ROADS CONDATION SURVEY DATA SHEET														SKETCH:		
LINK ID: 14E		SECTION ID:.....(14E/1).....					SAMPLE UNIT:.. (Km 100 -----Km 105).....									
LINK NAME: .....( MADANI- EL-GADARIF).....							SECTION NAME: ...(EL FAU -ELGEDARIF).....									
SURVEYED BY:.....		DATE:.....					SAMPLE AREA (M)35000.....				SHEET NO :...(15).....					
1-ALLIGATOR CRAKING		6- DEPRESSTION				11-PATCHING				16-SHOVING						
2-BLEEDING		7- EDGE CRACKING				12-POLISHEDE AGG.				17-SLIPPAGE CRACKING						
3-BLOCK CRACKING		8-JT-REFLECTION CR.				13-POTHOLE				18-SWELL						
4-BUMPS & SAGS		9-LANE SH. DROP				14-RAILROAD CROSSING				19-WEATHER&RAVELING						
5-CORRUGATION		10-LOG.-TR.CR				15-RUTTING										
DISTRESS		SEVERITY	QUANTITY											TOTAL	DENSITY%	DUDACT VALUE
9		M	8	3	3	12	15	0	0	0	0	0	0	41	0.12	0
3		L	1	3.22	1	5	35	0	0	0	0	0	0	45.22	0.13	0
9		L	9	0	0	0	0	0	0	0	0	0	0	9	0.03	0
11		0	196	0	0	0	0	0	0	0	0	0	0	196	0.56	0
1		L	2.25	0	0	0	0	0	0	0	0	0	0	2.25	0.01	0
3		M	6	3	0	0	0	0	0	0	0	0	0	9	0.03	0
6		M	7.5	0	0	0	0	0	0	0	0	0	0	7.5	0.02	0
16		L	20	15	0	0	0	0	0	0	0	0	0	35	0.10	0
16		L	8.5	100	36	80	25	30	0	0	0	0	0	279.5	0.80	0
12		H	1	0	0	0	0	0	0	0	0	0	0	1	0.00	0
16		M	50	4	15	45	5	0	0	0	0	0	0	119	0.34	0
6		H	30	0	0	0	0	0	0	0	0	0	0	30	0.09	13
0		0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0

ASPHALT PAVED ROADS CONDATION SURVEY DATA SHEET														SKETCH:		
LINK ID: 14E		SECTION ID:.....(14E/1).....						SAMPLE UNIT:... (Km 107 -----Km 112).....								
LINK NAME: .....( MADANI- EL-GADARIF).....								SECTION NAME: ...(EL FAU -ELGEDARIF).....								
SURVEYED BY:.....		DATE:.....						SAMPLE AREA (M)35000....				SHEET NO.:...(16).....				
1-ALLIGATOR CRAKING		6- DEPRESSION				11-PATCHING				16-SHOVING						
2-BLEEDING		7- EDGE CRACKING				12-POLISHEDE AGG.				17-SLIPPAGE CRACKING						
3-BLOCK CRACKING		8-JT-REFLECTION CR.				13-POTHOLE				18-SWELL						
4-BUMPS & SAGS		9-LANE SH. DROP				14-RAILROAD CROSSING				19-WEATHER&RAVELING						
5-CORRUGATION		10-LOG.-TR.CR				15-RUTTING										
DISTRESS		SEVERITY	QUANTITY											TOTAL	DENSITY%	DUDACT VALUE
16		M	40	120	80	40	130	70	0	0	0	0	0	480	1.37	3
16		H	100	10	90	0	0	0	0	0	0	0	0	200	0.57	5
1		M	126	51	0	0	0	0	0	0	0	0	0	177	0.51	17
0		0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0

Data Collection for Link (ELGADARIF - KASSALA)

ASPHALT PAVED ROADS CONDATION SURVEY DATA SHEET													SKETCH:			
LINK ID: 03S1		SECTION ID:.....(03S1/2).....						SAMPLE UNIT:... (Km3 -----Km8).....								
LINK NAME: .....( GEDARIF-KASSALA).....						SECTION NAME: ...(EL GEDARIF-KHASM EL GIRBA)...										
SURVEYED BY:.....		DATE:.....				SAMPLE AREA (M)35000.....				SHEET NO.:...(1).....						
1-ALLIGATOR CRAKING		6- DEPRESSION				11-PATCHING				16-SHOVING						
2-BLEEDING		7- EDGE CRACKING				12-POLISHEDE AGG.				17-SLIPPAGE CRACKING						
3-BLOCK CRACKING		8-JT-REFLECTION CR.				13-POTHOLE				18-SWELL						
4-BUMPS & SAGS		9-LANE SH. DROP				14-RAILROAD CROSSING				19-WEATHER&RAVELING						
5-CORRUGATION		10-LOG.-TR.CR				15-RUTTING										
DISTRESS		SEVERITY	QUANTITY										TOTAL	DENSITY%	DUDACT VALUE	
14		M	91.5	167	133.4	2026.5	367.5	1610	0	0	0	0	0	4395.9	12.56	45
14		H	379.9	293	2206.5	3258.5	630	70	0	0	0	0	0	6837.9	19.54	70
10		M	8	0	0	0	0	0	0	0	0	0	0	8	0.02	0
9		M	167	0	0	0	0	0	0	0	0	0	0	167	0.48	0
13		H	28	0	0	0	0	0	0	0	0	0	0	28	0.08	0
6		M	71.5	0	0	0	0	0	0	0	0	0	0	71.5	0.20	8
12		H	20	0	0	0	0	0	0	0	0	0	0	20	0.06	20
0		0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0

ASPHALT PAVED ROADS CONDATION SURVEY DATA SHEET													SKETCH:				
LINK ID: 03S1		SECTION ID:.....(03S1/2).....						SAMPLE UNIT:... (Km 11-----Km 16).....									
LINK NAME: .....( GEDARIF-KASSALA).....							SECTION NAME: ...(EL GEDARIF-KHASM EL GIRBA)...										
SURVEYED BY:.....		DATE:.....						SAMPLE AREA (M)35000.....				SHEET NO :...(2).....					
1-ALLIGATOR CRAKING		6- DEPRESSTION				11-PATCHING				16-SHOVING							
2-BLEEDING		7- EDGE CRACKING				12-POLISHEDE AGG.				17-SLIPPAGE CRACKING							
3-BLOCK CRACKING		8-JT-REFLECTION CR.				13-POTHOLE				18-SWELL							
4-BUMPS & SAGS		9-LANE SH. DROP				14-RAILROAD CROSSING				19-WEATHER&RAVELING							
5-CORRUGATION		10-LOG.-TR.CR				15-RUTTING											
DISTRESS		SEVERITY	QUANTITY										TOTAL	DENSITY%	DUDACT VALUE		
14		M	89	56	102	0	0	0	0	0	0	0	247	0.7	16		
9		M	143	30	0	0	0	0	0	0	0	0	173	0.5	0		
12		M	29	0	0	0	0	0	0	0	0	0	29	0.1	5		
0		0	0	0	0	0	0	0	0	0	0	0	0	0.0	0		

ASPHALT PAVED ROADS CONDATON SURVEY DATA SHEET													SKETCH:			
LINK ID: 03S1	SECTION ID:.....(03S1/2).....						SAMPLE UNIT:.. (Km 19-----Km 24).....									
LINK NAME: .....( GEDARIF-KASSALA).....							SECTION NAME: ...(EL GEDARIF-KHASM EL GIRBA)...									
SURVEYED BY:.....	DATE:.....					SAMPLE AREA (M)35000.....				SHEET NO :...(3).....						
1-ALLIGATOR CRAKING	6- DEPRESSTION					11-PATCHING				16-SHOVING						
2-BLEEDING	7- EDGE CRACKING					12-POLISHEDE AGG.				17-SLIPPAGE CRACKING						
3-BLOCK CRACKING	8-JT-REFLECTION CR.					13-POTHOLE				18-SWELL						
4-BUMPS & SAGS	9-LANE SH. DROP					14-RAILROAD CROSSING				19-WEATHER&RAVELING						
5-CORRUGATION	10-LOG.-TR.CR					15-RUTTING										
DISTRESS	SEVERITY	QUANTITY											TOTAL	DENSITY%	DUDACT VALUE	
1	M	45	98	0	0	0	0	0	0	0	0	0	143	0.4	10	
14	M	183	80.5	86.5	50.5	0	0	0	0	0	0	0	400.5	1.1	13	
14	H	148.5	209.5	224.5	113	226.6	193	0	0	0	0	0	1115.1	3.2	41	
9	M	924	350	735	0	0	0	0	0	0	0	0	2009	5.7	49	
6	M	193.5	37	137	47	86.5	0	0	0	0	0	0	501	1.4	9	
6	H	87.4	0	0	0	0	0	0	0	0	0	0	87.4	0.2	13	
10	H	12	0	0	0	0	0	0	0	0	0	0	12	0.0	0	
9	H	50	0	0	0	0	0	0	0	0	0	0	50	0.1	3	
1	H	27	129.2	0	0	0	0	0	0	0	0	0	156.2	0.4	20	
12	H	12	0	0	0	0	0	0	0	0	0	0	12	0.0	0	
12	M	9	0	0	0	0	0	0	0	0	0	0	9	0.0	0	
16	M	14	0	0	0	0	0	0	0	0	0	0	14	0.0	0	
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.0	0	

ASPHALT PAVED ROADS CONDATON SURVEY DATA SHEET														SKETCH:		
LINK ID: 03S1	SECTION ID:.....(03S1/2).....					SAMPLE UNIT:.. (Km 27-----Km 32).....										
LINK NAME: .....( GEDARIF-KASSALA).....						SECTION NAME: ..(EL GEDARIF-KHASM EL GIRBA)...										
SURVEYED BY:.....		DATE:.....				SAMPLE AREA (M)35000.....				SHEET NO :...(4).....						
1-ALLIGATOR CRAKING		6- DEPRESSTION				11-PATCHING				16-SHOVING						
2-BLEEDING		7- EDGE CRACKING				12-POLISHEDE AGG.				17-SLIPPAGE CRACKING						
3-BLOCK CRACKING		8-JT-REFLECTION CR.				13-POTHOLE				18-SWELL						
4-BUMPS & SAGS		9-LANE SH. DROP				14-RAILROAD CROSSING				19-WEATHER&RAVELING						
5-CORRUGATION		10-LOG.-TR.CR				15-RUTTING										
DISTRESS	SEVERITY	QUANTITY												TOTAL	DENSITY%	DUDAC VALUE
9	M	307	381	415	410	0	0	0	0	0	0	0	0	1513	4.3	8
6	M	172.25	47.5	0	0	0	0	0	0	0	0	0	0	219.75	0.6	8
9	L	30	0	0	0	0	0	0	0	0	0	0	0	30	0.1	0
14	M	158.5	86.25	0	0	0	0	0	0	0	0	0	0	244.75	0.7	17
6	L	9.5	0	0	0	0	0	0	0	0	0	0	0	9.5	0.0	0
14	H	4.6	59.5	0	0	0	0	0	0	0	0	0	0	64.1	0.2	8
12	M	20	0	0	0	0	0	0	0	0	0	0	0	20	0.1	5
3	H	1	0	0	0	0	0	0	0	0	0	0	0	1	0.0	0
6	H	209.5	0	0	0	0	0	0	0	0	0	0	0	209.5	0.6	15
9	H	60	0	0	0	0	0	0	0	0	0	0	0	60	0.2	3
12	H	1	0	0	0	0	0	0	0	0	0	0	0	1	0.0	0
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.0	0

ASPHALT PAVED ROADS CONDATON SURVEY DATA SHEET													SKETCH:			
LINK ID: 03S1		SECTION ID:.....(03S1/2).....					SAMPLE UNIT:.. (Km 35-----Km 40).....									
LINK NAME: .....( GEDARIF-KASSALA).....							SECTION NAME: ... (EL GEDARIF-KHASM EL GIRBA)...									
SURVEYED BY:.....		DATE:.....					SAMPLE AREA (M)35000.....			SHEET NO :... (5).....						
1-ALLIGATOR CRAKING		6- DEPRESSTION					11-PATCHING			16-SHOVING						
2-BLEEDING		7- EDGE CRACKING					12-POLISHEDE AGG.			17-SLIPPAGE CRACKING						
3-BLOCK CRACKING		8-JT-REFLECTION CR.					13-POTHOLE			18-SWELL						
4-BUMPS & SAGS		9-LANE SH. DROP					14-RAILROAD CROSSING			19-WEATHER&RAVELING						
5-CORRUGATION		10-LOG.-TR.CR					15-RUTTING									
DISTRESS		SEVERITY	QUANTITY											TOTAL	DENSITY%	DUDACT VALUE
9		H	10	2	0	0	0	0	0	0	0	0	12	0.0	0	
12		H	5	0	0	0	0	0	0	0	0	0	5	0.0	0	
14		M	56	0	0	0	0	0	0	0	0	0	56	0.2	6	
16		M	60.5	0	0	0	0	0	0	0	0	0	60.5	0.2	4	
16		L	38.5	0	0	0	0	0	0	0	0	0	38.5	0.1	0	
12		M	28	0	0	0	0	0	0	0	0	0	28	0.1	5	
14		H	89.5	0	0	0	0	0	0	0	0	0	89.5	0.3	12	
9		L	65	0	0	0	0	0	0	0	0	0	65	0.2	0	
3		L	21	0	0	0	0	0	0	0	0	0	21	0.1	0	
9		M	692	0	0	0	0	0	0	0	0	0	692	2.0	5	
6		M	162.5	0	0	0	0	0	0	0	0	0	162.5	0.5	8	
0		0	0	0	0	0	0	0	0	0	0	0	0	0.0	0	

ASPHALT PAVED ROADS CONDATON SURVEY DATA SHEET													SKETCH:			
LINK ID: 03S1		SECTION ID:.....(03S1/2).....					SAMPLE UNIT:.. (Km 43 -----Km 48).....									
LINK NAME: .....( GEDARIF-KASSALA).....							SECTION NAME: ...(EL GEDARIF-KHASM EL GIRBA)...									
SURVEYED BY:.....		DATE:.....					SAMPLE AREA (M)35000.....			SHEET NO.:...(6).....						
1-ALLIGATOR CRAKING		6- DEPRESSTION				11-PATCHING				16-SHOVING						
2-BLEEDING		7- EDGE CRACKING				12-POLISHEDE AGG.				17-SLIPPAGE CRACKING						
3-BLOCK CRACKING		8-JT-REFLECTION CR.				13-POTHOLE				18-SWELL						
4-BUMPS & SAGS		9-LANE SH. DROP				14-RAILROAD CROSSING				19-WEATHER&RAVELING						
5-CORRUGATION		10-LOG.-TR.CR				15-RUTTING										
DISTRESS		SEVERITY	QUANTITY											TOTAL	DENSITY%	DUDACT VALUE
14		M	246.5	62.5	357.5	152	0	0	0	0	0	0	0	818.5	2.3	25
12		M	21	0	0	0	0	0	0	0	0	0	0	21	0.1	5
9		M	590	352	476	0	0	0	0	0	0	0	0	1418	4.1	10
11		0	175	0	0	0	0	0	0	0	0	0	0	175	0.5	0
9		L	6	0	0	0	0	0	0	0	0	0	0	6	0.0	0
9		H	221	0	0	0	0	0	0	0	0	0	0	221	0.6	4
14		H	183.5	0	0	0	0	0	0	0	0	0	0	183.5	0.5	20
16		M	21	0	0	0	0	0	0	0	0	0	0	21	0.1	8
8		H	7	0	0	0	0	0	0	0	0	0	0	7	0.0	0
0		0	0	0	0	0	0	0	0	0	0	0	0	0	0.0	0

ASPHALT PAVED ROADS CONDATION SURVEY DATA SHEET													SKETCH:		
LINK ID: 03S1	SECTION ID:.....(03S1/2).....					SAMPLE UNIT:.. (Km 51 -----Km 56).....									
LINK NAME: .....( GEDARIF-KASSALA).....						SECTION NAME: ..(EL GEDARIF-KHASM EL GIRBA)...									
SURVEYED BY:.....	DATE:.....					SAMPLE AREA (M)35000.....				SHEET NO:....(7).....					
1-ALLIGATOR CRAKING	6- DEPRESSTION				11-PATCHING				16-SHOVING						
2-BLEEDING	7- EDGE CRACKING				12-POLISHEDE AGG.				17-SLIPPAGE CRACKING						
3-BLOCK CRACKING	8-JT-REFLECTION CR.				13-POTHOLE				18-SWELL						
4-BUMPS & SAGS	9-LANE SH. DROP				14-RAILROAD CROSSING				19-WEATHER&RAVELING						
5-CORRUGATION	10-LOG.-TR.CR				15-RUTTING										
DISTRESS	SEVERITY	QUANTITY											TOTAL	DENSITY%	DUDACT VALUE
16	M	220	140	121	428	0	0	0	0	0	0	0	909	2.60	15
9	M	322	185	0	0	0	0	0	0	0	0	0	507	1.45	1
12	M	58	0	0	0	0	0	0	0	0	0	0	58	0.17	5
16	H	160	42.5	408.5	139	0	0	0	0	0	0	0	750	2.14	25
12	H	7	20	0	0	0	0	0	0	0	0	0	27	0.08	20
9	H	182	67	0	0	0	0	0	0	0	0	0	249	0.71	6
14	M	495	305	244	0	0	0	0	0	0	0	0	1044	2.98	29
16	L	14.5	0	0	0	0	0	0	0	0	0	0	14.5	0.04	0
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0

ASPHALT PAVED ROADS CONDATION SURVEY DATA SHEET													SKETCH:		
LINK ID: 03S1		SECTION ID:.....(03S1/2).....						SAMPLE UNIT:... (Km 59 -----Km 64).....							
LINK NAME: .....( GEDARIF-KASSALA).....						SECTION NAME: ...(EL GEDARIF-KHASM EL GIRBA)...									
SURVEYED BY:.....		DATE:.....				SAMPLE AREA (M)35000.....			SHEET NO:....(8).....						
1-ALLIGATOR CRAKING	6- DEPRESSTION	11-PATCHING				16-SHOVING									
2-BLEEDING	7- EDGE CRACKING	12-POLISHEDE AGG.				17-SLIPPAGE CRACKING									
3-BLOCK CRACKING	8-JT-REFLECTION CR.	13-POTHOLE				18-SWELL									
4-BUMPS & SAGS	9-LANE SH. DROP	14-RAILROAD CROSSING				19-WEATHER&RAVELING									
5-CORRUGATION	10-LOG.-TR.CR	15-RUTTING													
DISTRESS	SEVERITY	QUANTITY											TOTAL	DENSITY%	DUDACT VALUE
12	L	9	0	0	0	0	0	0	0	0	0	0	9	0.03	0
9	L	85	77	30.5	0	0	0	0	0	0	0	0	192.5	0.55	0
11	0	181	877	0	0	0	0	0	0	0	0	0	1058	3.02	1
12	H	9	0	0	0	0	0	0	0	0	0	0	9	0.03	0
9	M	154	0	0	0	0	0	0	0	0	0	0	154	0.44	0
14	M	379	0	0	0	0	0	0	0	0	0	0	379	1.08	20
18	M	4.2	0	0	0	0	0	0	0	0	0	0	4.2	0.01	0
9	H	78	0	0	0	0	0	0	0	0	0	0	78	0.22	3
14	H	37.5	0	0	0	0	0	0	0	0	0	0	37.5	0.11	7
16	M	198	0	0	0	0	0	0	0	0	0	0	198	0.57	5
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0

ASPHALT PAVED ROADS CONDATON SURVEY DATA SHEET													SKETCH:		
LINK ID: 03S1	SECTION ID:.....(03S1/2).....						SAMPLE UNIT:.. (Km 67 -----Km 72).....								
LINK NAME: .....( GEDARIF-KASSALA).....						SECTION NAME: ...(EL GEDARIF-KHASM EL GIRBA)...									
SURVEYED BY:.....	DATE:.....					SAMPLE AREA (M)35000.....				SHEET NO:....(9).....					
1-ALLIGATOR CRAKING	6- DEPRESSTION				11-PATCHING				16-SHOVING						
2-BLEEDING	7- EDGE CRACKING				12-POLISHEDE AGG.				17-SLIPPAGE CRACKING						
3-BLOCK CRACKING	8-JT-REFLECTION CR.				13-POTHOLE				18-SWELL						
4-BUMPS & SAGS	9-LANE SH. DROP				14-RAILROAD CROSSING				19-WEATHER&RAVELING						
5-CORRUGATION	10-LOG.-TR.CR				15-RUTTING										
DISTRESS	SEVERITY	QUANTITY											TOTAL	DENSITY%	DUDACT VALUE
12	H	14	0	0	0	0	0	0	0	0	0	0	14	0.04	0
9	M	57	35	0	0	0	0	0	0	0	0	0	92	0.26	0
14	M	170.5	0	0	0	0	0	0	0	0	0	0	170.5	0.49	10
9	L	67.5	0	0	0	0	0	0	0	0	0	0	67.5	0.19	0
12	L	2	0	0	0	0	0	0	0	0	0	0	2	0.01	0
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0

ASPHALT PAVED ROADS CONDATON SURVEY DATA SHEET													SKETCH:			
LINK ID: 03S1	SECTION ID:.....(03S1/2).....						SAMPLE UNIT:.. (Km 75 -----Km 80).....									
LINK NAME: .....( GEDARIF-KASSALA).....						SECTION NAME: ...(EL GEDARIF-KHASM EL GIRBA)...										
SURVEYED BY:.....		DATE:.....				SAMPLE AREA (M)35000.....				SHEET NO:...(10).....						
1-ALLIGATOR CRAKING	6- DEPRESSTION				11-PATCHING				16-SHOVING							
2-BLEEDING	7- EDGE CRACKING				12-POLISHEDE AGG.				17-SLIPPAGE CRACKING							
3-BLOCK CRACKING	8-JT-REFLECTION CR.				13-POTHOLE				18-SWELL							
4-BUMPS & SAGS	9-LANE SH. DROP				14-RAILROAD CROSSING				19-WEATHER&RAVELING							
5-CORRUGATION	10-LOG.-TR.CR				15-RUTTING											
DISTRESS	SEVERITY	QUANTITY											TOTAL	DENSITY%	DUDACT VALUE	
12	L	22	0	0	0	0	0	0	0	0	0	0	22	0.06	2	
12	H	36	2	0	0	0	0	0	0	0	0	0	38	0.11	20	
10	M	6	6.9	0	0	0	0	0	0	0	0	0	12.9	0.04	0	
3	M	52.5	637	0	0	0	0	0	0	0	0	0	689.5	1.97	6	
16	H	330	110	0	0	0	0	0	0	0	0	0	440	1.26	20	
16	M	55	60	0	0	0	0	0	0	0	0	0	115	0.33	4	
2	M	35	0	0	0	0	0	0	0	0	0	0	35	0.10	1	
1	M	9	0	0	0	0	0	0	0	0	0	0	9	0.03	0	
9	M	61.5	112.5	26	0	0	0	0	0	0	0	0	200	0.57	0	
11	0	140	0	0	0	0	0	0	0	0	0	0	140	0.40	0	
14	L	77	0	0	0	0	0	0	0	0	0	0	77	0.22	2	
14	M	276.5	0	0	0	0	0	0	0	0	0	0	276.5	0.79	17	
16	L	28	0	0	0	0	0	0	0	0	0	0	28	0.08	0	
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0	

ASPHALT PAVED ROADS CONDATON SURVEY DATA SHEET													SKETCH:		
LINK ID: 03S1	SECTION ID:.....(03S1/2).....				SAMPLE UNIT:.. (Km 83 -----Km 88).....										
LINK NAME: .....( GEDARIF-KASSALA).....					SECTION NAME: ... (EL GEDARIF-KHASM EL GIRBA)...										
SURVEYED BY:.....	DATE:.....				SAMPLE AREA (M)35000.....				SHEET NO.:...(11).....						
1-ALLIGATOR CRAKING	6- DEPRESSION				11-PATCHING				16-SHOVING						
2-BLEEDING	7- EDGE CRACKING				12-POLISHEDE AGG.				17-SLIPPAGE CRACKING						
3-BLOCK CRACKING	8-JT-REFLECTION CR.				13-POTHOLE				18-SWELL						
4-BUMPS & SAGS	9-LANE SH. DROP				14-RAILROAD CROSSING				19-WEATHER&RAVELING						
5-CORRUGATION	10-LOG.-TR.CR				15-RUTTING										
DISTRESS	SEVERITY	QUANTITY											TOTAL	DENSITY%	DUDACT VALUE
16	L	97.5	0	0	0	0	0	0	0	0	0	0	97.5	0.28	0
9	M	174.5	153	134	3.5	0	0	0	0	0	0	0	465	1.33	1
11	0	157.5	0	0	0	0	0	0	0	0	0	0	157.5	0.45	0
16	M	101.5	0	0	0	0	0	0	0	0	0	0	101.5	0.29	4
1	M	185.4	12	0	0	0	0	0	0	0	0	0	197.4	0.56	17
12	H	28	0	0	0	0	0	0	0	0	0	0	28	0.08	20
14	M	329	0	0	0	0	0	0	0	0	0	0	329	0.94	19
3	M	510.5	161	0	0	0	0	0	0	0	0	0	671.5	1.92	5
10	M	10.65	0	0	0	0	0	0	0	0	0	0	10.65	0.03	0
1	H	60	0	0	0	0	0	0	0	0	0	0	60	0.17	12
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0

ASPHALT PAVED ROADS CONDATON SURVEY DATA SHEET													SKETCH:		
LINK ID: 03S1		SECTION ID:.....(03S1/2).....					SAMPLE UNIT:... (Km 91 -----Km 96).....								
LINK NAME: .....( GEDARIF-KASSALA).....							SECTION NAME: ... (EL GEDARIF-KHASM EL GIRBA)...								
SURVEYED BY:.....		DATE:.....					SAMPLE AREA (M)35000.....				SHEET NO:....(12).....				
1-ALLIGATOR CRAKING		6- DEPRESSTION					11-PATCHING				16-SHOVING				
2-BLEEDING		7- EDGE CRACKING					12-POLISHEDE AGG.				17-SLIPPAGE CRACKING				
3-BLOCK CRACKING		8-JT-REFLECTION CR.					13-POTHOLE				18-SWELL				
4-BUMPS & SAGS		9-LANE SH. DROP					14-RAILROAD CROSSING				19-WEATHER&RAVELING				
5-CORRUGATION		10-LOG.-TR.CR					15-RUTTING								
DISTRESS		SEVERITY	QUANTITY										TOTAL	DENSITY%	DUDACT VALUE
16		M	137.5	214.5	115	80	170	230	0	0	0	0	947	2.71	15
14		M	455	0	0	0	0	0	0	0	0	0	455	1.30	20
12		H	25	0	0	0	0	0	0	0	0	0	25	0.07	20
9		M	129.5	115	95	175	0	0	0	0	0	0	514.5	1.47	1
14		L	1172.5	0	0	0	0	0	0	0	0	0	1172.5	3.35	18
2		M	0.75	0	0	0	0	0	0	0	0	0	0.75	0.00	0
16		H	83.5	0	0	0	0	0	0	0	0	0	83.5	0.24	19
1		M	51	0	0	0	0	0	0	0	0	0	51	0.15	8
0		0	0	0	0	0	0	0	0	0	0	0	0	0.00	0

ASPHALT PAVED ROADS CONDATON SURVEY DATA SHEET													SKETCH:		
LINK ID: 03S1	SECTION ID:.....(03S1/2).....					SAMPLE UNIT:.. (Km 99 -----Km 104).....									
LINK NAME: .....( GEDARIF-KASSALA).....						SECTION NAME: ...(EL GEDARIF-KHASM EL GIRBA)...									
SURVEYED BY:.....	DATE:.....					SAMPLE AREA (M)35000.....				SHEET NO:....(13).....					
1-ALLIGATOR CRAKING	6- DEPRESSTION					11-PATCHING				16-SHOVING					
2-BLEEDING	7- EDGE CRACKING					12-POLISHEDE AGG.				17-SLIPPAGE CRACKING					
3-BLOCK CRACKING	8-JT-REFLECTION CR.					13-POTHOLE				18-SWELL					
4-BUMPS & SAGS	9-LANE SH. DROP					14-RAILROAD CROSSING				19-WEATHER&RAVELING					
5-CORRUGATION	10-LOG.-TR.CR					15-RUTTING									
DISTRESS	SEVERITY	QUANTITY											TOTAL	DENSITY%	DUDACT VALUE
14	M	2751	1190	0	0	0	0	0	0	0	0	0	3941	11.26	46
3	M	3297	1190	1015	105	0	0	0	0	0	0	0	5607	16.02	20
1	M	358	81	45	0	0	0	0	0	0	0	0	484	1.38	21
12	H	30	8	0	0	0	0	0	0	0	0	0	38	0.11	20
3	H	2702	1365	2639	1627.5	910	0	0	0	0	0	0	9243.5	26.41	46
1	H	184.8	511.2	222	87	0	0	0	0	0	0	0	1005	2.87	40
14	H	1512	574	0	0	0	0	0	0	0	0	0	2086	5.96	51
10	M	44.95	16.71	28.2	6.3	0	0	0	0	0	0	0	96.16	0.27	10
2	M	356	0	0	0	0	0	0	0	0	0	0	356	1.02	3
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0

ASPHALT PAVED ROADS CONDATON SURVEY DATA SHEET													SKETCH:		
LINK ID: 03S1	SECTION ID:.....(03S1/2).....					SAMPLE UNIT:.. (Km 107 -----Km 112).....									
LINK NAME: .....( GEDARIF-KASSALA).....						SECTION NAME: ...(EL GEDARIF-KHASM EL GIRBA)...									
SURVEYED BY:.....	DATE:.....					SAMPLE AREA (M)35000.....				SHEET NO.:...(14).....					
1-ALLIGATOR CRAKING	6- DEPRESSTION				11-PATCHING				16-SHOVING						
2-BLEEDING	7- EDGE CRACKING				12-POLISHEDE AGG.				17-SLIPPAGE CRACKING						
3-BLOCK CRACKING	8-JT-REFLECTION CR.				13-POTHOLE				18-SWELL						
4-BUMPS & SAGS	9-LANE SH. DROP				14-RAILROAD CROSSING				19-WEATHER&RAVELING						
5-CORRUGATION	10-LOG.-TR.CR				15-RUTTING										
DISTRESS	SEVERITY	QUANTITY											TOTAL	DENSITY%	DUDACT VALUE
9	M	50.5	0	0	0	0	0	0	0	0	0	0	50.5	0.14	0
1	M	298.8	124.8	192	139.8	0	0	0	0	0	0	0	755.4	2.16	28
3	M	1015	213.5	1274	1176	0	0	0	0	0	0	0	3678.5	10.51	18
12	H	4	31	3	0	0	0	0	0	0	0	0	38	0.11	20
1	H	144	134	64	0	0	0	0	0	0	0	0	342	0.98	30
10	M	36	38.7	36.45	48.1	28.45	8	0	0	0	0	0	195.7	0.56	20
14	M	105	1568	0	0	0	0	0	0	0	0	0	1673	4.78	31
3	H	490	175	0	0	0	0	0	0	0	0	0	665	1.90	11
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0

ASPHALT PAVED ROADS CONDATON SURVEY DATA SHEET													SKETCH:			
LINK ID: 03S1		SECTION ID:.....(03S1/2).....					SAMPLE UNIT:.. (Km 115 -----Km 120).....									
LINK NAME: .....( GEDARIF-KASSALA).....							SECTION NAME: ...(EL GEDARIF-KHASM EL GIRBA)...									
SURVEYED BY:.....		DATE:.....					SAMPLE AREA (M)35000.....				SHEET NO.:...(15).....					
1-ALLIGATOR CRAKING		6- DEPRESSTION				11-PATCHING				16-SHOVING						
2-BLEEDING		7- EDGE CRACKING				12-POLISHEDE AGG.				17-SLIPPAGE CRACKING						
3-BLOCK CRACKING		8-JT-REFLECTION CR.				13-POTHOLE				18-SWELL						
4-BUMPS & SAGS		9-LANE SH. DROP				14-RAILROAD CROSSING				19-WEATHER&RAVELING						
5-CORRUGATION		10-LOG.-TR.CR				15-RUTTING										
DISTRESS		SEVERITY	QUANTITY											TOTAL	DENSITY%	DUDACT VALUE
3		M	780.5	877.5	514.5	1575	791	0	0	0	0	0	4538.5	12.97	18	
1		M	102.6	138	272.4	7.2	269.6	0	0	0	0	0	789.8	2.26	28	
3		H	721	1743	714	553	0	0	0	0	0	0	3731	10.66	30	
1		H	25.8	201.8	240.4	0	0	0	0	0	0	0	468	1.34	30	
12		H	18	35	6	0	0	0	0	0	0	0	59	0.17	20	
9		M	109	7	0	0	0	0	0	0	0	0	116	0.33	0	
10		M	1.32	2	33	0	0	0	0	0	0	0	36.32	0.10	5	
14		M	1330	0	0	0	0	0	0	0	0	0	1330	3.80	28	
14		H	1820	0	0	0	0	0	0	0	0	0	1820	5.20	50	
0		0	0	0	0	0	0	0	0	0	0	0	0	0.00	0	

ASPHALT PAVED ROADS CONDATON SURVEY DATA SHEET													SKETCH:			
LINK ID: 03S1	SECTION ID:.....(03S1/2).....					SAMPLE UNIT:.. (Km 123 -----Km 128).....										
LINK NAME: .....( GEDARIF-KASSALA).....						SECTION NAME: ...(EL GEDARIF-KHASM EL GIRBA)...										
SURVEYED BY:.....		DATE:.....					SAMPLE AREA (M)35000.....				SHEET NO :...(16).....					
1-ALLIGATOR CRAKING		6- DEPRESSTION				11-PATCHING				16-SHOVING						
2-BLEEDING		7- EDGE CRACKING				12-POLISHEDE AGG.				17-SLIPPAGE CRACKING						
3-BLOCK CRACKING		8-JT-REFLECTION CR.				13-POTHOLE				18-SWELL						
4-BUMPS & SAGS		9-LANE SH. DROP				14-RAILROAD CROSSING				19-WEATHER&RAVELING						
5-CORRUGATION		10-LOG.-TR.CR				15-RUTTING										
DISTRESS	SEVERITY	QUANTITY											TOTAL	DENSITY%	DUDACT VALUE	
1	M	260.2	102	114.6	264	132	51.6	144	88.8	135	156	187.2	1635.4	4.67	38	
3	M	1316	1187.5	500.5	1225	875	1211	896	977	881	164.5	0	9233	26.38	27	
11	0	27	0	0	0	0	0	0	0	0	0	0	27	0.08	0	
1	H	77	203.6	298.9	82.8	99.8	13.8	93	0	0	0	0	868.9	2.48	40	
12	H	12	14	4	2	8	0	0	0	0	0	0	40	0.11	20	
9	M	21	59.5	134	3	0	0	0	0	0	0	0	217.5	0.62	1	
10	L	1.2	0	0	0	0	0	0	0	0	0	0	1.2	0.00	0	
10	M	8.8	40.75	25.55	7.1	26.2	47.44	10.5	4.4	0	0	0	170.74	0.49	20	
9	H	39	0	0	0	0	0	0	0	0	0	0	39	0.11	3	
6	M	100	0	0	0	0	0	0	0	0	0	0	100	0.29	8	
3	H	339.5	1676.5	700	0	0	0	0	0	0	0	0	2716	7.76	27	
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0	

ASPHALT PAVED ROADS CONDATION SURVEY DATA SHEET													SKETCH:			
LINK ID: 03S1		SECTION ID:.....(03S1/1).....						SAMPLE UNIT:.. (Km 4 -----Km 9).....								
LINK NAME: .....(GEDARIF-KASSALA).....						SECTION NAME:...(KHASHM EL GIRBA- KASSALA)										
SURVEYED BY:.....		DATE:.....				SAMPLE AREA (M)35000.....				SHEET NO :....(1).....						
1-ALLIGATOR CRAKING		6- DEPRESSTION				11-PATCHING				16-SHOVING						
2-BLEEDING		7- EDGE CRACKING				12-POLISHEDE AGG.				17-SLIPPAGE CRACKING						
3-BLOCK CRACKING		8-JT-REFLECTION CR.				13-POTHOLE				18-SWELL						
4-BUMPS & SAGS		9-LANE SH. DROP				14-RAILROAD CROSSING				19-WEATHER&RAVELING						
5-CORRUGATION		10-LOG.-TR.CR				15-RUTTING										
DISTRESS		SEVERITY	QUANTITY										TOTAL	DENSITY%	DUDACT VALUE	
1		H	224	35	245	87.5	13.5	150.4	16	82.8	21	20	895.2	1790.4	5.12	43
3		M	1438.5	84	147	42	119	350	140	833	644	0	3797.5	7595	21.70	21
9		M	106.5	78.5	69.5	61	110	0	0	0	0	0	425.5	851	2.43	2
12		H	20	35	10.5	0	0	0	0	0	0	0	65.5	131	0.37	27
9		H	25.5	48	76	0	0	0	0	0	0	0	149.5	299	0.85	3
1		M	36	24	43	7.2	10	25	25.2	10	23	0	203.413	406.825	1.16	18
10		M	10.5	10.52	0.35	22.225	10.1	11.88	9.05	5.29	13.42	0	93.335	186.67	0.53	13
3		H	245	420	175	412.5	0	0	0	0	0	0	1252.5	2505	7.16	15
9		L	2	0	0	0	0	0	0	0	0	0	2	4	0.01	0
0		0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0

ASPHALT PAVED ROADS CONDATION SURVEY DATA SHEET													SKETCH:			
LINK ID: 03S1		SECTION ID:.....(03S1/1).....					SAMPLE UNIT:.. (Km 11 -----Km 16).....									
LINK NAME: .....(GEDARIF-KASSALA).....							SECTION NAME: ...(KHASHM EL GIRBA- KASSALA)									
SURVEYED BY:.....		DATE:.....					SAMPLE AREA (M)35000.....				SHEET NO :...(2).....					
1-ALLIGATOR CRAKING		6- DEPRESSTION					11-PATCHING				16-SHOVING					
2-BLEEDING		7- EDGE CRACKING					12-POLISHEDE AGG.				17-SLIPPAGE CRACKING					
3-BLOCK CRACKING		8-JT-REFLECTION CR.					13-POTHOLE				18-SWELL					
4-BUMPS & SAGS		9-LANE SH. DROP					14-RAILROAD CROSSING				19-WEATHER&RAVELING					
5-CORRUGATION		10-LOG.-TR.CR					15-RUTTING									
DISTRESS		SEVERITY	QUANTITY											TOTAL	DENSITY%	DUDACT VALUE
3		H	1575	2317	1673	427	1190	1463	2562	1316	3885	3276	0	19684	56.24	60
10		M	11.88	24.3	15.41	7	7.7	19.8	17.64	24	18.39	33.5	0	179.62	0.51	21
12		H	13	22	48	3	23	0	0	0	0	0	0	109	0.31	30
9		H	34	42	21	0	0	0	0	0	0	0	0	97	0.28	3
1		H	41.8	0	0	0	0	0	0	0	0	0	0	41.8	0.12	12
9		M	22.5	0	0	0	0	0	0	0	0	0	0	22.5	0.06	0
6		M	60	0	0	0	0	0	0	0	0	0	0	60	0.17	8
0		0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0

ASPHALT PAVED ROADS CONDATION SURVEY DATA SHEET													SKETCH:		
LINK ID: 03S1	SECTION ID:.....(03S1/1).....					SAMPLE UNIT:... (Km 18-----Km 23).....									
LINK NAME: .....(GEDARIF-KASSALA).....						SECTION NAME: ...(KHASHM EL GIRBA- KASSALA)									
SURVEYED BY:.....	DATE:.....					SAMPLE AREA (M)35000.....				SHEET NO:....(3).....					
1-ALLIGATOR CRAKING	6- DEPRESSTION				11-PATCHING				16-SHOVING						
2-BLEEDING	7- EDGE CRACKING				12-POLISHEDE AGG.				17-SLIPPAGE CRACKING						
3-BLOCK CRACKING	8-JT-REFLECTION CR.				13-POTHOLE				18-SWELL						
4-BUMPS & SAGS	9-LANE SH. DROP				14-RAILROAD CROSSING				19-WEATHER&RAVELING						
5-CORRUGATION	10-LOG.-TR.CR				15-RUTTING										
DISTRESS	SEVERITY	QUANTITY											TOTAL	DENSITY%	DUDACT VALUE
10	M	49.52	33.69	48.3	151	34.4	42.05	0	0	0	0	0	358.96	1.0	28
3	M	350	0	0	0	0	0	0	0	0	0	0	350	1.0	0
12	H	16	11	0	0	0	0	0	0	0	0	0	27	0.1	20
6	M	85.3	24	0	0	0	0	0	0	0	0	0	109.3	0.3	8
7	H	12.8	0	0	0	0	0	0	0	0	0	0	12.8	0.0	0
3	H	3451	1799	1988	805	0	0	0	0	0	0	0	8043	23.0	44
9	H	7	56.5	0	0	0	0	0	0	0	0	0	63.5	0.2	3
1	H	66	0	0	0	0	0	0	0	0	0	0	66	0.2	17
16	H	600	522	650	50	0	0	0	0	0	0	0	1822	5.2	39
16	M	1047	79.5	0	0	0	0	0	0	0	0	0	1126.5	3.2	20
2	H	70	0	0	0	0	0	0	0	0	0	0	70	0.2	2
16	L	75	0	0	0	0	0	0	0	0	0	0	75	0.2	0
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.0	0

ASPHALT PAVED ROADS CONDATION SURVEY DATA SHEET													SKETCH:		
LINK ID: 03S1		SECTION ID:.....(03S1/1).....					SAMPLE UNIT:... (Km 25-----Km 30).....								
LINK NAME: .....( GEDARIF-KASSALA).....							SECTION NAME: ...(KHASHM EL GIRBA- KASSALA)								
SURVEYED BY:.....		DATE:.....					SAMPLE AREA (M):35000.....				SHEET NO :...(4).....				
1-ALLIGATOR CRAKING		6- DEPRESSTION				11-PATCHING				16-SHOVING					
2-BLEEDING		7- EDGE CRACKING				12-POLISHEDE AGG.				17-SLIPPAGE CRACKING					
3-BLOCK CRACKING		8-JT-REFLECTION CR.				13-POTHOLE				18-SWELL					
4-BUMPS & SAGS		9-LANE SH. DROP				14-RAILROAD CROSSING				19-WEATHER&RAVELING					
5-CORRUGATION		10-LOG.-TR.CR				15-RUTTING									
DISTRESS		SEVERITY	QUANTITY										TOTAL	DENSITY%	DUDACT VALUE
16		M	113	119	62	33	0	0	0	0	0	0	327	0.9	6
9		M	127	10	0	0	0	0	0	0	0	0	137	0.4	0
6		M	9	0	0	0	0	0	0	0	0	0	9	0.0	0
16		H	93	0	0	0	0	0	0	0	0	0	93	0.3	11
12		H	1	0	0	0	0	0	0	0	0	0	1	0.0	0
2		H	42	0	0	0	0	0	0	0	0	0	42	0.1	2
0		0	0	0	0	0	0	0	0	0	0	0	0	0.0	0

ASPHALT PAVED ROADS CONDATION SURVEY DATA SHEET													SKETCH:		
LINK ID: 03S1	SECTION ID:.....(03S1/1).....					SAMPLE UNIT:... (Km 32-----Km 37).....									
LINK NAME: .....( GEDARIF-KASSALA).....						SECTION NAME: ... (KHASHM EL GIRBA- KASSALA)									
SURVEYED BY:.....	DATE:.....					SAMPLE AREA (M)35000.....				SHEET NO.:...(5).....					
1-ALLIGATOR CRAKING	6- DEPRESSTION				11-PATCHING				16-SHOVING						
2-BLEEDING	7- EDGE CRACKING				12-POLISHEDE AGG.				17-SLIPPAGE CRACKING						
3-BLOCK CRACKING	8-JT-REFLECTION CR.				13-POTHOLE				18-SWELL						
4-BUMPS & SAGS	9-LANE SH. DROP				14-RAILROAD CROSSING				19-WEATHER&RAVELING						
5-CORRUGATION	10-LOG.-TR.CR				15-RUTTING										
DISTRESS	SEVERITY	QUANTITY											TOTAL	DENSITY%	DUDACT VALUE
9	L	14	0	0	0	0	0	0	0	0	0	0	14	0.0	0
9	M	86	155.5	185	198	0	0	0	0	0	0	0	624.5	1.8	4
16	L	17	0	0	0	0	0	0	0	0	0	0	17	0.0	0
3	M	1228.5	616	553	728	1242.5	0	0	0	0	0	0	4368	12.5	6
1	M	77.4	105	79.2	30.6	0	0	0	0	0	0	0	292.2	0.8	20
3	L	22.4	1264	0	0	0	0	0	0	0	0	0	1286.4	3.7	3
1	L	120	0	0	0	0	0	0	0	0	0	0	120	0.3	5
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.0	0

ASPHALT PAVED ROADS CONDATION SURVEY DATA SHEET													SKETCH:			
LINK ID: 03S1		SECTION ID:.....(03S1/1).....						SAMPLE UNIT:.. (Km 39 -----Km 44).....								
LINK NAME: .....( GEDARIF-KASSALA).....							SECTION NAME: ... (KHASHM EL GIRBA- KASSALA)									
SURVEYED BY:.....		DATE:.....				SAMPLE AREA (M)35000.....				SHEET NO.:...(6).....						
1-ALLIGATOR CRAKING		6- DEPRESSTION				11-PATCHING				16-SHOVING						
2-BLEEDING		7- EDGE CRACKING				12-POLISHEDE AGG.				17-SLIPPAGE CRACKING						
3-BLOCK CRACKING		8-JT-REFLECTION CR.				13-POTHOLE				18-SWELL						
4-BUMPS & SAGS		9-LANE SH. DROP				14-RAILROAD CROSSING				19-WEATHER&RAVELING						
5-CORRUGATION		10-LOG.-TR.CR				15-RUTTING										
DISTRESS		SEVERITY	QUANTITY											TOTAL	DENSITY%	DUDACT VALUE
1		M	192	104.4	161.4	102	111.6	80.4	66	137	155.4	660	0	1770.6	5.1	39
3		M	878.5	1246	560	937	1176	973	105	0	0	0	0	5875.5	16.8	20
9		M	83	61	36	0	0	0	0	0	0	0	0	180	0.5	0
10		H	0.27	0	0	0	0	0	0	0	0	0	0	0.27	0.0	0
9		H	58	0	0	0	0	0	0	0	0	0	0	58	0.2	3
1		L	80.4	15	42	0	0	0	0	0	0	0	0	137.4	0.4	5
9		L	16	0	0	0	0	0	0	0	0	0	0	16	0.0	0
1		H	113	0	0	0	0	0	0	0	0	0	0	113	0.3	19
0		0	0	0	0	0	0	0	0	0	0	0	0	0	0.0	0

ASPHALT PAVED ROADS CONDATION SURVEY DATA SHEET													SKETCH:		
LINK ID: 03S1	SECTION ID:.....(03S1/1).....					SAMPLE UNIT:... (Km 46 -----Km 51).....									
LINK NAME: .....( GEDARIF-KASSALA).....						SECTION NAME: ...(KHASHM EL GIRBA- KASSALA)									
SURVEYED BY:.....	DATE:.....					SAMPLE AREA (M)35000.....				SHEET NO.:...(7).....					
1-ALLIGATOR CRAKING	6- DEPRESSTION					11-PATCHING				16-SHOVING					
2-BLEEDING	7- EDGE CRACKING					12-POLISHEDE AGG.				17-SLIPPAGE CRACKING					
3-BLOCK CRACKING	8-JT-REFLECTION CR.					13-POTHOLE				18-SWELL					
4-BUMPS & SAGS	9-LANE SH. DROP					14-RAILROAD CROSSING				19-WEATHER&RAVELING					
5-CORRUGATION	10-LOG.-TR.CR					15-RUTTING									
DISTRESS	SEVERITY	QUANTITY											TOTAL	DENSITY%	DUDACT VALUE
9	H	42	7	0	0	0	0	0	0	0	0	0	49	0.14	3
9	M	211	14	65	9	258	0	0	0	0	0	0	557	1.59	4
1	M	107.4	28.8	126	134.4	4.2	76.2	130.8	109	0	0	0	716.4	2.05	18
3	M	2030	1118	2254	2191	959	197.4	0	0	0	0	0	8749.4	25.00	25
16	M	12	0	0	0	0	0	0	0	0	0	0	12	0.03	0
3	L	245	0	0	0	0	0	0	0	0	0	0	245	0.70	0
8	H	30	0	0	0	0	0	0	0	0	0	0	30	0.09	7
1	H	124.2	353	211	366.5	449.5	49	0	0	0	0	0	1553.2	4.44	50
3	H	1029	0	0	0	0	0	0	0	0	0	0	1029	2.94	15
18	H	2.88	0	0	0	0	0	0	0	0	0	0	2.88	0.01	0
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0

ASPHALT PAVED ROADS CONDATION SURVEY DATA SHEET													SKETCH:			
LINK ID: 03S1		SECTION ID:.....(03S1/1).....					SAMPLE UNIT:... (Km 53 -----Km 58).....									
LINK NAME: .....( GEDARIF-KASSALA).....							SECTION NAME: ...(KHASHM EL GIRBA- KASSALA)									
SURVEYED BY:.....		DATE:.....					SAMPLE AREA (M)35000.....				SHEET NO :....(8).....					
1-ALLIGATOR CRAKING		6- DEPRESSTION					11-PATCHING				16-SHOVING					
2-BLEEDING		7- EDGE CRACKING					12-POLISHEDE AGG.				17-SLIPPAGE CRACKING					
3-BLOCK CRACKING		8-JT-REFLECTION CR.					13-POTHOLE				18-SWELL					
4-BUMPS & SAGS		9-LANE SH. DROP					14-RAILROAD CROSSING				19-WEATHER&RAVELING					
5-CORRUGATION		10-LOG.-TR.CR					15-RUTTING									
DISTRESS		SEVERITY	QUANTITY											TOTAL	DENSITY%	DUDACT VALUE
1		L	156	140.4	0	0	0	0	0	0	0	0	296.4	0.85	9	
3		L	409.5	0	0	0	0	0	0	0	0	0	409.5	1.17	0	
1		M	183.8	339.6	441	0	0	0	0	0	0	0	964.4	2.76	30	
3		M	857.5	1169	455	0	0	0	0	0	0	0	2481.5	7.09	14	
9		L	19	0	0	0	0	0	0	0	0	0	19	0.05	0	
12		H	4	0	0	0	0	0	0	0	0	0	4	0.01	0	
10		M	0.15	0	0	0	0	0	0	0	0	0	0.15	0.00	0	
1		H	36	0	0	0	0	0	0	0	0	0	36	0.10	12	
9		M	103	0	0	0	0	0	0	0	0	0	103	0.29	0	
0		0	0	0	0	0	0	0	0	0	0	0	0	0.00	0	

ASPHALT PAVED ROADS CONDATION SURVEY DATA SHEET													SKETCH:			
LINK ID: 03S1		SECTION ID:.....(03S1/1).....					SAMPLE UNIT:... (Km 60 -----Km 65).....									
LINK NAME: .....( GEDARIF-KASSALA).....							SECTION NAME: ...(KHASM EL GIRBA- KASSALA)									
SURVEYED BY:.....		DATE:.....					SAMPLE AREA (M)35000.....				SHEET NO.:...(9).....					
1-ALLIGATOR CRAKING 6- DEPRESSION 11-PATCHING 2-BLEEDING 7- EDGE CRACKING 12-POLISHEDE AGG. 16-SHOVING 3-BLOCK CRACKING 8-JT-REFLECTION CR. 13-POTHOLE 17-SLIPPAGE CRACKING 4-BUMPS & SAGS 9-LANE SH. DROP 14-RAILROAD CROSSING 18-SWELL 5-CORRUGATION 10-LOG.-TR.CR 15-RUTTING 19-WEATHER&RAVELING																
DISTRESS		SEVERITY	QUANTITY										TOTAL	DENSITY%	DUDACT VALUE	
16		M	141	204.5	231	107	242.5	155	0	0	0	0	0	1081	3.09	20
9		M	8.6	0	0	0	0	0	0	0	0	0	0	8.6	0.02	0
16		L	188	0	0	0	0	0	0	0	0	0	0	188	0.54	1
16		H	270	30	0	0	0	0	0	0	0	0	0	300	0.86	18
0		0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0

ASPHALT PAVED ROADS CONDATION SURVEY DATA SHEET														SKETCH:		
LINK ID: 03S1		SECTION ID:.....(03S1/1).....						SAMPLE UNIT:... (Km 67 -----Km 72).....								
LINK NAME: .....( GEDARIF-KASSALA).....								SECTION NAME: ...(KHASM EL GIRBA- KASSALA)								
SURVEYED BY:.....		DATE:.....						SAMPLE AREA (M)35000.....				SHEET NO.:...(10).....				
1-ALLIGATOR CRAKING		6- DEPRESSTION				11-PATCHING				16-SHOVING						
2-BLEEDING		7- EDGE CRACKING				12-POLISHEDE AGG.				17-SLIPPAGE CRACKING						
3-BLOCK CRACKING		8-JT-REFLECTION CR.				13-POTHOLE				18-SWELL						
4-BUMPS & SAGS		9-LANE SH. DROP				14-RAILROAD CROSSING				19-WEATHER&RAVELING						
5-CORRUGATION		10-LOG.-TR.CR				15-RUTTING										
DISTRESS		SEVERITY	QUANTITY											TOTAL	DENSITY%	DUDACT VALUE
8		H	17	0	0	0	0	0	0	0	0	0	17	0.05	7	
8		M	5	0	0	0	0	0	0	0	0	0	5	0.01	0	
7		L	16	0	0	0	0	0	0	0	0	0	16	0.05	0	
2		M	44	281.5	0	0	0	0	0	0	0	0	325.5	0.93	2	
12		H	1	0	0	0	0	0	0	0	0	0	1	0.00	0	
16		L	127	87.5	100	0	0	0	0	0	0	0	314.5	0.90	3	
16		M	52	297	123	245	0	0	0	0	0	0	717	2.05	14	
16		H	105	157	65	0	0	0	0	0	0	0	327	0.93	19	
0		0	0	0	0	0	0	0	0	0	0	0	0	0.00	0	

Data Collection for Link (KASSALA – HAYIA)

ASPHALT PAVED ROADS CONDATION SURVEY DATA SHEET														SKETCH:			
LINK ID: 03N2		SECTION ID:.....(03N2/5).....						SAMPLE UNIT:.. (Km2 -----Km 7).....									
LINK NAME: .....( KASSALA - HAYIA).....								SECTION NAME:...(KASSALA - ABRAK).....									
SURVEYED BY:.....		DATE:.....				SAMPLE AREA (M)35000.....				SHEET NO :...(1).....							
1-ALLIGATOR CRAKING		6- DEPRESSION				11-PATCHING				16-SHOVING							
2-BLEEDING		7- EDGE CRACKING				12-POLISHEDE AGG.				17-SLIPPAGE CRACKING							
3-BLOCK CRACKING		8-JT-REFLECTION CR.				13-POTHOLE				18-SWELL							
4-BUMPS & SAGS		9-LANE SH. DROP				14-RAILROAD CROSSING				19-WEATHER&RAVELING							
5-CORRUGATION		10-LOG.-TR.CR				15-RUTTING											
DISTRESS		SEVERITY	QUANTITY											TOTAL	DENSITY%	DUDACT VALUE	
1		M	1.5	8	9	37.5	5	4.5	7.5	26	75	9	15	0	198	0.57	6
18		M	1.05	1.75	0	0	0	0	0	0	0	0	0	0	2.8	0.01	0
7		L	5	0	0	0	0	0	0	0	0	0	0	0	5	0.01	0
8		H	70	0	0	0	0	0	0	0	0	0	0	0	70	0.20	0
18		L	0.3	1	0	0	0	0	0	0	0	0	0	0	1.3	0.00	0
9		M	16	12	85	48	98	0	0	0	0	0	0	0	259	0.74	0
9		L	17	49	31	224.5	113	0	0	0	0	0	0	0	434.5	1.24	0
3		M	18	7	7.5	10.5	17.5	2.1	63	55	26	7.5	123	0	337.1	0.96	3
3		L	35	17	3.5	18	91	102.5	0	0	0	0	0	0	267	0.76	0
1		L	17	9	4.5	34	7.5	6.4	2.4	12	4	19	7.5	507.4	630.7	1.80	14
2		L	2	0	0	0	0	0	0	0	0	0	0	0	2	0.01	0
0		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0

ASPHALT PAVED ROADS CONDATION SURVEY DATA SHEET														SKETCH:		
LINK ID:03N2		SECTION ID:.....(03N2/5).....					SAMPLE UNIT... (Km9-----Km 14).....									
LINK NAME: .....( KASSALA - HAYIA).....							SECTION NAME:...(KASSALA - ABRAK).....									
SURVEYED BY:.....		DATE:.....					SAMPLE AREA (M)35000....			SHEET NO :...(2).....						
1-ALLIGATOR CRAKING	6- DEPRESSION				11-PATCHING				16-SHOVING							
2-BLEEDING	7- EDGE CRACKING				12-POLISHEDE AGG.				17-SLIPPAGE CRACKING							
3-BLOCK CRACKING	8-JT-REFLECTION CR.				13-POTHOLE				18-SWELL							
4-BUMPS & SAGS	9-LANE SH. DROP				14-RAILROAD CROSSING				19-WEATHER&RAVELING							
5-CORRUGATION	10-LOG.-TR.CR				15-RUTTING											
DISTRESS	SEVERITY	QUANTITY												TOTAL	DENSITY%	DUDACT VALUE
18	L	7.3	0	0	0	0	0	0	0	0	0	0	0	7.3	0.0	0
8	H	125	0	0	0	0	0	0	0	0	0	0	0	125	0.4	0
9	M	29	18	12	56	70.5	78.5	77.7	0	0	0	0	0	341.7	1.0	3
3	L	2.5	2	3	10	10	5	71.2	93	0	0	0	0	196.7	0.6	0
3	M	1.75	8	378.2	0	0	0	0	0	0	0	0	0	387.95	1.1	4
9	L	21	26	22	13	19	580.2	0	0	0	0	0	0	681.2	1.9	0
8	M	130	80	1000	0	0	0	0	0	0	0	0	0	1210	3.5	6
7	H	4	0	0	0	0	0	0	0	0	0	0	0	4	0.0	0
11		35000	0	0	0	0	0	0	0	0	0	0	0	35000	100.0	20
1	M	5.5	0	0	0	0	0	0	0	0	0	0	0	5.5	0.0	0
1	L	7.5	4	54	19.6	16.5	5.6	2	3	0	0	0	0	112.2	0.3	5
8	L	8000	0	0	0	0	0	0	0	0	0	0	0	8000	22.9	8
18	M	3.5	0	0	0	0	0	0	0	0	0	0	0	3.5	0.0	0
7	M	8	0	0	0	0	0	0	0	0	0	0	0	8	0.0	0
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.0	0

ASPHALT PAVED ROADS CONDATON SURVEY DATA SHEET														SKETCH:			
LINK ID:03N2		SECTION ID:.....(03N2/5).....						SAMPLE UNIT:.. (Km 16-----Km 21).....									
LINK NAME: .....( KASSALA - HAYIA).....						SECTION NAME: ...(KASSALA - ABRAK).....											
SURVEYED BY:.....		DATE:.....				SAMPLE AREA (M)35000.....				SHEET NO:...(3).....							
1-ALLIGATOR CRAKING		6- DEPRESSION				11-PATCHING				16-SHOVING							
2-BLEEDING		7- EDGE CRACKING				12-POLISHEDE AGG.				17-SLIPPAGE CRACKING							
3-BLOCK CRACKING		8-JT-REFLECTION CR.				13-POTHOLE				18-SWELL							
4-BUMPS & SAGS		9-LANE SH. DROP				14-RAILROAD CROSSING				19-WEATHER&RAVELING							
5-CORRUGATION		10-LOG-TR.CR				15-RUTTING											
DISTRESS		SEVERITY	QUANTITY											TOTAL	DENSITY%	DUDACT VALUE	
9		M	86	123	10	0	0	0	0	0	0	0	0	219	0.6	0	
9		L	110	87	96	0	0	0	0	0	0	0	0	293	0.8	0	
3		M	6	2.5	5	2	6	3.5	14	7	9	4	0	59	0.2	0	
3		L	12	3	1.5	4	0	0	0	0	0	0	0	20.5	0.1	0	
11		0	35000	0	0	0	0	0	0	0	0	0	0	35000	100.0	20	
12		H	3	0	0	0	0	0	0	0	0	0	0	3	0.0	0	
1		M	32	106	38	223	3	3.5	19	14	5	28	9	480.5	1.4	21	
7		L	67	120	42	0	0	0	0	0	0	0	0	229	0.7	0	
1		L	8	285.8	1.2	5	3	11	1.5	8	10	9.5	3.6	3.5	350.1	1.0	10
8		H	400	0	0	0	0	0	0	0	0	0	0	400	1.1	0	
18		M	3.5	2.8	2.1	2.8	0	0	0	0	0	0	0	11.2	0.0	0	
7		M	51	32	0	0	0	0	0	0	0	0	0	83	0.2	0	
1		H	1	3	0	0	0	0	0	0	0	0	0	4	0.0	0	
0		0	0	0	0	0	0	0	0	0	0	0	0	0	0.0	0	

ASPHALT PAVED ROADS CONDATON SURVEY DATA SHEET														SKETCH:		
LINK ID:03N2		SECTION ID:.....(03N2/5).....					SAMPLE UNIT:.. (Km 23-----Km 28).....									
LINK NAME: .....( KASSALA - HAYIA).....							SECTION NAME: ...(KASSALA - ABRAK).....									
SURVEYED BY:.....		DATE:.....					SAMPLE AREA (M)35000.....				SHEET NO:...(4).....					
1-ALLIGATOR CRAKING		6- DEPRESSION				11-PATCHING				16-SHOVING						
2-BLEEDING		7- EDGE CRACKING				12-POLISHEDE AGG.				17-SLIPPAGE CRACKING						
3-BLOCK CRACKING		8-JT-REFLECTION CR.				13-POTHOLE				18-SWELL						
4-BUMPS & SAGS		9-LANE SH. DROP				14-RAILROAD CROSSING				19-WEATHER&RAVELING						
5-CORRUGATION		10-LOG-TR.CR				15-RUTTING										
DISTRESS		SEVERITY	QUANTITY											TOTAL	DENSITY%	DUDACT VALUE
9		L	39	62	139	0	0	0	0	0	0	0	0	240	0.7	0
1		L	1.2	0.8	0	0	0	0	0	0	0	0	0	2	0.0	0
9		M	6	68	195	0	0	0	0	0	0	0	0	269	0.8	3
3		L	1.5	1.5	2.5	62	0	0	0	0	0	0	0	67.5	0.2	0
8		M	2000	0	0	0	0	0	0	0	0	0	0	2000	5.7	7
8		L	6000	0	0	0	0	0	0	0	0	0	0	6000	17.1	8
3		M	8	11	6	12	2.5	7	0	0	0	0	0	46.5	0.1	0
0		0	0	0	0	0	0	0	0	0	0	0	0	0	0.0	0

ASPHALT PAVED ROADS CONDATON SURVEY DATA SHEET														SKETCH:		
LINK ID:03N2	SECTION ID:.....(03N2/5).....					SAMPLE UNIT:.. (Km 30-----Km 35).....										
LINK NAME: .....( KASSALA - HAYIA).....					SECTION NAME: ...(KASSALA - ABRAK).....											
SURVEYED BY:.....		DATE:.....				SAMPLE AREA (M)35000.....				SHEET NO :...(5).....						
1-ALLIGATOR CRAKING	6- DEPRESSTION				11-PATCHING				16-SHOVING							
2-BLEEDING	7- EDGE CRACKING				12-POLISHEDE AGG.				17-SLIPPAGE CRACKING							
3-BLOCK CRACKING	8-JT-REFLECTION CR.				13-POTHOLE				18-SWELL							
4-BUMPS & SAGS	9-LANE SH. DROP				14-RAILROAD CROSSING				19-WEATHER&RAVELING							
5-CORRUGATION	10-LOG.-TR.CR				15-RUTTING											
DISTRESS	SEVERITY	QUANTITY												TOTAL	DENSITY%	DUDACT VALUE
9	L	232	298	314	0	0	0	0	0	0	0	0	0	844	2.4	0
7	L	39	0	0	0	0	0	0	0	0	0	0	0	39	0.1	0
1	L	0.9	12.3	7	90	25.5	91	105	3	14	58.5	53	115	575.2	1.6	13
8	M	590	0	0	0	0	0	0	0	0	0	0	0	590	1.7	5
9	M	165	120	0	0	0	0	0	0	0	0	0	0	285	0.8	2
1	M	10	64	60	30	4.9	40	31	191	0	0	0	0	430.8	1.2	21
18	M	3.5	0	0	0	0	0	0	0	0	0	0	0	3.5	0.0	0
2	H	5	0	0	0	0	0	0	0	0	0	0	0	5	0.0	0
3	M	11	4.5	20	18	40	9	7	6	4	96	8	20	243.5	0.7	4
3	L	2	1.5	5	24.5	7	18	0	0	0	0	0	0	58	0.2	0
12	L	4	0	0	0	0	0	0	0	0	0	0	0	4	0.0	0
8	H	350	0	0	0	0	0	0	0	0	0	0	0	350	1.0	0
8	L	8000	0	0	0	0	0	0	0	0	0	0	0	8000	22.9	9
18	L	0.7	0	0	0	0	0	0	0	0	0	0	0	0.7	0.0	0
11		35000	0	0	0	0	0	0	0	0	0	0	0	35000	100.0	20
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.0	0

ASPHALT PAVED ROADS CONDATON SURVEY DATA SHEET														SKETCH:		
LINK ID: 03N2	SECTION ID:.....(03N2/5).....					SAMPLE UNIT:.. (Km 37 -----Km 42).....										
LINK NAME: .....( KASSALA - HAYIA).....						SECTION NAME: ...(KASSALA - ABRAK).....										
SURVEYED BY:.....	DATE:.....					SAMPLE AREA (M)35000.....				SHEET NO :...(6).....						
1-ALLIGATOR CRAKING	6- DEPRESSTION				11-PATCHING				16-SHOVING							
2-BLEEDING	7- EDGE CRACKING				12-POLISHEDE AGG.				17-SLIPPAGE CRACKING							
3-BLOCK CRACKING	8-JT-REFLECTION CR.				13-POTHOLE				18-SWELL							
4-BUMPS & SAGS	9-LANE SH. DROP				14-RAILROAD CROSSING				19-WEATHER&RAVELING							
5-CORRUGATION	10-LOG.-TR.CR				15-RUTTING											
DISTRESS	SEVERITY	QUANTITY												TOTAL	DENSITY%	DUDACT VALUE
3	M	6	3	6	3	0	0	0	0	0	0	0	0	18	0.05	0
1	M	60	38	0	0	0	0	0	0	0	0	0	0	98	0.28	12
1	H	320	0	0	0	0	0	0	0	0	0	0	0	320	0.91	30
3	L	4	4	0	0	0	0	0	0	0	0	0	0	8	0.02	0
2	L	5	100	95	60	270	100	5	100	95	60	60	270	1220	3.49	3
17	M	9	3	1	9	3	1	0	0	0	0	0	0	26	0.07	5
17	L	11	38	6	5	38	0	0	0	0	0	0	0	98	0.28	0
10	M	14	9	46	6	14	5	4	46	6	0	0	0	150	0.43	7
8	L	8000	6000	0	0	0	0	0	0	0	0	0	0	14000	40.00	15
8	M	2000	4000	0	0	0	0	0	0	0	0	0	0	6000	17.14	10
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0

ASPHALT PAVED ROADS CONDTION SURVEY DATA SHEET														SKETCH:			
LINK ID: 03N2		SECTION ID:.....(03N2/5).....						SAMPLE UNIT:.. (Km 44 -----Km 49).....									
LINK NAME: .....( KASSALA - HAYIA).....						SECTION NAME: ...(KASSALA - ABRAK).....											
SURVEYED BY:.....		DATE:.....				SAMPLE AREA (M)35000.....				SHEET NO:...(7).....							
1-ALLIGATOR CRAKING		6- DEPRESSION				11-PATCHING				16-SHOVING							
2-BLEEDING		7- EDGE CRACKING				12-POLISHEDE AGG.				17-SLIPPAGE CRACKING							
3-BLOCK CRACKING		8-JT-REFLECTION CR.				13-POTHOLE				18-SWELL							
4-BUMPS & SAGS		9-LANE SH. DROP				14-RAILROAD CROSSING				19-WEATHER&RAVELING							
5-CORRUGATION		10-LOG.-TR.CR				15-RUTTING											
DISTRESS		SEVERITY	QUANTITY											TOTAL	DENSITY%	DUDACT VALUE	
16		M	56	135	120	250	115	10	35	81	50	12.5	264	0	1128.5	3.22	4
16		L	55	130	192.5	320	20	140	17	40	110	12	10	50	1096.5	3.13	3
16		H	72.5	13.5	0	0	0	0	0	0	0	0	0	0	86	0.25	2
2		L	100	85	250	70	110	0	0	0	0	0	0	0	615	1.76	0
8		H	1900	0	0	0	0	0	0	0	0	0	0	0	1900	5.43	9
8		L	3100	0	0	0	0	0	0	0	0	0	0	0	3100	8.86	4
8		M	2000	0	0	0	0	0	0	0	0	0	0	0	2000	5.71	5
0		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0

ASPHALT PAVED ROADS CONDATON SURVEY DATA SHEET														SKETCH:		
LINK ID:03N2		SECTION ID:....(03N2/5).....						SAMPLE UNIT:.. (Km 51 -----Km 56).....								
LINK NAME:.....(KASSALA - HAYIA).....						SECTION NAME:...(KASSALA - ABRAK).....										
SURVEYED BY:.....		DATE:.....				SAMPLE AREA (M)35000.....				SHEET NO :...(8).....						
1-ALLIGATOR CRAKING		6- DEPRESSION				11-PATCHING				16-SHOVING						
2-BLEEDING		7- EDGE CRACKING				12-POLISHEDE AGG.				17-SLIPPAGE CRACKING						
3-BLOCK CRACKING		8-JT-REFLECTION CR.				13-POTHOLE				18-SWELL						
4-BUMPS & SAGS		9-LANE SH. DROP				14-RAILROAD CROSSING				19-WEATHER&RAVELING						
5-CORRUGATION		10-LOG.-TR.CR				15-RUTTING										
DISTRESS		SEVERITY	QUANTITY											TOTAL	DENSITY%	DUDACT VALUE
2		L	50	35	150	250	300	500	0	0	0	0	0	1285	3.67	0
16		L	15	2000	0	0	0	0	0	0	0	0	0	2015	5.76	5
16		M	1000	0	0	0	0	0	0	0	0	0	0	1000	2.86	6
8		H	7000	0	0	0	0	0	0	0	0	0	0	7000	20.00	23
8		M	3000	0	0	0	0	0	0	0	0	0	0	3000	8.57	8
0		0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0

ASPHALT PAVED ROADS CONDTION SURVEY DATA SHEET														SKETCH:		
LINK ID:03N2	SECTION ID:.....(03N2/5).....						SAMPLE UNIT:.. (Km 58 -----Km 63).....									
LINK NAME: .....( KASSALA - HAYIA).....							SECTION NAME: ...(KASSALA - ABRAK).....									
SURVEYED BY:.....	DATE:.....						SAMPLE AREA (M)35000.....				SHEET NO :...(9).....					
1-ALLIGATOR CRAKING	6- DEPRESSION					11-PATCHING					16-SHOVING					
2-BLEEDING	7- EDGE CRACKING					12-POLISHEDE AGG.					17-SLIPPAGE CRACKING					
3-BLOCK CRACKING	8-JT-REFLECTION CR.					13-POTHOLE					18-SWELL					
4-BUMPS & SAGS	9-LANE SH. DROP					14-RAILROAD CROSSING					19-WEATHER&RAVELING					
5-CORRUGATION	10-LOG-TR.CR					15-RUTTING										
DISTRESS	SEVERITY	QUANTITY												TOTAL	DENSITY%	DUDACT VALUE
16	L	40	25	50	150	55	15	15	10	17.5	25	50	27.5	480	1.37	0
16	M	70	7.5	80	93.5	45	100	150	55	15	85	30	100	831	2.37	7
2	L	100	10	10	100	50	25	75	0	0	0	0	0	370	1.06	0
2	M	30	0	0	0	0	0	0	0	0	0	0	0	30	0.09	0
16	H	5	5	93.5	50	40	1700	0	0	0	0	0	0	1893.5	5.41	20
10	M	10	0	0	0	0	0	0	0	0	0	0	0	10	0.03	3
17	H	7	0	0	0	0	0	0	0	0	0	0	0	7	0.02	8
12	H	3	0	0	0	0	0	0	0	0	0	0	0	3	0.01	20
8	H	6000	0	0	0	0	0	0	0	0	0	0	0	6000	17.14	30
8	M	4000	0	0	0	0	0	0	0	0	0	0	0	4000	11.43	9
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0

ASPHALT PAVED ROADS CONDTION SURVEY DATA SHEET														SKETCH:		
LINK ID:03N2	SECTION ID:.....(03N2/5).....					SAMPLE UNIT:... (Km 65 -----Km 70).....										
LINK NAME: .....( KASSALA - HAYIA).....						SECTION NAME: ...(KASSALA - ABRAK).....										
SURVEYED BY:.....	DATE:.....					SAMPLE AREA (M)35000.....				SHEET NO.:...(10).....						
1-ALLIGATOR CRAKING	6- DEPRESSION					11-PATCHING				16-SHOVING						
2-BLEEDING	7- EDGE CRACKING					12-POLISHEDE AGG.				17-SLIPPAGE CRACKING						
3-BLOCK CRACKING	8-JT-REFLECTION CR.					13-POTHOLE				18-SWELL						
4-BUMPS & SAGS	9-LANE SH. DROP					14-RAILROAD CROSSING				19-WEATHER&RAVELING						
5-CORRUGATION	10-LOG-TR.CR					15-RUTTING										
DISTRESS	SEVERITY	QUANTITY												TOTAL	DENSITY%	DUDACT VALUE
16	L	150	110	200	150	0	0	0	0	0	0	0	0	610	1.74	0
16	M	90	150	0	0	0	0	0	0	0	0	0	0	240	0.69	3
2	L	200	105	200	0	0	0	0	0	0	0	0	0	505	1.44	0
17	H	3	0	0	0	0	0	0	0	0	0	0	0	3	0.01	8
17	M	1.2	0	0	0	0	0	0	0	0	0	0	0	1.2	0.00	4
8	M	2500	0	0	0	0	0	0	0	0	0	0	0	2500	7.14	8
8	H	7500	0	0	0	0	0	0	0	0	0	0	0	7500	21.43	24
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0

ASPHALT PAVED ROADS CONDATION SURVEY DATA SHEET														SKETCH:		
LINK ID: 03N2		SECTION ID:.....(03N2/2).....					SAMPLE UNIT:.. (Km 1 -----Km 6).....									
LINK NAME:.....(KASSALA - HAYIA).....							SECTION NAME:...(ABRAK - UMADAM).....									
SURVEYED BY:.....		DATE:.....					SAMPLE AREA (M)35000.....				SHEET NO:....(1).....					
1-ALLIGATOR CRAKING		6- DEPRESSTION				11-PATCHING				16-SHOVING						
2-BLEEDING		7- EDGE CRACKING				12-POLISHEDE AGG.				17-SLIPPAGE CRACKING						
3-BLOCK CRACKING		8-JT-REFLECTION CR.				13-POTHOLE				18-SWELL						
4-BUMPS & SAGS		9-LANE SH. DROP				14-RAILROAD CROSSING				19-WEATHER&RAVELING						
5-CORRUGATION		10-LOG.-TR.CR				15-RUTTING										
DISTRESS		SEVERITY	QUANTITY											TOTAL	DENSITY%	DUDACT VALUE
9		M	258	306	293	279	0	0	0	0	0	0	0	1136	3.25	10
9		L	315	147	0	0	0	0	0	0	0	0	0	462	1.32	0
7		M	145	0	0	0	0	0	0	0	0	0	0	145	0.41	5
7		H	14	15	21	0	0	0	0	0	0	0	0	50	0.14	7
16		H	10	3.5	24	8.5	0	0	0	0	0	0	0	46	0.13	7
16		L	15	2.5	13	10	0	0	0	0	0	0	0	40.5	0.12	0
3		M	807	240	21	40	266	338	1178	438	0	0	0	3328	9.51	17
1		M	6	8	122	20	6	20	12	118	121.2	89.2	0	522.4	1.49	25
6		H	42	35	35	17.5	0	0	0	0	0	0	0	129.5	0.37	15
6		M	35	17.5	0	0	0	0	0	0	0	0	0	52.5	0.15	8
8		H	4500	0	0	0	0	0	0	0	0	0	0	4500	12.86	17
9		H	85	0	0	0	0	0	0	0	0	0	0	85	0.24	4
16		M	7.5	4	69.5	0	0	0	0	0	0	0	0	81	0.23	4
8		M	5500	0	0	0	0	0	0	0	0	0	0	5500	15.71	10
1		H	30	60	133.5	116.6	0	0	0	0	0	0	0	340.1	0.97	30
1		L	116.8	0	0	0	0	0	0	0	0	0	0	116.8	0.33	4
3		L	48	60	20	54	42	30	3	33	0	0	0	290	0.83	0

ASPHALT PAVED ROADS CONDATION SURVEY DATA SHEET														SKETCH:		
LINK ID:03N2		SECTION ID:.....(03N2/2).....						SAMPLE UNIT:.. (Km 8-----Km 13).....								
LINK NAME: .....( KASSALA - HAYIA).....								SECTION NAME:...(ABRAK - UMADAM).....								
SURVEYED BY:.....		DATE:.....						SAMPLE AREA (M)35000.....				SHEET NO:...(2).....				
1-ALLIGATOR CRAKING		6- DEPRESSTION				11-PATCHING				16-SHOVING						
2-BLEEDING		7- EDGE CRACKING				12-POLISHEDE AGG.				17-SLIPPAGE CRACKING						
3-BLOCK CRACKING		8-JT-REFLECTION CR.				13-POTHOLE				18-SWELL						
4-BUMPS & SAGS		9-LANE SH. DROP				14-RAILROAD CROSSING				19-WEATHER&RAVELING						
5-CORRUGATION		10-LOG.-TR.CR				15-RUTTING										
DISTRESS	SEVERITY	QUANTITY												TOTAL	DENSITY%	DUDACT VALUE
18	M	3.5	7	0	0	0	0	0	0	0	0	0	10.5	0.0	0	
9	L	328	409	85	0	0	0	0	0	0	0	0	822	2.3	0	
7	M	12	5	7	0	0	0	0	0	0	0	0	24	0.1	5	
9	M	240	266	0	0	0	0	0	0	0	0	0	506	1.4	4	
3	M	605.9	3182	599	475.5	1678.5	137	0	0	0	0	0	6677.9	19.1	23	
12	H	5	2	4	0	0	0	0	0	0	0	0	11	0.0	20	
3	L	151	0	0	0	0	0	0	0	0	0	0	151	0.4	0	
3	H	210	4*90	50	0	0	0	0	0	0	0	0	260	0.7	6	
6	M	9	5	6	0	0	0	0	0	0	0	0	20	0.1	9	
1	M	296	118	0	0	0	0	0	0	0	0	0	414	1.2	20	
1	L	169	0	0	0	0	0	0	0	0	0	0	169	0.5	6	
1	H	20	23	190	0	0	0	0	0	0	0	0	233	0.7	23	
10	M	35	4	4	6	0	0	0	0	0	0	0	49	0.1	4	
8	L	3000	0	0	0	0	0	0	0	0	0	0	3000	8.6	4	
8	M	7000	0	0	0	0	0	0	0	0	0	0	7000	20.0	12	

mm

ASPHALT PAVED ROADS CONDATION SURVEY DATA SHEET													SKETCH:		
LINK ID: 03N2		SECTION ID:.....(03N2/2).....					SAMPLE UNIT:... (Km 15-----Km 20).....								
LINK NAME: (KASSALA - HAYIA).....							SECTION NAME: ... (ABRAK - UMADAM).....								
SURVEYED BY:.....		DATE:.....					SAMPLE AREA (M)35000....				SHEET NO. ....(3).....				
1-ALLIGATOR CRAKING		6- DEPRESSTION				11-PATCHING				16-SHOVING					
2-BLEEDING		7- EDGE CRACKING				12-POLISHEDE AGG.				17-SLIPPAGE CRACKING					
3-BLOCK CRACKING		8-JT-REFLECTION CR.				13-POTHOLE				18-SWELL					
4-BUMPS & SAGS		9-LANE SH. DROP				14-RAILROAD CROSSING				19-WEATHER&RAVELING					
5-CORRUGATION		10-LOG.-TR.CR				15-RUTTING									
DISTRESS	SEVERITY	QUANTITY											TOTAL	DENSITY%	DUDACT VALUE
12	H	181	0	0	0	0	0	0	0	0	0	0	181	0.52	40
9	L	323	291	0	0	0	0	0	0	0	0	0	614	1.75	0
9	M	392	251	0	0	0	0	0	0	0	0	0	643	1.84	0
18	M	1.5	1.5	0	0	0	0	0	0	0	0	0	3	0.01	4
7	H	179	0	0	0	0	0	0	0	0	0	0	179	0.51	6
9	H	156	0	0	0	0	0	0	0	0	0	0	156	0.45	6
10	H	20	10	6	22.5	0	0	0	0	0	0	0	58.5	0.17	8
16	H	107	160	45	40	0	0	0	0	0	0	0	352	1.01	7
1	L	187.5	0	0	0	0	0	0	0	0	0	0	187.5	0.54	6
1	M	105	0	0	0	0	0	0	0	0	0	0	105	0.30	12
2	L	20	60	41	65	20	0	0	0	0	0	0	206	0.59	0
3	M	112	70	9	60	35	0	0	0	0	0	0	286	0.82	4
16	L	40	26	16.5	26	20	0	0	0	0	0	0	128.5	0.37	0
6	M	3	2	8	7	0	0	0	0	0	0	0	20	0.06	8
8	M	4000	0	0	0	0	0	0	0	0	0	0	4000	11.43	9
8	L	2500	0	0	0	0	0	0	0	0	0	0	2500	7.14	5
8	H	3500	0	0	0	0	0	0	0	0	0	0	3500	10.00	15
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0

ASPHALT PAVED ROADS CONDATION SURVEY DATA SHEET													SKETCH:			
LINK ID: 03N2		SECTION ID:.....(03N2/2).....						SAMPLE UNIT:.. (Km 22-----Km 27).....								
LINK NAME: .....( KASSALA - HAYIA).....						SECTION NAME: ... (ABRAK - UMADAM).....										
SURVEYED BY:.....		DATE:.....				SAMPLE AREA (M)35000.....				SHEET NO.:...(4).....						
1-ALLIGATOR CRAKING		6- DEPRESSTION				11-PATCHING				16-SHOVING						
2-BLEEDING		7- EDGE CRACKING				12-POLISHEDE AGG.				17-SLIPPAGE CRACKING						
3-BLOCK CRACKING		8-JT-REFLECTION CR.				13-POTHOLE				18-SWELL						
4-BUMPS & SAGS		9-LANE SH. DROP				14-RAILROAD CROSSING				19-WEATHER&RAVELING						
5-CORRUGATION		10-LOG.-TR.CR				15-RUTTING										
DISTRESS		SEVERITY	QUANTITY										TOTAL	DENSITY%	DUDACT VALUE	
10		M	21	0	0	0	0	0	0	0	0	0	21	0.1	0	
4		L	104	31	10	0	0	0	0	0	0	0	145	0.4	0	
9		L	374	0	0	0	0	0	0	0	0	0	374	1.1	0	
1		H	12.2	0	0	0	0	0	0	0	0	0	12.2	0.0	12	
2		M	7	50	0	0	0	0	0	0	0	0	57	0.2	1	
2		L	150	4	150	0	0	0	0	0	0	0	304	0.9	0	
1		L	14	26	0	0	0	0	0	0	0	0	40	0.1	5	
3		L	14	0	0	0	0	0	0	0	0	0	14	0.0	0	
17		L	1	0	0	0	0	0	0	0	0	0	1	0.0	0	
8		L	7600	0	0	0	0	0	0	0	0	0	7600	21.7	8	
8		M	2400	0	0	0	0	0	0	0	0	0	2400	6.9	7	
5		M	50	24	17	0	0	0	0	0	0	0	91	0.3	7	
0		0	0	0	0	0	0	0	0	0	0	0	0	0.0	0	

ASPHALT PAVED ROADS CONDATION SURVEY DATA SHEET														SKETCH:		
LINK ID:03N2		SECTION ID:....(03N2/2).....						SAMPLE UNIT:... (Km 29-----Km 34).....								
LINK NAME: .....( KASSALA - HAYIA).....								SECTION NAME: ...(ABRAK - UMADAM).....								
SURVEYED BY:.....		DATE:.....						SAMPLE AREA (M)35000.....				SHEET NO :...(5).....				
1-ALLIGATOR CRAKING		6- DEPRESSTION				11-PATCHING				16-SHOVING						
2-BLEEDING		7- EDGE CRACKING				12-POLISHEDE AGG.				17-SLIPPAGE CRACKING						
3-BLOCK CRACKING		8-JT-REFLECTION CR.				13-POTHOLE				18-SWELL						
4-BUMPS & SAGS		9-LANE SH. DROP				14-RAILROAD CROSSING				19-WEATHER&RAVELING						
5-CORRUGATION		10-LOG.-TR.CR				15-RUTTING										
DISTRESS		SEVERITY	QUANTITY											TOTAL	DENSITY%	DUDACT VALUE
4		L	300	60	70	0	0	0	0	0	0	0	430	1.2	4	
7		M	5	7	2	6	11	24	0	0	0	0	55	0.2	5	
5		L	100	95	150	176	0	0	0	0	0	0	521	1.5	0	
2		L	22	31	28	0	0	0	0	0	0	0	81	0.2	0	
12		M	2	4	6	5	0	0	0	0	0	0	17	0.0	4	
8		L	2000	0	0	0	0	0	0	0	0	0	2000	5.7	4	
8		M	5000	0	0	0	0	0	0	0	0	0	5000	14.3	20	
8		H	3000	0	0	0	0	0	0	0	0	0	3000	8.6	12	
0		0	0	0	0	0	0	0	0	0	0	0	0	0.0	0	

ASPHALT PAVED ROADS CONDATION SURVEY DATA SHEET														SKETCH:				
LINK ID: 03N2		SECTION ID:.....(03N2/2).....						SAMPLE UNIT:.. (Km 36 -----Km 41).....										
LINK NAME: .....( KASSALA - HAYIA).....						SECTION NAME: ...(ABRAK - UMADAM).....												
SURVEYED BY:.....		DATE:.....						SAMPLE AREA (M)35000.....				SHEET NO.:...(6).....						
1-ALLIGATOR CRAKING		6- DEPRESSTION				11-PATCHING				16-SHOVING								
2-BLEEDING		7- EDGE CRACKING				12-POLISHEDE AGG.				17-SLIPPAGE CRACKING								
3-BLOCK CRACKING		8-JT-REFLECTION CR.				13-POTHOLE				18-SWELL								
4-BUMPS & SAGS		9-LANE SH. DROP				14-RAILROAD CROSSING				19-WEATHER&RAVELING								
5-CORRUGATION		10-LOG.-TR.CR				15-RUTTING												
DISTRESS		SEVERITY	QUANTITY											TOTAL	DENSITY%	DUDACT VALUE		
10		M	130	0	0	0	0	0	0	0	0	0	130	0.4	6			
1		H	142.5	0	0	0	0	0	0	0	0	0	142.5	0.4	20			
9		L	314	197	0	0	0	0	0	0	0	0	511	1.5	0			
3		M	1215	1258.5	632.5	0	0	0	0	0	0	0	3106	8.9	12			
9		M	411	452	329	0	0	0	0	0	0	0	1192	3.4	7			
7		M	13	17	22	0	0	0	0	0	0	0	52	0.1	5			
7		H	30	7	9	11	13	19	25	17	0	0	131	0.4	9			
3		H	3202	2112	0	0	0	0	0	0	0	0	5314	15.2	35			
1		M	272.6	209.4	0	0	0	0	0	0	0	0	482	1.4	11			
12		H	143	43	0	0	0	0	0	0	0	0	186	0.5	40			
4		L	6	7	11	14	5	0	0	0	0	0	43	0.1	0			
8		L	7000	0	0	0	0	0	0	0	0	0	7000	20.0	8			
8		M	3000	0	0	0	0	0	0	0	0	0	3000	8.6	7			
0		0	0	0	0	0	0	0	0	0	0	0	0	0.0	0			

ASPHALT PAVED ROADS CONDATION SURVEY DATA SHEET														SKETCH:		
LINK ID: 03N2		SECTION ID:.....(03N2/2).....						SAMPLE UNIT:.. (Km 43 -----Km 48).....								
LINK NAME: .....( KASSALA - HAYIA).....						SECTION NAME: ...(ABRAK - UMADAM).....										
SURVEYED BY:.....		DATE:.....				SAMPLE AREA (M)35000.....				SHEET NO:...(7).....						
1-ALLIGATOR CRAKING		6- DEPRESSTION				11-PATCHING				16-SHOVING						
2-BLEEDING		7- EDGE CRACKING				12-POLISHEDE AGG.				17-SLIPPAGE CRACKING						
3-BLOCK CRACKING		8-JT-REFLECTION CR.				13-POTHOLE				18-SWELL						
4-BUMPS & SAGS		9-LANE SH. DROP				14-RAILROAD CROSSING				19-WEATHER&RAVELING						
5-CORRUGATION		10-LOG.-TR.CR				15-RUTTING										
DISTRESS	SEVERITY	QUANTITY												TOTAL	DENSITY%	DUDACT VALUE
8	L	13400	0	0	0	0	0	0	0	0	0	0	0	13400	38.29	17
8	M	5400	0	0	0	0	0	0	0	0	0	0	0	5400	15.43	21
17	H	116	0	0	0	0	0	0	0	0	0	0	0	116	0.33	11
10	M	299	43	0	0	0	0	0	0	0	0	0	0	342	0.98	9
7	H	5	5	9	13	15	0	0	0	0	0	0	0	47	0.13	8
18	M	0.9	1.5	1.5	0.5	1.5	0.6	0	0	0	0	0	0	6.5	0.02	0
18	L	0.3	0.45	1	0	0	0	0	0	0	0	0	0	1.75	0.01	0
1	L	134.5	264.5	0	0	0	0	0	0	0	0	0	0	399	1.14	10
3	M	1107	0	0	0	0	0	0	0	0	0	0	0	1107	3.16	8
10	L	260	455	106	0	0	0	0	0	0	0	0	0	821	2.35	5
1	M	465	0	0	0	0	0	0	0	0	0	0	0	465	1.33	21
10	H	92	0	0	0	0	0	0	0	0	0	0	0	92	0.26	8
12	H	8	6	1	8	2	2	4	3	16	8	7	65	0.19	51	
3	L	138	0	0	0	0	0	0	0	0	0	0	0	138	0.39	0
9	L	871	0	0	0	0	0	0	0	0	0	0	0	871	2.49	0
17	M	48	0	0	0	0	0	0	0	0	0	0	0	48	0.14	4
3	H	26	0	0	0	0	0	0	0	0	0	0	0	26	0.07	0
12	M	5	6	0	0	0	0	0	0	0	0	0	0	11	0.03	4
6	M	4	0	0	0	0	0	0	0	0	0	0	0	4	0.01	8
4	L	50	35	25	41	0	0	0	0	0	0	0	0	151	0.43	0
8	M	4000	0	0	0	0	0	0	0	0	0	0	0	4000	11.43	19
8	L	6000	0	0	0	0	0	0	0	0	0	0	0	6000	17.14	11
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0	

ASPHALT PAVED ROADS CONDATION SURVEY DATA SHEET															SKETCH:			
LINK ID: (03N2).....		SECTION ID:.....(03N2/3).....				SAMPLE UNIT:.. (Km 6 -----Km 11)...												
LINK NAME: .....( KASSALA - HAYIA).....		SECTION NAME: ...(UMADAM -DURDAIB)																
SURVEYED BY:.....		DATE:.....				SAMPLE AREA (M):35000				SHEET NO:...(1).....								
1-ALLIGATOR CRAKING		6- DEPRESSTION				11-PATCHING				16-SHOVING								
2-BLEEDING		7- EDGE CRACKING				12-POLISHEDE AGG.				17-SLIPPAGE CRACKING								
3-BLOCK CRACKING		8-JT-REFLECTION CR.				13-POTHOLE				18-SWELL								
4-BUMPS & SAGS		9-LANE SH. DROP				14-RAILROAD CROSSING				19-WEATHER&RAVELING								
5-CORRUGATION		10-LOG.-TR.CR				15-RUTTING												
DISTRESS		SEVERITY	QUANTITY													TOTAL	DENSITY%	DUDACT VALUE
10		L	52	0	0	0	0	0	0	0	0	0	0	0	52	0.15	0	
9		H	4640	0	0	0	0	0	0	0	0	0	0	0	4640	13.26	33	
8		L	6500	0	0	0	0	0	0	0	0	0	0	0	6500	18.57	7	
8		M	3500	0	0	0	0	0	0	0	0	0	0	0	3500	10.00	9	
11		0	24500	0	0	0	0	0	0	0	0	0	0	0	24500	70.00	16	
12		L	0	61	51	0	0	0	0	0	0	0	0	0	112	0.32	7	
12		M	102	0	0	0	0	0	0	0	0	0	0	0	102	0.29	14	
3		M	1509	1376	0	0	0	0	0	0	0	0	0	0	2885	8.24	14	
9		M	1257	0	0	0	0	0	0	0	0	0	0	0	1257	3.59	7	
9		L	224	0	0	0	0	0	0	0	0	0	0	0	224	0.64	0	
1		H	230	0	0	0	0	0	0	0	0	0	0	0	230	0.66	12	
1		L	121	0	0	0	0	0	0	0	0	0	0	0	121	0.35	0	
1		M	165	0	0	0	0	0	0	0	0	0	0	0	165	0.47	7	
3		H	2787	0	0	0	0	0	0	0	0	0	0	0	2787	7.96	26	
10		H	154.5	0	0	0	0	0	0	0	0	0	0	0	154.5	0.44	15	
10		M	351.5	0	0	0	0	0	0	0	0	0	0	0	351.5	1.00	10	
0		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0	

ASPHALT PAVED ROADS CONDATION SURVEY DATA SHEET															SKETCH:		
LINK ID:(03N2).....		SECTION ID:.....(03N2/3).....				SAMPLE UNIT:... (Km 14-----Km 19).....											
LINK NAME: .....( KASSALA - HAYIA).....						SECTION NAME: ...(UMADAM -DURDAIB)											
SURVEYED BY:.....		DATE:.....				SAMPLE AREA (M)35000				SHEET NO :...(2).....							
1-ALLIGATOR CRAKING		6- DEPRESSTION				11-PATCHING				16-SHOVING							
2-BLEEDING		7- EDGE CRACKING				12-POLISHEDE AGG.				17-SLIPPAGE CRACKING							
3-BLOCK CRACKING		8-JT-REFLECTION CR.				13-POTHOLE				18-SWELL							
4-BUMPS & SAGS		9-LANE SH. DROP				14-RAILROAD CROSSING				19-WEATHER&RAVELING							
5-CORRUGATION		10-LOG.-TR.CR				15-RUTTING											
DISTRESS		SEVERITY	QUANTITY												TOTAL	DENSITY%	DUDACT VALUE
8		H	4500	0	0	0	0	0	0	0	0	0	0	4500	12.86	17	
8		M	5000	500	0	0	0	0	0	0	0	0	0	5500	15.71	7	
3		M	6030	0	0	0	0	0	0	0	0	0	0	6030	17.23	20	
12		H	31	0	0	0	0	0	0	0	0	0	0	31	0.09	20	
7		H	46	0	0	0	0	0	0	0	0	0	0	46	0.13	10	
1		M	829	0	0	0	0	0	0	0	0	0	0	829	2.37	22	
9		M	1500	0	0	0	0	0	0	0	0	0	0	1500	4.29	10	
12		M	62	0	0	0	0	0	0	0	0	0	0	62	0.18	10	
10		M	71	0	0	0	0	0	0	0	0	0	0	71	0.20	5	
11		0	30800	0	0	0	0	0	0	0	0	0	0	30800	88.00	17	
9		H	400	0	0	0	0	0	0	0	0	0	0	400	1.14	9	

ASPHALT PAVED ROADS CONDATION SURVEY DATA SHEET															SKETCH:			
LINK ID: (03N2).....			SECTION ID:.....(03N2/3).....					SAMPLE UNIT:.. (Km 22-----Km 27).....										
LINK NAME: .....( KASSALA - HAYIA).....								SECTION NAME: ...(UMADAM -DURDAIB)										
SURVEYED BY:.....		DATE:.....			SAMPLE AREA (M)35000					SHEET NO:...(3).....								
1-ALLIGATOR CRAKING		6- DEPRESSTION					11-PATCHING					16-SHOVING						
2-BLEEDING		7- EDGE CRACKING					12-POLISHEDE AGG.					17-SLIPPAGE CRACKING						
3-BLOCK CRACKING		8-JT-REFLECTION CR.					13-POTHOLE					18-SWELL						
4-BUMPS & SAGS		9-LANE SH. DROP					14-RAILROAD CROSSING					19-WEATHER&RAVELING						
5-CORRUGATION		10-LOG.-TR.CR					15-RUTTING											
DISTRESS		SEVERITY	QUANTITY													TOTAL	DENSITY%	DUDACT VALUE
9		L	224	0	0	0	0	0	0	0	0	0	0	0	224	0.6	0	
9		M	120	0	0	0	0	0	0	0	0	0	0	0	120	0.3	0	
1		L	100	10	100	10	0	0	0	0	0	0	0	0	220	0.6	4	
3		H	28	126	49	98	0	0	0	0	0	0	0	0	301	0.9	7	
3		M	4375	0	0	0	0	0	0	0	0	0	0	0	4375	12.5	16	
3		L	3558	0	0	0	0	0	0	0	0	0	0	0	3558	10.2	8	
10		M	6	2	0	0	0	0	0	0	0	0	0	0	8	0.0	0	
8		M	5000	0	0	0	0	0	0	0	0	0	0	0	5000	14.3	10	
8		L	5000	0	0	0	0	0	0	0	0	0	0	0	5000	14.3	7	
11		0	28000	0	0	0	0	0	0	0	0	0	0	0	28000	80.0	17	
0		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.0	0	

ASPHALT PAVED ROADS CONDATION SURVEY DATA SHEET															SKETCH:			
LINK ID: (03N2).....			SECTION ID:.....(03N2/3).....					SAMPLE UNIT:.. (Km 30-----Km 35).....										
LINK NAME: .....( KASSALA - HAYIA).....								SECTION NAME: ...(UMADAM -DURDAIB)										
SURVEYED BY:.....		DATE:.....			SAMPLE AREA (M)35000					SHEET NO:...(4).....								
1-ALLIGATOR CRAKING		6- DEPRESSTION			11-PATCHING					16-SHOVING								
2-BLEEDING		7- EDGE CRACKING			12-POLISHEDE AGG.					17-SLIPPAGE CRACKING								
3-BLOCK CRACKING		8-JT-REFLECTION CR.			13-POTHOLE					18-SWELL								
4-BUMPS & SAGS		9-LANE SH. DROP			14-RAILROAD CROSSING					19-WEATHER&RAVELING								
5-CORRUGATION		10-LOG.-TR.CR			15-RUTTING													
DISTRESS		SEVERITY	QUANTITY													TOTAL	DENSITY%	DUDACT VALUE
9		L	536	0	0	0	0	0	0	0	0	0	0	0	536	1.53	0	
2		L	1000	600	0	0	0	0	0	0	0	0	0	0	1600	4.57	3	
3		L	1123	0	0	0	0	0	0	0	0	0	0	0	1123	3.21	4	
1		L	138	0	0	0	0	0	0	0	0	0	0	0	138	0.39	6	
3		M	401	0	0	0	0	0	0	0	0	0	0	0	401	1.15	5	
2		M	2800	0	0	0	0	0	0	0	0	0	0	0	2800	8.00	11	
9		M	7	9	11	4	6	0	0	0	0	0	0	0	37	0.11	0	
9		L	40	21	32	0	0	0	0	0	0	0	0	0	93	0.27	0	
8		M	1000	0	0	0	0	0	0	0	0	0	0	0	1000	2.86	5	
8		L	4000	0	0	0	0	0	0	0	0	0	0	0	4000	11.43	6	
0		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0	

ASPHALT PAVED ROADS CONDATION SURVEY DATA SHEET															SKETCH:		
LINK ID: (03N2).....		SECTION ID:.....(03N2/3).....					SAMPLE UNIT:... (Km 38-----Km 43).....										
LINK NAME: .....( KASSALA - HAYIA).....							SECTION NAME: ...(UMADAM -DURDAIB)										
SURVEYED BY:.....		DATE:.....					SAMPLE AREA (M):35000				SHEET NO :...(5).....						
1-ALLIGATOR CRAKING 6- DEPRESSION 11-PATCHING 16-SHOVING 2-BLEEDING 7- EDGE CRACKING 12-POLISHEDE AGG. 17-SLIPPAGE CRACKING 3-BLOCK CRACKING 8-JT-REFLECTION CR. 13-POTHOLE 18-SWELL 4-BUMPS & SAGS 9-LANE SH. DROP 14-RAILROAD CROSSING 19-WEATHER&RAVELING 5-CORRUGATION 10-LOG.-TR.CR 15-RUTTING																	
DISTRESS		SEVERITY	QUANTITY												TOTAL	DENSITY%	DUDACT VALUE
16		H	46	12.5	0	0	0	0	0	0	0	0	0	0	58.5	0.17	0
16		M	25	24	5.5	0	0	0	0	0	0	0	0	0	54.5	0.16	0
16		L	15	0	0	0	0	0	0	0	0	0	0	0	15	0.04	0
12		M	10	0	0	0	0	0	0	0	0	0	0	0	10	0.03	0
1		L	500	10	0	0	0	0	0	0	0	0	0	0	510	1.46	13
9		L	21	20	0	0	0	0	0	0	0	0	0	0	41	0.12	0
8		M	7000	0	0	0	0	0	0	0	0	0	0	0	7000	20.00	13
8		L	3000	0	0	0	0	0	0	0	0	0	0	0	3000	8.57	6
0		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0

ASPHALT PAVED ROADS CONDATION SURVEY DATA SHEET															SKETCH:		
LINK ID: (03N2).....		SECTION ID:.....(03N2/3).....					SAMPLE UNIT:.. (Km 46 -----Km 51).....										
LINK NAME: .....( KASSALA - HAYIA).....										SECTION NAME: ...(UMADAM -DURDAIB).....							
SURVEYED BY:.....		DATE:.....					SAMPLE AREA (M):35000				SHEET NO :...(6).....						
1-ALLIGATOR CRAKING		6- DEPRESSTION					11-PATCHING				16-SHOVING						
2-BLEEDING		7- EDGE CRACKING					12-POLISHEDE AGG.				17-SLIPPAGE CRACKING						
3-BLOCK CRACKING		8-JT-REFLECTION CR.					13-POTHOLE				18-SWELL						
4-BUMPS & SAGS		9-LANE SH. DROP					14-RAILROAD CROSSING				19-WEATHER&RAVELING						
5-CORRUGATION		10-LOG.-TR.CR					15-RUTTING										
DISTRESS		SEVERITY	QUANTITY												TOTAL	DENSITY%	DUDACT VALUE
2		L	2765	0	0	0	0	0	0	0	0	0	0	0	2765	7.90	3
9		L	263	500	0	0	0	0	0	0	0	0	0	0	763	2.18	0
9		M	110	0	0	0	0	0	0	0	0	0	0	0	110	0.31	4
3		L	820	0	0	0	0	0	0	0	0	0	0	0	820	2.34	3
1		H	237.5	75	0	0	0	0	0	0	0	0	0	0	312.5	0.89	30
16		L	25	50	30	0	0	0	0	0	0	0	0	0	105	0.30	0
10		H	20	0	0	0	0	0	0	0	0	0	0	0	20	0.06	4
16		H	60	0	0	0	0	0	0	0	0	0	0	0	60	0.17	0
12		L	2	0	0	0	0	0	0	0	0	0	0	0	2	0.01	0
18		M	3.5	0	0	0	0	0	0	0	0	0	0	0	3.5	0.01	0
6		10.5	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0
11		0	17500	0	0	0	0	0	0	0	0	0	0	0	17500	50.00	12
8		L	3000	0	0	0	0	0	0	0	0	0	0	0	3000	8.57	5
8		M	2000	0	0	0	0	0	0	0	0	0	0	0	2000	5.71	6
0		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0

ASPHALT PAVED ROADS CONDATON SURVEY DATA SHEET															SKETCH:			
LINK ID: (03N2).....		SECTION ID:.....(03N2/3).....					SAMPLE UNIT:.. (Km 54 -----Km 59).....											
LINK NAME: .....( KASSALA - HAYIA).....							SECTION NAME: ... (UMADAM -DURDAIB).....											
SURVEYED BY:.....		DATE:.....			SAMPLE AREA (M):35000				SHEET NO.:...(7).....									
1-ALLIGATOR CRAKING		6- DEPRESSTION				11-PATCHING				16-SHOVING								
2-BLEEDING		7- EDGE CRACKING				12-POLISHEDE AGG.				17-SLIPPAGE CRACKING								
3-BLOCK CRACKING		8-JT-REFLECTION CR.				13-POTHOLE				18-SWELL								
4-BUMPS & SAGS		9-LANE SH. DROP				14-RAILROAD CROSSING				19-WEATHER&RAVELING								
5-CORRUGATION		10-LOG.-TR.CR				15-RUTTING												
DISTRESS		SEVERITY	QUANTITY													TOTAL	DENSITY%	DUDACT VALUE
1		L	415.5	0	0	0	0	0	0	0	0	0	0	0	415.5	1.19	10	
1		M	16	30	0	0	0	0	0	0	0	0	0	0	46	0.13	6	
9		L	384	0	0	0	0	0	0	0	0	0	0	0	384	1.10	0	
9		L	7	0	0	0	0	0	0	0	0	0	0	0	7	0.02	0	
3		L	12	1200	27	6	0	0	0	0	0	0	0	0	1245	3.56	4	
7		M	10	50	20	0	0	0	0	0	0	0	0	0	80	0.23	0	
8		L	4000	0	0	0	0	0	0	0	0	0	0	0	4000	11.43	6	
8		M	6000	0	0	0	0	0	0	0	0	0	0	0	6000	17.14	10	
7		H	30	200	10	0	0	0	0	0	0	0	0	0	240	0.69	9	
3		M	96	0	0	0	0	0	0	0	0	0	0	0	96	0.27	0	
10		H	45	1	0	0	0	0	0	0	0	0	0	0	46	0.13	7	
7		L	100	16	0	0	0	0	0	0	0	0	0	0	116	0.33	0	
12		H	2	1	0	0	0	0	0	0	0	0	0	0	3	0.01	0	
14		L	490	560	0	0	0	0	0	0	0	0	0	0	1050	3.00	17	
12		L	3	0	0	0	0	0	0	0	0	0	0	0	3	0.01	0	
11		0	28000	0	0	0	0	0	0	0	0	0	0	0	28000	80.00	17	
0		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0	

ASPHALT PAVED ROADS CONDATON SURVEY DATA SHEET															SKETCH:			
LINK ID: (03N2).....			SECTION ID:.....(03N2/3).....					SAMPLE UNIT:.. (Km 62 -----Km 67).....										
LINK NAME: .....( KASSALA - HAYIA).....								SECTION NAME: ... (UMADAM -DURDAIB).....										
SURVEYED BY:.....			DATE:.....					SAMPLE AREA (M):35000			SHEET NO:...(8).....							
1-ALLIGATOR CRAKING		6- DEPRESSTION				11-PATCHING				16-SHOVING								
2-BLEEDING		7- EDGE CRACKING				12-POLISHEDE AGG.				17-SLIPPAGE CRACKING								
3-BLOCK CRACKING		8-JT-REFLECTION CR.				13-POTHOLE				18-SWELL								
4-BUMPS & SAGS		9-LANE SH. DROP				14-RAILROAD CROSSING				19-WEATHER&RAVELING								
5-CORRUGATION		10-LOG.-TR.CR				15-RUTTING												
DISTRESS		SEVERITY	QUANTITY													TOTAL	DENSITY%	DUDACT VALUE
9		L	299	570	0	0	0	0	0	0	0	0	0	0	869	2.48	0	
9		M	431	0	0	0	0	0	0	0	0	0	0	0	431	1.23	3	
1		L	223	157.5	0	0	0	0	0	0	0	0	0	0	380.5	1.09	10	
3		L	1769	0	0	0	0	0	0	0	0	0	0	0	1769	5.05	6	
12		H	3	6	0	0	0	0	0	0	0	0	0	0	9	0.03	0	
1		M	50	20	30	20	20	0	0	0	0	0	0	0	140	0.40	6	
10		H	4	3	2	1	39	0	0	0	0	0	0	0	49	0.14	7	
8		L	5000	0	0	0	0	0	0	0	0	0	0	0	5000	14.29	7	
8		M	3000	0	0	0	0	0	0	0	0	0	0	0	3000	8.57	8	
11		0	21000	0	0	0	0	0	0	0	0	0	0	0	21000	60.00	14	
0		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0	

ASPHALT PAVED ROADS CONDATON SURVEY DATA SHEET															SKETCH:		
LINK ID: (03N2).....			SECTION ID:.....(03N2/3).....					SAMPLE UNIT:.. (Km 70 -----Km 75).....									
LINK NAME: .....( KASSALA - HAYIA).....								SECTION NAME: ...(UMADAM -DURDAIB).....									
SURVEYED BY:.....			DATE:.....					SAMPLE AREA (M):35000				SHEET NO :...(9).....					
1-ALLIGATOR CRAKING		6- DEPRESSTION				11-PATCHING				16-SHOVING							
2-BLEEDING		7- EDGE CRACKING				12-POLISHEDE AGG.				17-SLIPPAGE CRACKING							
3-BLOCK CRACKING		8-JT-REFLECTION CR.				13-POTHOLE				18-SWELL							
4-BUMPS & SAGS		9-LANE SH. DROP				14-RAILROAD CROSSING				19-WEATHER&RAVELING							
5-CORRUGATION		10-LOG.-TR.CR				15-RUTTING											
DISTRESS	SEVERITY	QUANTITY													TOTAL	DENSITY%	DUDACT VALUE
9	L	120	30	30	70	20	100	0	0	0	0	0	0	0	370	1.06	0
7	L	5	0	0	0	0	0	0	0	0	0	0	0	0	5	0.01	0
1	L	29	10	20	18	0	0	0	0	0	0	0	0	0	77	0.22	4
12	L	3	2	0	0	0	0	0	0	0	0	0	0	0	5	0.01	0
7	H	3	3	5	5	0	0	0	0	0	0	0	0	0	16	0.05	0
9	M	10	0	0	0	0	0	0	0	0	0	0	0	0	10	0.03	0
4	M	210	0	0	0	0	0	0	0	0	0	0	0	0	210	0.60	10
6	M	6	7	7	0	0	0	0	0	0	0	0	0	0	20	0.06	8
7	M	1	5	10	12	0	0	0	0	0	0	0	0	0	28	0.08	0
8	H	4800	3000	0	0	0	0	0	0	0	0	0	0	0	7800	22.29	24
6	H	14	0	0	0	0	0	0	0	0	0	0	0	0	14	0.04	0
3	L	30	18	60	0	0	0	0	0	0	0	0	0	0	108	0.31	0
11	0	31500	0	0	0	0	0	0	0	0	0	0	0	0	31500	90.00	18
8	M	2200	0	0	0	0	0	0	0	0	0	0	0	0	2200	6.29	5
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0

ASPHALT PAVED ROADS CONDATON SURVEY DATA SHEET															SKETCH:		
LINK ID: (03N2).....		SECTION ID:.....(03N2/3).....					SAMPLE UNIT:.. (Km 78 -----Km 83).....										
LINK NAME: (KASSALA - HAYIA).....							SECTION NAME: ... (UMADAM -DURDAIB).....										
SURVEYED BY:.....		DATE:.....					SAMPLE AREA (M):35000				SHEET NO:....(10).....						
1-ALLIGATOR CRAKING		6- DEPRESSION					11-PATCHING				16-SHOVING						
2-BLEEDING		7- EDGE CRACKING					12-POLISHEDE AGG.				17-SLIPPAGE CRACKING						
3-BLOCK CRACKING		8-JT-REFLECTION CR.					13-POTHOLE				18-SWELL						
4-BUMPS & SAGS		9-LANE SH. DROP					14-RAILROAD CROSSING				19-WEATHER&RAVELING						
5-CORRUGATION		10-LOG.-TR.CR					15-RUTTING										
DISTRESS		SEVERITY	QUANTITY												TOTAL	DENSITY%	DUDACT VALUE
10		H	172.5	0	0	0	0	0	0	0	0	0	0	0	172.5	0.49	15
12		H	57	104	49	0	0	0	0	0	0	0	0	0	210	0.60	43
12		M	65	96	0	0	0	0	0	0	0	0	0	0	161	0.46	20
9		M	239	0	0	0	0	0	0	0	0	0	0	0	239	0.68	0
10		M	8.5	0	0	0	0	0	0	0	0	0	0	0	8.5	0.02	0
3		M	9318	6740	0	0	0	0	0	0	0	0	0	0	16058	45.88	33
7		H	761	0	0	0	0	0	0	0	0	0	0	0	761	2.17	10
3		H	2870	0	0	0	0	0	0	0	0	0	0	0	2870	8.20	27
14		M	2112	0	0	0	0	0	0	0	0	0	0	0	2112	6.03	36
3		L	1000	600	840	500	280	500	0	0	0	0	0	0	3720	10.63	9
1		L	20	0	0	0	0	0	0	0	0	0	0	0	20	0.06	4
11		0	31500	0	0	0	0	0	0	0	0	0	0	0	31500	90.00	18
8		M	1000	0	0	0	0	0	0	0	0	0	0	0	1000	2.86	6
8		L	4000	0	0	0	0	0	0	0	0	0	0	0	4000	11.43	7
0		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0

ASPHALT PAVED ROADS CONDATON SURVEY DATA SHEET															SKETCH:		
LINK ID: (03N2).....		SECTION ID: .....(03N2/3).....					SAMPLE UNIT:.. (Km 86 -----Km 91).....										
LINK NAME: .....( KASSALA - HAYIA).....							SECTION NAME: ..(UMADAM -DURDAIB).....										
SURVEYED BY:.....		DATE:.....					SAMPLE AREA (M)35000				SHEET NO :...(11).....						
1-ALLIGATOR CRAKING		6- DEPRESSTION					11-PATCHING				16-SHOVING						
2-BLEEDING		7- EDGE CRACKING					12-POLISHEDE AGG.				17-SLIPPAGE CRACKING						
3-BLOCK CRACKING		8-JT-REFLECTION CR.					13-POTHOLE				18-SWELL						
4-BUMPS & SAGS		9-LANE SH. DROP					14-RAILROAD CROSSING				19-WEATHER&RAVELING						
5-CORRUGATION		10-LOG.-TR.CR					15-RUTTING										
DISTRESS		SEVERITY	QUANTITY												TOTAL	DENSITY%	DUDACT VALUE
3	H	700	1200	0	0	0	0	0	0	0	0	0	0	0	1900	5.43	20
3	M	10200	0	0	0	0	0	0	0	0	0	0	0	0	10200	29.14	27
9	L	100	200	19	7	0	0	0	0	0	0	0	0	0	326	0.93	0
9	M	50	500	600	500	300	0	0	0	0	0	0	0	0	1950	5.57	13
8	L	500	2000	500	2000	1500	0	0	0	0	0	0	0	0	6500	18.57	8
12	H	30	30	10	14	8	0	0	0	0	0	0	0	0	92	0.26	30
8	M	1000	500	0	0	0	0	0	0	0	0	0	0	0	1500	4.29	5
1	L	200	0	0	0	0	0	0	0	0	0	0	0	0	200	0.57	4
7	H	25	50	0	0	0	0	0	0	0	0	0	0	0	75	0.21	0
12	L	8	18	18	8	9	8	0	0	0	0	0	0	0	69	0.20	6
7	M	30	0	0	0	0	0	0	0	0	0	0	0	0	30	0.09	0
10	M	4	6	0	0	0	0	0	0	0	0	0	0	0	10	0.03	0
3	L	1500	2500	0	0	0	0	0	0	0	0	0	0	0	4000	11.43	9
9	H	200	0	0	0	0	0	0	0	0	0	0	0	0	200	0.57	6
11	0	31500	0	0	0	0	0	0	0	0	0	0	0	0	31500	90.00	18
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0

ASPHALT PAVED ROADS CONDATON SURVEY DATA SHEET															SKETCH:		
LINK ID: (03N2).....		SECTION ID:.....(03N2/3).....					SAMPLE UNIT:.. (Km 94 -----Km 99).....										
LINK NAME: .....( KASSALA - HAYIA).....							SECTION NAME: ..(UMADAM -DURDAIB).....										
SURVEYED BY:.....		DATE:.....					SAMPLE AREA (M)35000				SHEET NO :...(12).....						
1-ALLIGATOR CRAKING		6- DEPRESSION					11-PATCHING				16-SHOVING						
2-BLEEDING		7- EDGE CRACKING					12-POLISHEDE AGG.				17-SLIPPAGE CRACKING						
3-BLOCK CRACKING		8-JT-REFLECTION CR.					13-POTHOLE				18-SWELL						
4-BUMPS & SAGS		9-LANE SH. DROP					14-RAILROAD CROSSING				19-WEATHER&RAVELING						
5-CORRUGATION		10-LOG.-TR.CR					15-RUTTING										
DISTRESS		SEVERITY	QUANTITY												TOTAL	DENSITY%	DUDACT VALUE
12		M	202	24	0	0	0	0	0	0	0	0	0	0	226	0.65	26
3		M	5610	80	70	36	15	42	0	0	0	0	0	0	5853	16.72	20
9		L	1143	240	0	0	0	0	0	0	0	0	0	0	1383	3.95	4
1		L	1091.5	0	0	0	0	0	0	0	0	0	0	0	1091.5	3.12	20
9		H	1304	0	0	0	0	0	0	0	0	0	0	0	1304	3.73	20
12		H	193	18	0	0	0	0	0	0	0	0	0	0	211	0.60	43
7		H	865	0	0	0	0	0	0	0	0	0	0	0	865	2.47	10
9		M	1901	250	60	0	0	0	0	0	0	0	0	0	2211	6.32	14
14		H	1262	0	0	0	0	0	0	0	0	0	0	0	1262	3.61	45
3		L	5255	0	0	0	0	0	0	0	0	0	0	0	5255	15.01	10
3		H	84	0	0	0	0	0	0	0	0	0	0	0	84	0.24	3
10		H	43	0	0	0	0	0	0	0	0	0	0	0	43	0.12	7
1		L	150	120	68	42	26	0	0	0	0	0	0	0	406	1.16	10
1		M	11	0	0	0	0	0	0	0	0	0	0	0	11	0.03	0
11			32900	0	0	0	0	0	0	0	0	0	0	0	32900	94.00	19
8		M	4000	0	0	0	0	0	0	0	0	0	0	0	4000	11.43	9
8		L	4000	0	0	0	0	0	0	0	0	0	0	0	4000	11.43	5
0		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0

ASPHALT PAVED ROADS CONDATION SURVEY DATA SHEET															SKETCH:		
LINK ID: (03N2).....		SECTION ID:....(03N2/3).....					SAMPLE UNIT:... (Km102 -----Km 107).....										
LINK NAME: .....( KASSALA - HAYIA).....							SECTION NAME: ...(UMADAM -DURDAIB).....										
SURVEYED BY:.....		DATE:.....					SAMPLE AREA (M):35000				SHEET NO:...(13).....						
1-ALLIGATOR CRAKING		6- DEPRESSTION					11-PATCHING				16-SHOVING						
2-BLEEDING		7- EDGE CRACKING					12-POLISHEDE AGG.				17-SLIPPAGE CRACKING						
3-BLOCK CRACKING		8-JT-REFLECTION CR.					13-POTHOLE				18-SWELL						
4-BUMPS & SAGS		9-LANE SH. DROP					14-RAILROAD CROSSING				19-WEATHER&RAVELING						
5-CORRUGATION		10-LOG.-TR.CR					15-RUTTING										
DISTRESS		SEVERITY	QUANTITY												TOTAL	DENSITY%	DUDACT VALUE
3		H	9250	0	0	0	0	0	0	0	0	0	0	0	9250	26.43	45
7		H	100	50	0	0	0	0	0	0	0	0	0	0	150	0.43	8
7		M	100	25	0	0	0	0	0	0	0	0	0	0	125	0.36	5
8		M	1000	1000	500	1000	0	0	0	0	0	0	0	0	3500	10.00	9
12		H	11	10	10	20	50	80	0	0	0	0	0	0	181	0.52	40
8		L	1000	1000	1000	1500	1000	0	0	0	0	0	0	0	5500	15.71	7
9		H	650	300	100	500	0	0	0	0	0	0	0	0	1550	4.43	20
3		L	900	1280	800	0	0	0	0	0	0	0	0	0	2980	8.51	8
1		H	100	60	75	200	0	0	0	0	0	0	0	0	435	1.24	30
12		L	8	10	20	30	18	6	0	0	0	0	0	0	92	0.26	7
9		M	340	400	200	600	0	0	0	0	0	0	0	0	1540	4.40	10
9		L	210	0	0	0	0	0	0	0	0	0	0	0	210	0.60	0
10		M	6	0	0	0	0	0	0	0	0	0	0	0	6	0.02	0
1		M	400	0	0	0	0	0	0	0	0	0	0	0	400	1.14	21
3		M	800	0	0	0	0	0	0	0	0	0	0	0	800	2.29	6
0		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0

ASPHALT PAVED ROADS CONDATION SURVEY DATA SHEET															SKETCH:		
LINK ID: (03N2).....	SECTION ID:....(03N2/3).....				SAMPLE UNIT:.. (Km110 -----Km115).....												
LINK NAME: .....( KASSALA - HAYIA).....					SECTION NAME: ...(UMADAM -DURDAIB).....												
SURVEYED BY:.....	DATE:.....				SAMPLE AREA (M):35000					SHEET NO:...(14).....							
1-ALLIGATOR CRAKING	6- DEPRESSTION				11-PATCHING					16-SHOVING							
2-BLEEDING	7- EDGE CRACKING				12-POLISHEDE AGG.					17-SLIPPAGE CRACKING							
3-BLOCK CRACKING	8-JT-REFLECTION CR.				13-POTHOLE					18-SWELL							
4-BUMPS & SAGS	9-LANE SH. DROP				14-RAILROAD CROSSING					19-WEATHER&RAVELING							
5-CORRUGATION	10-LOG.-TR.CR				15-RUTTING												
DISTRESS	SEVERITY	QUANTITY													TOTAL	DENSITY%	DUDACT VALUE
9	H	35	0	0	0	0	0	0	0	0	0	0	0	0	35	0.10	0
12	M	93	6	2	2	4	7	9	8	12	3	10	0	0	156	0.45	20
12	H	5	81	6	23	6	3	4	15	7	15	7	198	62	432	1.23	52
3	H	4200	1200	21525	0	0	0	0	0	0	0	0	0	0	26925	76.93	66
11	0	32900	0	0	0	0	0	0	0	0	0	0	0	0	32900	94.00	19
8	L	6000	0	0	0	0	0	0	0	0	0	0	0	0	6000	17.14	8
8	M	4000	0	0	0	0	0	0	0	0	0	0	0	0	4000	11.43	9
10	M	51	0	0	0	0	0	0	0	0	0	0	0	0	51	0.15	4
7	H	2610	0	0	0	0	0	0	0	0	0	0	0	0	2610	7.46	21
10	H	145	0	0	0	0	0	0	0	0	0	0	0	0	145	0.41	13
3	M	1.5	0.8	2	6	0	0	0	0	0	0	0	0	0	10.3	0.03	0
12	L	2	3	4	6	0	0	0	0	0	0	0	0	0	15	0.04	0
9	M	30	170	50	0	0	0	0	0	0	0	0	0	0	250	0.71	0
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0

ASPHALT PAVED ROADS CONDTION SURVEY DATA SHEET															SKETCH:		
LINK ID: (03N2).....		SECTION ID:.....(03N2/3).....					SAMPLE UNIT:... (Km 118 -----Km 123).....										
LINK NAME: .....( KASSALA - HAYIA).....							SECTION NAME: ... (UMADAM -DURDAIB).....										
SURVEYED BY:.....		DATE:.....					SAMPLE AREA (M):35000				SHEET NO:...(15).....						
1-ALLIGATOR CRAKING		6- DEPRESSTION					11-PATCHING				16-SHOVING						
2-BLEEDING		7- EDGE CRACKING					12-POLISHEDE AGG.				17-SLIPPAGE CRACKING						
3-BLOCK CRACKING		8-JT-REFLECTION CR.					13-POTHOLE				18-SWELL						
4-BUMPS & SAGS		9-LANE SH. DROP					14-RAILROAD CROSSING				19-WEATHER&RAVELING						
5-CORRUGATION		10-LOG.-TR.CR					15-RUTTING										
DISTRESS		SEVERITY	QUANTITY												TOTAL	DENSITY%	DUDACT VALUE
10		M	83	0	0	0	0	0	0	0	0	0	0	0	83	0.24	5
12		L	41	10	0	0	0	0	0	0	0	0	0	0	51	0.15	5
7		H	541	0	0	0	0	0	0	0	0	0	0	0	541	1.55	9
7		M	382	0	0	0	0	0	0	0	0	0	0	0	382	1.09	7
9		M	600	1000	500	500	2000	0	0	0	0	0	0	0	4600	13.14	20
9		L	5	82	0	0	0	0	0	0	0	0	0	0	87	0.25	0
3		H	350	390	1841	0	0	0	0	0	0	0	0	0	2581	7.37	25
8		M	600	1000	500	500	2000	0	0	0	0	0	0	0	4600	13.14	8
8		L	400	500	1000	500	0	0	0	0	0	0	0	0	2400	6.86	5
12		H	10	7	3	7	0	0	0	0	0	0	0	0	27	0.08	20
12		M	14	3	12	10	5	3	4	0	0	0	0	0	51	0.15	7
10		L	0.5	6	2	0.5	2	4	0	0	0	0	0	0	15	0.04	0
3		M	10294	400	600	600	0	0	0	0	0	0	0	0	11894	33.98	28
9		H	13	0	0	0	0	0	0	0	0	0	0	0	13	0.04	0
8		H	500	0	0	0	0	0	0	0	0	0	0	0	500	1.43	0
10		H	2	0	0	0	0	0	0	0	0	0	0	0	2	0.01	0
3		L	600	500	600	750	1500	0	0	0	0	0	0	0	3950	11.29	9
11		0	28000	0	0	0	0	0	0	0	0	0	0	0	28000	80.00	17
0		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0

ASPHALT PAVED ROADS CONDTION SURVEY DATA SHEET															SKETCH:		
LINK ID: (03N2).....		SECTION ID:.....(03N2/3).....					SAMPLE UNIT... (Km 125 -----Km 130).....										
LINK NAME: .....( KASSALA - HAYIA).....					SECTION NAME: ... (UMADAM -DURDAIB).....												
SURVEYED BY:.....		DATE:.....					SAMPLE AREA (M):35000				SHEET NO:...(16).....						
1-ALLIGATOR CRAKING		6- DEPRESSTION					11-PATCHING				16-SHOVING						
2-BLEEDING		7- EDGE CRACKING					12-POLISHEDE AGG.				17-SLIPPAGE CRACKING						
3-BLOCK CRACKING		8-JT-REFLECTION CR.					13-POTHOLE				18-SWELL						
4-BUMPS & SAGS		9-LANE SH. DROP					14-RAILROAD CROSSING				19-WEATHER&RAVELING						
5-CORRUGATION		10-LOG.-TR.CR					15-RUTTING										
DISTRESS		SEVERITY	QUANTITY												TOTAL	DENSITY%	DUDACT VALUE
10		L	1	1	0.5	2	1	9	0	0	0	0	0	0	14.5	0.04	0
1		M	30	60	34	20	33	43	30	35	50	0	0	0	335	0.96	21
7		H	1413	300	500	500	0	0	0	0	0	0	0	0	2713	7.75	20
3		M	1692	725	0	0	0	0	0	0	0	0	0	0	2417	6.91	13
3		H	7364	3660	0	0	0	0	0	0	0	0	0	0	11024	31.50	50
9		M	15	23	42	22	117	60	64	36	45	0	0	0	424	1.21	3
10		M	2	6	7	25	25	75	15	25	0	0	0	0	180	0.51	7
9		H	20	15	12	17	15	27	16	20	50	13	111	0	316	0.90	7
9		L	20	43	15	60	0	0	0	0	0	0	0	0	138	0.39	0
1		H	190	22	43	23	40	20	25	40	50	100	0	0	553	1.58	28
10		H	42	9	9	9	16	3	63	16	42	35	16	56	316	0.90	18
12		H	7	9	8	2	6	2	10	7	20	74	25	40	210	0.60	43
2		H	3	5	35	5	10	0	0	0	0	0	0	0	58	0.17	3
3		L	2100	900	750	250	490	0	0	0	0	0	0	0	4490	12.83	9
11		0	3500	0	0	0	0	0	0	0	0	0	0	0	3500	10.00	4
8		M	3700	0	0	0	0	0	0	0	0	0	0	0	3700	10.57	9
8		L	6300	0	0	0	0	0	0	0	0	0	0	0	6300	18.00	9
0		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0

ASPHALT PAVED ROADS CONDATION SURVEY DATA SHEET																SKETCH:		
LINK ID:...(03N2)...		SECTION ID:...(03N2/4).....					SAMPLE UNIT:...(Km 0 -----Km 5).....											
LINK NAME: .....( KASSALA - HAYIA).....							SECTION NAME: ...(DURDAIB-ADROUT)....											
SURVEYED BY:...		DATE:.....					SAMPLE AREA (M)35000					SHEET NO :...(1).....						
1-ALLIGATOR CRAKING	6- DEPRESSION	11-PATCHING					16-SHOVING											
2-BLEEDING	7- EDGE CRACKING	12-POLISHEDE AGG.					17-SLIPPAGE CRACKING											
3-BLOCK CRACKING	8-JT-REFLECTION CR.	13-POTHOLE					18-SWELL											
4-BUMPS & SAGS	9-LANE SH. DROP	14-RAILROAD CROSSING					19-WEATHER&RAVELING											
5-CORRUGATION	10-LOG.-TR.CR	15-RUTTING																
DISTRESS	SEVERITY	QUANTITY														TOTAL	DENSITY%	DUDACT VALUE
8	M	3500	0	0	0	0	0	0	0	0	0	0	0	0	3500	10.00	9	
12	H	23	0	0	0	0	0	0	0	0	0	0	0	0	23	0.07	0	
12	L	62	0	0	0	0	0	0	0	0	0	0	0	0	62	0.18	0	
12	M	25	0	0	0	0	0	0	0	0	0	0	0	0	25	0.07	0	
1	M	200	45	1000	800	0	0	0	0	0	0	0	0	0	2045	5.84	40	
3	M	500	2000	0	0	0	0	0	0	0	0	0	0	0	2500	7.14	14	
3	L	600	1200	1500	0	0	0	0	0	0	0	0	0	0	3300	9.43	8	
7	H	45	16	0	0	0	0	0	0	0	0	0	0	0	61	0.17	0	
9	M	1050	0	0	0	0	0	0	0	0	0	0	0	0	1050	3.00	7	
9	L	300	350	400	140	280	300	100	0	0	0	0	0	0	1870	5.34	4	
8	L	500	3500	0	0	0	0	0	0	0	0	0	0	0	4000	11.43	5	
10	M	2	7	10	0	0	0	0	0	0	0	0	0	0	19	0.05	0	
10	L	6.5	0	0	0	0	0	0	0	0	0	0	0	0	6.5	0.02	0	
1	L	200	1500	1000	1000	1000	1000	100	0	0	0	0	0	0	5800	16.57	19	
8	H	500	0	0	0	0	0	0	0	0	0	0	0	0	500	1.43	0	
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0	

ASPHALT PAVED ROADS CONDATION SURVEY DATA SHEET																SKETCH:			
LINK ID:...(03N2)...		SECTION ID:....(03N2/4).....					SAMPLE UNIT:...(Km 6-----Km 11).....												
LINK NAME:.....(KASSALA - HAYIA).....							SECTION NAME:...(DURDAIB-ADROUT)....												
SURVEYED BY:...		DATE:.....				SAMPLE AREA (M)35000					SHEET NO:...(2).....								
1-ALLIGATOR CRAKING		6- DEPRESSION					11-PATCHING					16-SHOVING							
2-BLEEDING		7- EDGE CRACKING					12-POLISHEDE AGG.					17-SLIPPAGE CRACKING							
3-BLOCK CRACKING		8-JT-REFLECTION CR.					13-POTHOLE					18-SWELL							
4-BUMPS & SAGS		9-LANE SH. DROP					14-RAILROAD CROSSING					19-WEATHER&RAVELING							
5-CORRUGATION		10-LOG.-TR.CR					15-RUTTING												
DISTRESS		SEVERITY	QUANTITY													TOTAL	DENSITY%	DUDACT VALUE	
3		L	440	360	248	143.5	180	60	129	60	24.5	180	740	296	224	110	3195	0.0	0
10		M	9	0.4	7	0.5	1	6	14	11	0	0	0	0	0	0	48.9	7.0	D. V.
1		L	110	65	150	5	6	23	15	45	67	120	60	23	0	0	689	0.0	4
3		M	154	112	150	160	108	104	68	119	750	180	245	26	276	0	2452	16.0	1
9		M	117	198	12	182	80	45	23	65	44	76	27	78	93	0	1040	12.0	5
11		0	35000	0	0	0	0	0	0	0	0	0	0	0	0	0	35000	7.0	2
8		M	3000	0	0	0	0	0	0	0	0	0	0	0	0	0	3000	20.0	0
8		L	6000	0	0	0	0	0	0	0	0	0	0	0	0	0	6000	8.0	0
1		M	23	32	28	55	24	63	12	41	21	0	0	0	0	0	299	7.0	0
0		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	21.0	13

ASPHALT PAVED ROADS CONADATION SURVEY DATA SHEET																SKETCH:			
LINK ID:...(03N2)...		SECTION ID:.....(03N2/4).....				SAMPLE UNIT:...(Km 12-----Km 17).....													
LINK NAME:.....(KASSALA - HAYIA).....						SECTION NAME:...(DURDAIB-ADROUT)....													
SURVEYED BY:...		DATE:.....				SAMPLE AREA (M)35000				SHEET NO.:...(3)...									
1-ALLIGATOR CRAKING		6- DEPRESSION				11-PATCHING				16-SHOVING									
2-BLEEDING		7- EDGE CRACKING				12-POLISHEDE AGG.				17-SLIPPAGE CRACKING									
3-BLOCK CRACKING		8-JT-REFLECTION CR.				13-POTHOLE				18-SWELL									
4-BUMPS & SAGS		9-LANE SH. DROP				14-RAILROAD CROSSING				19-WEATHER&RAVELING									
5-CORRUGATION		10-LOG.-TR.CR				15-RUTTING													
DISTRESS		SEVERITY	QUANTITY														TOTAL	DENSITY%	DUDACT VALUE
10	L	21.5	0	0	0	0	0	0	0	0	0	0	0	0	0	21.5	0.06	0	
8	M	6200	0	0	0	0	0	0	0	0	0	0	0	0	0	6200	17.71	12	
8	L	2800	0	0	0	0	0	0	0	0	0	0	0	0	0	2800	8.00	5	
3	L	1500	1600	619.5	70	77	40	28	60	44	160	0	0	0	0	4198.5	12.00	19	
1	L	700	14	65	30	0	0	0	0	0	0	0	0	0	0	809	2.31	16	
9	L	140	150	600	63	325	475	315	150	0	0	0	0	0	0	2218	6.34	4	
9	M	700	19	42	128	0	0	0	0	0	0	0	0	0	0	889	2.54	7	
1	M	300	40	37	20	20	14	15	45	0	0	0	0	0	0	491	1.40	21	
12	L	5	0	0	0	0	0	0	0	0	0	0	0	0	0	5	0.01	0	
10	L	8	1	1.5	0	0	0	0	0	0	0	0	0	0	0	10.5	0.03	0	
1	H	50	1	15	20	40	0	0	0	0	0	0	0	0	0	126	0.36	0	
10	H	7	14	0	0	0	0	0	0	0	0	0	0	0	0	21	0.06	0	
3	M	30	16.5	0	0	0	0	0	0	0	0	0	0	0	0	46.5	0.13	0	
11		2800	0	0	0	0	0	0	0	0	0	0	0	0	0	2800	0.00	0	

ASPHALT PAVED ROADS CONADATION SURVEY DATA SHEET																SKETCH:		
LINK ID:...(03N2)...		SECTION ID:.....(03N2/4).....				SAMPLE UNIT:.... (Km 18-----Km 23).....												
LINK NAME:.....(KASSALA - HAYIA).....						SECTION NAME:...(DURDAIB-ADROUT)....												
SURVEYED BY:...		DATE:.....				SAMPLE AREA (M):35000				SHEET NO.:...(4)...								
1-ALLIGATOR CRAKING		6- DEPRESSION				11-PATCHING				16-SHOVING								
2-BLEEDING		7- EDGE CRACKING				12-POLISHEDE AGG.				17-SLIPPAGE CRACKING								
3-BLOCK CRACKING		8-JT-REFLECTION CR.				13-POTHOLE				18-SWELL								
4-BUMPS & SAGS		9-LANE SH. DROP				14-RAILROAD CROSSING				19-WEATHER&RAVELING								
5-CORRUGATION		10-LOG-TR.CR				15-RUTTING												
DISTRESS		SEVERITY	QUANTITY													TOTAL	DENSITY%	DUDACT VALUE
9		M	48	87	44	0	0	0	0	0	0	0	0	0	0	179	0.5	3
7		H	32	47	0	0	0	0	0	0	0	0	0	0	0	79	0.2	0
12		M	29	0	0	0	0	0	0	0	0	0	0	0	0	29	0.1	0
3		H	600	172	270	165	9	210	390	132	0	0	0	0	0	1948	5.6	22
9		H	16	15	20	17	11	0	0	0	0	0	0	0	0	79	0.2	0
1		H	32	0	0	0	0	0	0	0	0	0	0	0	0	32	0.1	0
10		H	84	0	0	0	0	0	0	0	0	0	0	0	0	84	0.2	0
11		0	35000	0	0	0	0	0	0	0	0	0	0	0	0	35000	100.0	20
8		L	4000	0	0	0	0	0	0	0	0	0	0	0	0	4000	11.4	5
8		M	3000	0	0	0	0	0	0	0	0	0	0	0	0	3000	8.6	7
0		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.0	0

ASPHALT PAVED ROADS CONDATION SURVEY DATA SHEET																SKETCH:		
LINK ID:...(03N2)...		SECTION ID:....(03N2/4).....					SAMPLE UNIT:.. (Km 24-----Km 29).....											
LINK NAME: .....( KASSALA - HAYIA).....							SECTION NAME: ...(DURDAIB-ADROUT)....											
SURVEYED BY:...		DATE:.....					SAMPLE AREA (M)35000					SHEET NO:...(5)...						
1-ALLIGATOR CRAKING		6- DEPRESSION					11-PATCHING					16-SHOVING						
2-BLEEDING		7- EDGE CRACKING					12-POLISHEDE AGG.					17-SLIPPAGE CRACKING						
3-BLOCK CRACKING		8-JT-REFLECTION CR.					13-POTHOLE					18-SWELL						
4-BUMPS & SAGS		9-LANE SH. DROP					14-RAILROAD CROSSING					19-WEATHER&RAVELING						
5-CORRUGATION		10-LOG.-TR.CR					15-RUTTING											
DISTRESS	SEVERITY	QUANTITY														TOTAL	DENSITY%	DUDACT VALUE
3	H	1000	91	0	0	0	0	0	0	0	0	0	0	0	0	1091	3.1	16
3	L	260	57	400	250	1500	2950	0	0	0	0	0	0	0	0	5417	15.5	10
10	H	150	0	0	0	0	0	0	0	0	0	0	0	0	0	150	0.4	0
8	H	600	0	0	0	0	0	0	0	0	0	0	0	0	0	600	1.7	6
7	H	60	0	0	0	0	0	0	0	0	0	0	0	0	0	60	0.2	0
8	M	700	1000	3700	0	0	0	0	0	0	0	0	0	0	0	5400	15.4	10
8	L	1700	1800	0	0	0	0	0	0	0	0	0	0	0	0	3500	10.0	8
9	L	190	60	0	0	0	0	0	0	0	0	0	0	0	0	250	0.7	0
9	M	95	0	0	0	0	0	0	0	0	0	0	0	0	0	95	0.3	0
1	H	16	0	0	0	0	0	0	0	0	0	0	0	0	0	16	0.0	0
1	M	14	5	300	0	0	0	0	0	0	0	0	0	0	0	319	0.9	20
1	L	2.5	300	150	160	80	0	0	0	0	0	0	0	0	0	692.5	2.0	11
7	M	2	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0.0	0
12	L	6	0	0	0	0	0	0	0	0	0	0	0	0	0	6	0.0	0
12	M	3	0	0	0	0	0	0	0	0	0	0	0	0	0	3	0.0	0
10	L	31	4	0	0	0	0	0	0	0	0	0	0	0	0	35	0.1	0
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.0	0

ASPHALT PAVED ROADS CONDATION SURVEY DATA SHEET																SKETCH:		
LINK ID:...(03N2)...	SECTION ID:...(03N2/4).....	SAMPLE UNIT:.. (Km 30-----Km 35).....																
LINK NAME: .....( KASSALA - HAYIA).....		SECTION NAME: ..(DURDAIB-ADROUT)....																
SURVEYED BY:.....	DATE:.....	SAMPLE AREA (M)35000.....				SHEET NO:...(6).....												
1-ALLIGATOR CRAKING	6- DEPRESSION	11-PATCHING				16-SHOVING												
2-BLEEDING	7- EDGE CRACKING	12-POLISHEDE AGG.				17-SLIPPAGE CRACKING												
3-BLOCK CRACKING	8-JT-REFLECTION CR.	13-POTHOLE				18-SWELL												
4-BUMPS & SAGS	9-LANE SH. DROP	14-RAILROAD CROSSING				19-WEATHER&RAVELING												
5-CORRUGATION	10-LOG.-TR.CR	15-RUTTING																
DISTRESS	SEVERITY	QUANTITY														TOTAL	DENSITY%	DUDACT VALUE
1	L	3	35	34	11	31	36	8	76	26	20	26	0	0	0	306	0.9	10
9	L	44	107	146	58	102	48	0	0	0	0	0	0	0	0	505	1.4	0
3	M	77	147	215	88	175	30	140	56	0	0	0	0	0	0	928	2.7	8
9	M	17	22	95	14	67	94	37	74	137	0	0	0	0	0	557	1.6	4
3	L	247.5	75	126	0	0	0	0	0	0	0	0	0	0	0	448.5	1.3	0
10	L	10.5	0	0	0	0	0	0	0	0	0	0	0	0	0	10.5	0.0	0
12	H	39	0	0	0	0	0	0	0	0	0	0	0	0	0	39	0.1	0
10	M	13.5	14	20	10.5	0	0	0	0	0	0	0	0	0	0	58	0.2	0
3	H	600	210	121	60	335	0	0	0	0	0	0	0	0	0	1326	3.8	17
1	M	22	55	27	65	33	8	0	0	0	0	0	0	0	0	210	0.6	21
7	H	15	21	13	26	21	0	0	0	0	0	0	0	0	0	96	0.3	0
1	H	22	7	15	22	0	0	0	0	0	0	0	0	0	0	66	0.2	0
10	H	10	21	8	0	0	0	0	0	0	0	0	0	0	0	39	0.1	0
11	0	23800	0	0	0	0	0	0	0	0	0	0	0	0	0	23800	68.0	16
9	H	14	7	24	20	0	0	0	0	0	0	0	0	0	0	65	0.2	0
8	L	4000	0	0	0	0	0	0	0	0	0	0	0	0	0	4000	11.4	7
8	M	5000	0	0	0	0	0	0	0	0	0	0	0	0	0	5000	14.3	10
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.0	0

ASPHALT PAVED ROADS CONDATION SURVEY DATA SHEET															SKETCH:		
LINK ID:03N2		SECTION ID:.....(03N2/5).....					SAMPLE UNIT:... (Km 5 -----Km 10)...										
LINK NAME: .....( KASSALA - HAYIA).....							SECTION NAME: ...(ADROUT-HAYIA).....										
SURVEYED BY:.....		DATE:.....					SAMPLE AREA (M)35000				SHEET NO:...(1).....						
1-ALLIGATOR CRAKING		6- DEPRESSION					11-PATCHING				16-SHOVING						
2-BLEEDING		7- EDGE CRACKING					12-POLISHEDE AGG.				17-SLIPPAGE CRACKING						
3-BLOCK CRACKING		8-JT-REFLECTION CR.					13-POTHOLE				18-SWELL						
4-BUMPS & SAGS		9-LANE SH. DROP					14-RAILROAD CROSSING				19-WEATHER&RAVELING						
5-CORRUGATION		10-LOG.-TR.CR					15-RUTTING										
DISTRESS		SEVERITY	QUANTITY												TOTAL	DENSITY%	DUDACT VALUE
19	H	9	9	0	0	0	0	0	0	0	0	0	0	0	18	0.05	0
9	M	175	0	0	0	0	0	0	0	0	0	0	0	0	175	0.50	0
1	M	17	10.5	15	30	10	30	0	0	0	0	0	0	0	112.5	0.32	0
3	M	200	300	328	0	0	0	0	0	0	0	0	0	0	828	2.37	7
9	H	5	4	5	0	0	0	0	0	0	0	0	0	0	14	0.04	0
3	H	35	0	0	0	0	0	0	0	0	0	0	0	0	35	0.10	0
1	L	3	10	7	0	0	0	0	0	0	0	0	0	0	20	0.06	4
9	L	15	0	0	0	0	0	0	0	0	0	0	0	0	15	0.04	0
2	L	5	0	0	0	0	0	0	0	0	0	0	0	0	5	0.01	0
8	L	4000	0	0	0	0	0	0	0	0	0	0	0	0	4000	11.43	5
8	M	1000	0	0	0	0	0	0	0	0	0	0	0	0	1000	2.86	4
12	L	5	4	0	0	0	0	0	0	0	0	0	0	0	9	0.03	0
16	L	50	30	0	0	0	0	0	0	0	0	0	0	0	80	0.23	0
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0

ASPHALT PAVED ROADS CONDATION SURVEY DATA SHEET															SKETCH:		
LINK ID:03N2	SECTION ID:.....(03N2/5).....					SAMPLE UNIT:... (Km 12 -----Km 17)...											
LINK NAME: .....( KASSALA - HAYIA).....						SECTION NAME: ...(ADROUT-HAYIA).....											
SURVEYED BY:.....	DATE:.....					SAMPLE AREA (M)35000					SHEET NO:...(2)...						
1-ALLIGATOR CRAKING 6- DEPRESSION 11-PATCHING 16-SHOVING 2-BLEEDING 7- EDGE CRACKING 12-POLISHEDE AGG. 17-SLIPPAGE CRACKING 3-BLOCK CRACKING 8-JT-REFLECTION CR. 13-POTHOLE 18-SWELL 4-BUMPS & SAGS 9-LANE SH. DROP 14-RAILROAD CROSSING 19-WEATHER&RAVELING 5-CORRUGATION 10-LOG.-TR.CR 15-RUTTING																	
DISTRESS		SEVERITY	QUANTITY												TOTAL	DENSITY%	DUDACT VALUE
1	M	15	0	0	0	0	0	0	0	0	0	0	0	0	15	0.0	0
12	H	52	0	0	0	0	0	0	0	0	0	0	0	0	52	0.1	20
12	M	32	0	0	0	0	0	0	0	0	0	0	0	0	32	0.1	5
9	L	1326	0	0	0	0	0	0	0	0	0	0	0	0	1326	3.8	4
9	M	560	0	0	0	0	0	0	0	0	0	0	0	0	560	1.6	10
8	L	4500	0	0	0	0	0	0	0	0	0	0	0	0	4500	12.9	6
3	L	500	200	750	400	20	0	0	0	0	0	0	0	0	1870	5.3	5
3	M	1000	600	0	0	0	0	0	0	0	0	0	0	0	1600	4.6	12
8	M	2000	0	0	0	0	0	0	0	0	0	0	0	0	2000	5.7	7
1	L	1.5	0	0	0	0	0	0	0	0	0	0	0	0	1.5	0.0	0
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.0	0

ASPHALT PAVED ROADS CONDATION SURVEY DATA SHEET															SKETCH:		
LINK ID: 03N2		SECTION ID:.....(03N2/5).....					SAMPLE UNIT:... (Km 19 -----Km 24)...										
LINK NAME: .....( KASSALA - HAYIA).....							SECTION NAME:...(ADROUT-HAYIA).....										
SURVEYED BY:.....		DATE:.....					SAMPLE AREA (M):35000				SHEET NO:...(3).....						
1-ALLIGATOR CRAKING		6- DEPRESSION					11-PATCHING				16-SHOVING						
2-BLEEDING		7- EDGE CRACKING					12-POLISHEDE AGG.				17-SLIPPAGE CRACKING						
3-BLOCK CRACKING		8-JT-REFLECTION CR.					13-POTHOLE				18-SWELL						
4-BUMPS & SAGS		9-LANE SH. DROP					14-RAILROAD CROSSING				19-WEATHER&RAVELING						
5-CORRUGATION		10-LOG.-TR.CR					15-RUTTING										
DISTRESS		SEVERITY	QUANTITY												TOTAL	DENSITY%	DUDACT VALUE
9	L	1950	0	0	0	0	0	0	0	0	0	0	0	0	1950	5.6	4
12	L	8	0	0	0	0	0	0	0	0	0	0	0	0	8	0.0	0
14	H	30	33	14	0	0	0	0	0	0	0	0	0	0	77	0.2	12
8	M	7500	0	0	0	0	0	0	0	0	0	0	0	0	7500	21.4	23
1	L	100	75	20	75	0	0	0	0	0	0	0	0	0	270	0.8	4
3	L	100	800	300	525	120	600	1200	180	0	0	0	0	0	3825	10.9	9
9	M	17	21	7	0	0	0	0	0	0	0	0	0	0	45	0.1	0
12	M	8	0	0	0	0	0	0	0	0	0	0	0	0	8	0.0	0
8	L	2500	0	0	0	0	0	0	0	0	0	0	0	0	2500	7.1	4
12	H	8	0	0	0	0	0	0	0	0	0	0	0	0	8	0.0	0
11	0	31500	0	0	0	0	0	0	0	0	0	0	0	0	31500	90.0	18
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.0	0

ASPHALT PAVED ROADS CONDATION SURVEY DATA SHEET															SKETCH:		
LINK ID: 03N2	SECTION ID:.....(03N2/5).....					SAMPLE UNIT:... (Km 26 -----Km 31)...											
LINK NAME: .....( KASSALA - HAYIA).....						SECTION NAME:...(ADROUT-HAYIA).....											
SURVEYED BY:.....	DATE:.....					SAMPLE AREA (M)35000					SHEET NO:...(4).....						
1-ALLIGATOR CRAKING	6- DEPRESSION					11-PATCHING					16-SHOVING						
2-BLEEDING	7- EDGE CRACKING					12-POLISHEDE AGG.					17-SLIPPAGE CRACKING						
3-BLOCK CRACKING	8-JT-REFLECTION CR.					13-POTHOLE					18-SWELL						
4-BUMPS & SAGS	9-LANE SH. DROP					14-RAILROAD CROSSING					19-WEATHER&RAVELING						
5-CORRUGATION	10-LOG.-TR.CR					15-RUTTING											
DISTRESS	SEVERITY	QUANTITY													TOTAL	DENSITY%	DUDACT VALUE
3	H	138	150	350	900	60	400	490	225	2015	108	140	80	0	5056	14.4	35
10	M	3	6	1	2	3	0.5	0	0	0	0	0	0	0	15.5	0.0	0
3	M	270	160	120	105	300	240	300	356	60	492	210	525	760	3898	11.1	16
9	M	926	0	0	0	0	0	0	0	0	0	0	0	0	926	2.6	5
9	L	96	0	0	0	0	0	0	0	0	0	0	0	0	96	0.3	0
9	H	417	0	0	0	0	0	0	0	0	0	0	0	0	417	1.2	10
1	H	20	22	36	30	8	60	45	11	4.5	0	0	0	0	236.5	0.7	12
1	M	10	30	25	30	30	35	25	10	75	34	30	0	0	334	1.0	7
12	M	76	94	0	0	0	0	0	0	0	0	0	0	0	170	0.5	0
13	L	12	0	0	0	0	0	0	0	0	0	0	0	0	12	0.0	0
8	L	4500	0	0	0	0	0	0	0	0	0	0	0	0	4500	12.9	7
8	M	2000	0	0	0	0	0	0	0	0	0	0	0	0	2000	5.7	7
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.0	0

ASPHALT PAVED ROADS CONDATION SURVEY DATA SHEET															SKETCH:		
LINK ID:03N2		SECTION ID:.....(03N2/5).....					SAMPLE UNIT:.. (Km 33 -----Km 38)...										
LINK NAME: .....( KASSALA - HAYIA).....							SECTION NAME: ...(ADROUT-HAYIA).....										
SURVEYED BY:.....		DATE:.....				SAMPLE AREA (M)35000				SHEET NO:...(5).....							
1-ALLIGATOR CRAKING		6- DEPRESSION				11-PATCHING				16-SHOVING							
2-BLEEDING		7- EDGE CRACKING				12-POLISHEDE AGG.				17-SLIPPAGE CRACKING							
3-BLOCK CRACKING		8-JT-REFLECTION CR.				13-POTHOLE				18-SWELL							
4-BUMPS & SAGS		9-LANE SH. DROP				14-RAILROAD CROSSING				19-WEATHER&RAVELING							
5-CORRUGATION		10-LOG.-TR.CR				15-RUTTING											
DISTRESS	SEVERITY	QUANTITY													TOTAL	DENSITY%	DUDACT VALUE
12	H	51	0	0	0	0	0	0	0	0	0	0	0	0	51	0.1	20
8	L	250	250	4900	0	0	0	0	0	0	0	0	0	0	5400	15.4	7
9	H	7	21	14	32	0	0	0	0	0	0	0	0	0	74	0.2	4
3	L	188	93	70	2100	2100	100	600	350	0	0	0	0	0	5601	16.0	10
9	L	385	0	0	0	0	0	0	0	0	0	0	0	0	385	1.1	0
19	H	3.5	0	0	0	0	0	0	0	0	0	0	0	0	3.5	0.0	0
8	M	2250	0	0	0	0	0	0	0	0	0	0	0	0	2250	6.4	6
9	M	381	0	0	0	0	0	0	0	0	0	0	0	0	381	1.1	3
12	M	42	0	0	0	0	0	0	0	0	0	0	0	0	42	0.1	5
10	M	21	8	12	0	0	0	0	0	0	0	0	0	0	41	0.1	4
1	L	28	0	0	0	0	0	0	0	0	0	0	0	0	28	0.1	5
3	H	60	750	0	0	0	0	0	0	0	0	0	0	0	810	2.3	12
3	M	700	0	0	0	0	0	0	0	0	0	0	0	0	700	2.0	6
10	H	8	7	12	0	0	0	0	0	0	0	0	0	0	27	0.1	6
1	H	24	0	0	0	0	0	0	0	0	0	0	0	0	24	0.1	12
7	H	11	0	0	0	0	0	0	0	0	0	0	0	0	11	0.0	0
1	M	28	25	22	0	0	0	0	0	0	0	0	0	0	75	0.2	10
8	H	1200	0	0	0	0	0	0	0	0	0	0	0	0	1200	3.4	7
11	0	28000	0	0	0	0	0	0	0	0	0	0	0	0	28000	80.0	17
14	M	5	0	0	0	0	0	0	0	0	0	0	0	0	5	0.0	0

ASPHALT PAVED ROADS CONDATION SURVEY DATA SHEET															SKETCH:			
LINK ID:03N2		SECTION ID:.....(03N2/5).....					SAMPLE UNIT:... (Km 40 -----Km 45)...											
LINK NAME: .....( KASSALA - HAYIA).....							SECTION NAME: ...(ADROUT-HAYIA).....											
SURVEYED BY:.....		DATE:.....					SAMPLE AREA (M):35000				SHEET NO:...(6).....							
1-ALLIGATOR CRAKING		6- DEPRESSTION					11-PATCHING				16-SHOVING							
2-BLEEDING		7- EDGE CRACKING					12-POLISHEDE AGG.				17-SLIPPAGE CRACKING							
3-BLOCK CRACKING		8-JT-REFLECTION CR.					13-POTHOLE				18-SWELL							
4-BUMPS & SAGS		9-LANE SH. DROP					14-RAILROAD CROSSING				19-WEATHER&RAVELING							
5-CORRUGATION		10-LOG.-TR.CR					15-RUTTING											
DISTRESS		SEVERITY	QUANTITY												TOTAL	DENSITY%	DUDACT VALUE	
9		M	543	8	11	0	0	0	0	0	0	0	0	0	562	1.6	4	
3		M	44	280	12	175	60	325	90	160	90	300	150	480	2792	4958	14.2	16
9		L	759	0	0	0	0	0	0	0	0	0	0	0	0	759	2.2	0
3		L	366	25	444	0	0	0	0	0	0	0	0	0	0	835	2.4	3
12		L	2	27	0	0	0	0	0	0	0	0	0	0	0	29	0.1	3
1		M	3.5	70	10	6	2	5.5	8	1.5	80	11	4	0	0	201.5	0.6	7
18		M	0.7	0	0	0	0	0	0	0	0	0	0	0	0	0.7	0.0	0
9		H	93	0	0	0	0	0	0	0	0	0	0	0	0	93	0.3	4
1		H	30	15	40	5	8	5	0	0	0	0	0	0	0	103	0.3	17
10		H	4	1.5	1	0.5	1	0.5	1	1.5	0	0	0	0	0	11	0.0	0
3		H	1100	0	0	0	0	0	0	0	0	0	0	0	0	1100	3.1	16
1		L	5	20	7.5	0	0	0	0	0	0	0	0	0	0	32.5	0.1	5
8		L	4000	0	0	0	0	0	0	0	0	0	0	0	0	4000	11.4	6
8		M	2500	0	0	0	0	0	0	0	0	0	0	0	0	2500	7.1	7
0		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.0	0

ASPHALT PAVED ROADS CONDATION SURVEY DATA SHEET															SKETCH:			
LINK ID:03N2		SECTION ID:.....(03N2/5).....					SAMPLE UNIT:... (Km 47 -----Km 52)...											
LINK NAME: .....( KASSALA - HAYIA).....							SECTION NAME: ...(ADROUT-HAYIA).....											
SURVEYED BY:.....		DATE:.....					SAMPLE AREA (M)35000					SHEET NO:...(7).....						
1-ALLIGATOR CRAKING		6- DEPRESSION					11-PATCHING					16-SHOVING						
2-BLEEDING		7- EDGE CRACKING					12-POLISHEDE AGG.					17-SLIPPAGE CRACKING						
3-BLOCK CRACKING		8-JT-REFLECTION CR.					13-POTHOLE					18-SWELL						
4-BUMPS & SAGS		9-LANE SH. DROP					14-RAILROAD CROSSING					19-WEATHER&RAVELING						
5-CORRUGATION		10-LOG-TR.CR					15-RUTTING											
DISTRESS		SEVERITY	QUANTITY													TOTAL	DENSITY%	DUDACT VALUE
8		H	2000	0	0	0	0	0	0	0	0	0	0	0	2000	5.71	10	
3		L	4550	9	28	100	88	40	15	910	500	800	500	0	0	7540	21.54	13
3		M	1400	1400	20	400	90	0	0	0	0	0	0	0	3310	9.46	16	
1		L	19.5	6.5	10	20	10	20	0	0	0	0	0	0	86	0.25	4	
9		L	300	50	58	194	180	0	0	0	0	0	0	0	782	2.23	0	
9		M	200	25	407	450	660	420	0	0	0	0	0	0	2162	6.18	13	
16		L	20	50	200	0	0	0	0	0	0	0	0	0	270	0.77	0	
8		M	700	30	500	2400	700	500	0	0	0	0	0	0	4830	13.80	10	
8		L	700	800	1400	0	0	0	0	0	0	0	0	0	2900	8.29	4	
12		H	5	0	0	0	0	0	0	0	0	0	0	0	5	0.01	0	
12		M	4	16	0	0	0	0	0	0	0	0	0	0	20	0.06	0	
1		M	42	60	60	15	0	0	0	0	0	0	0	0	177	0.51	15	
1		H	40	15	0	0	0	0	0	0	0	0	0	0	55	0.16	14	
7		H	5	31	45	0	0	0	0	0	0	0	0	0	81	0.23	9	
3		H	400	0	0	0	0	0	0	0	0	0	0	0	400	1.14	10	
9		H	100	0	0	0	0	0	0	0	0	0	0	0	100	0.29	4	
0		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0	

ASPHALT PAVED ROADS CONDATION SURVEY DATA SHEET															SKETCH:			
LINK ID:03N2		SECTION ID:....(03N2/5).....					SAMPLE UNIT:... (Km 54 -----Km 59)...											
LINK NAME: .....( KASSALA - HAYIA).....							SECTION NAME: ...(ADROUT-HAYIA).....											
SURVEYED BY:.....		DATE:.....					SAMPLE AREA (M):35000				SHEET NO:....(8).....							
1-ALLIGATOR CRAKING		6- DEPRESSION					11-PATCHING				16-SHOVING							
2-BLEEDING		7- EDGE CRACKING					12-POLISHEDE AGG.				17-SLIPPAGE CRACKING							
3-BLOCK CRACKING		8-JT-REFLECTION CR.					13-POTHOLE				18-SWELL							
4-BUMPS & SAGS		9-LANE SH. DROP					14-RAILROAD CROSSING				19-WEATHER&RAVELING							
5-CORRUGATION		10-LOG-TR.CR					15-RUTTING											
DISTRESS		SEVERITY	QUANTITY													TOTAL	DENSITY%	DUDACT VALUE
3		M	420	150	343	100	450	260	160	40	164	92	25	410	778.5	3392.5	9.69	16
3		H	420	504	120	340	140	85	332	147	100	292	104	60	0	2644	7.55	24
9		M	5366	967	68	0	0	0	0	0	0	0	0	0	0	6401	18.29	24
9		H	330	83	0	0	0	0	0	0	0	0	0	0	0	413	1.18	8
12		L	37	0	0	0	0	0	0	0	0	0	0	0	0	37	0.11	3
12		M	21	0	0	0	0	0	0	0	0	0	0	0	0	21	0.06	0
1		H	145	0	0	0	0	0	0	0	0	0	0	0	0	145	0.41	0
1		M	172.5	0	0	0	0	0	0	0	0	0	0	0	0	172.5	0.49	6
10		M	2	0	0	0	0	0	0	0	0	0	0	0	0	2	0.01	0
12		H	1	0	0	0	0	0	0	0	0	0	0	0	0	1	0.00	0
9		L	593	0	0	0	0	0	0	0	0	0	0	0	0	593	1.69	0
8		M	2500	0	0	0	0	0	0	0	0	0	0	0	0	2500	7.14	8
8		L	3000	0	0	0	0	0	0	0	0	0	0	0	0	3000	8.57	4
0		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0

Deduct Value Curves

FIG 1: ALLIGATOR CRACKING

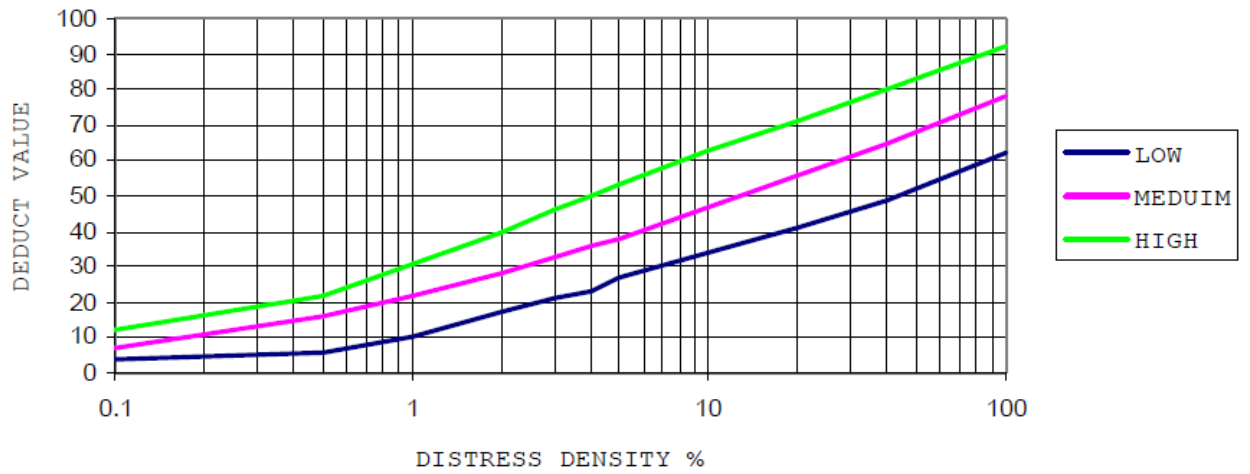


FIG 2: BLEEDING

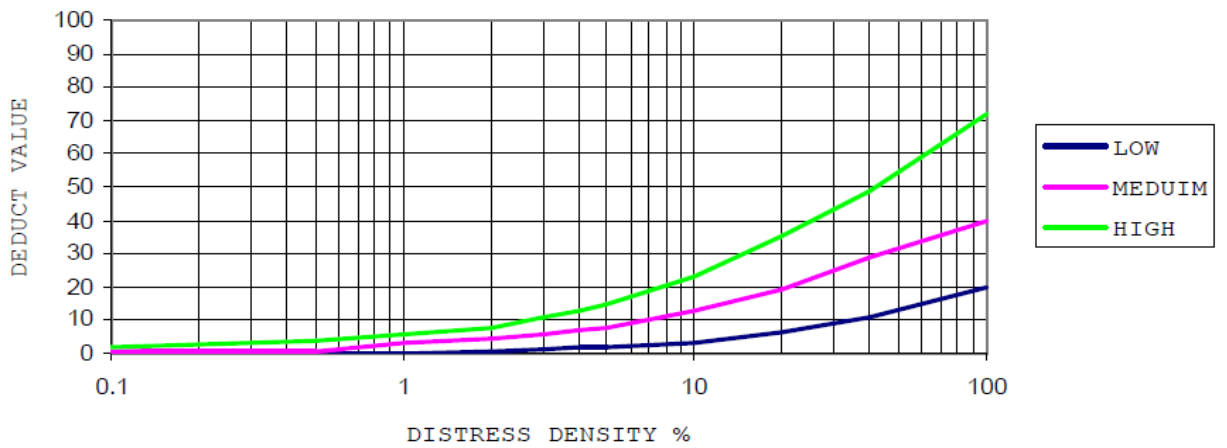


FIG 3: BLOCK CRACKING

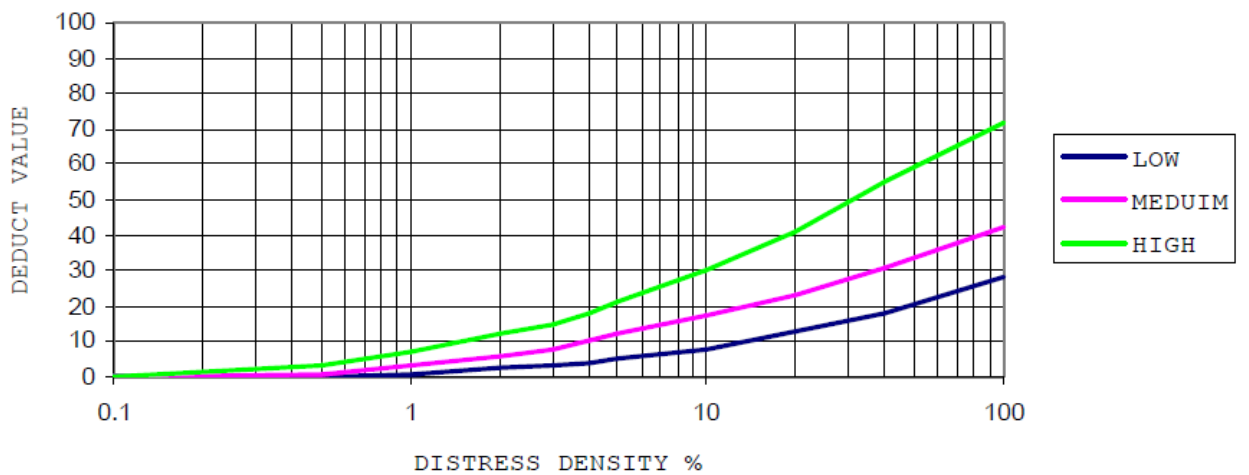


FIG 4: UPHEVAL & SETTLEMENT

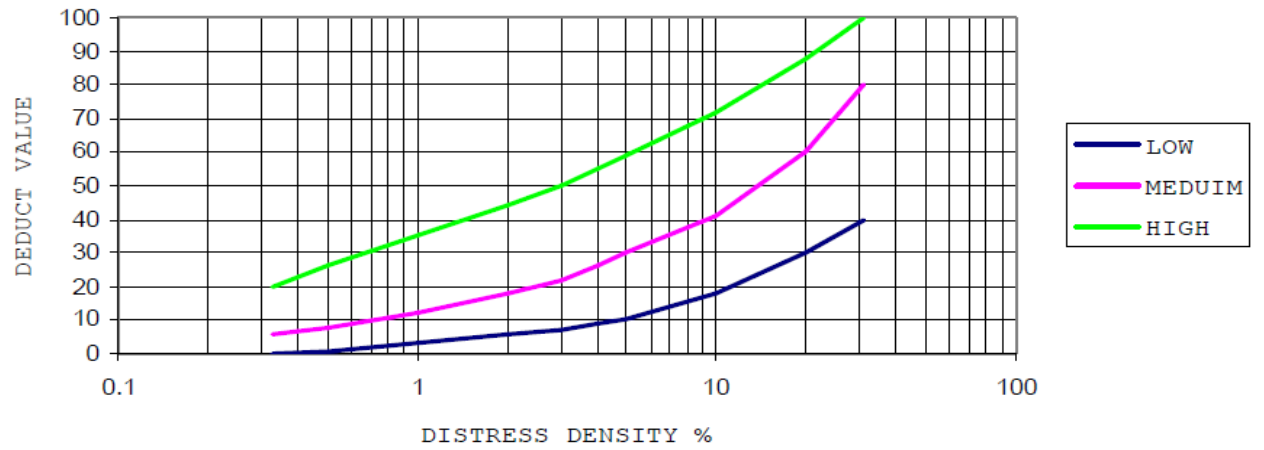


FIG 5: CORRUGATION

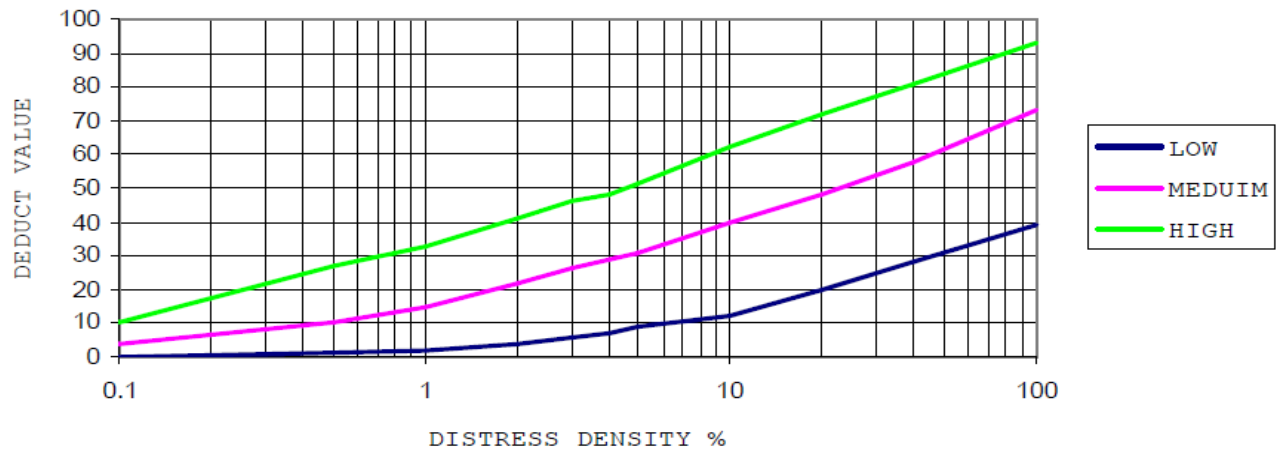


FIG 6: DEPRESSION

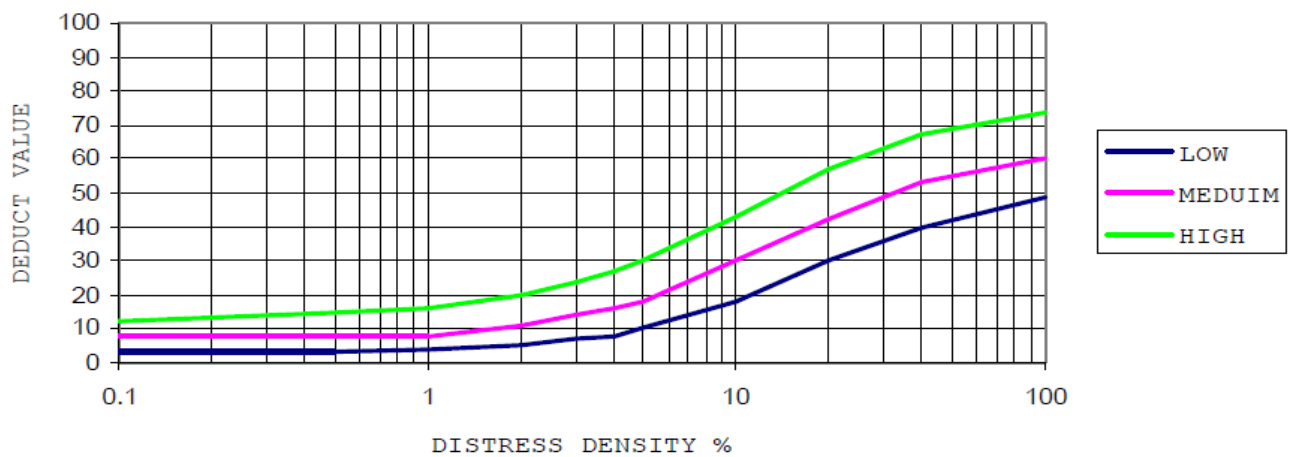


FIG 7: EDGE CRACKING

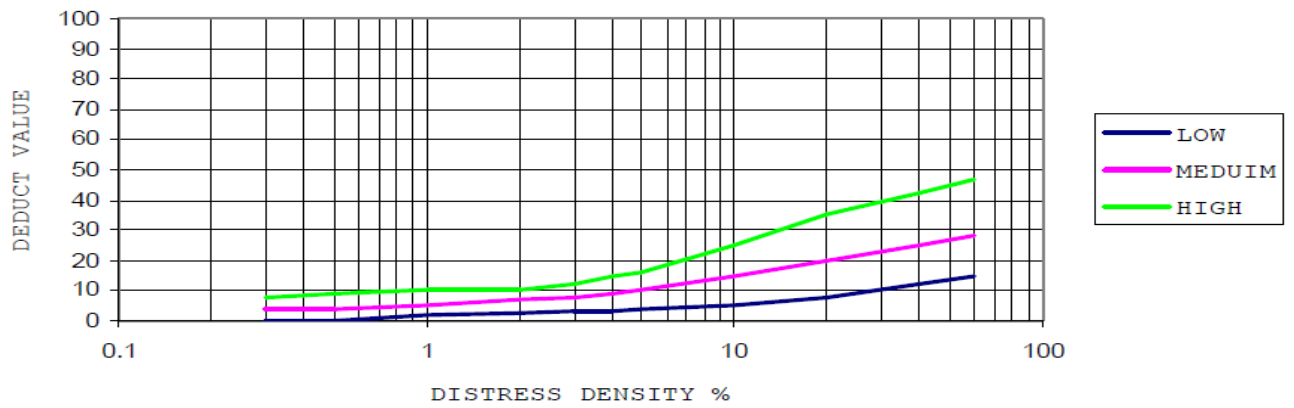


FIG 8: LANE/SHOULDER DROP-OFF

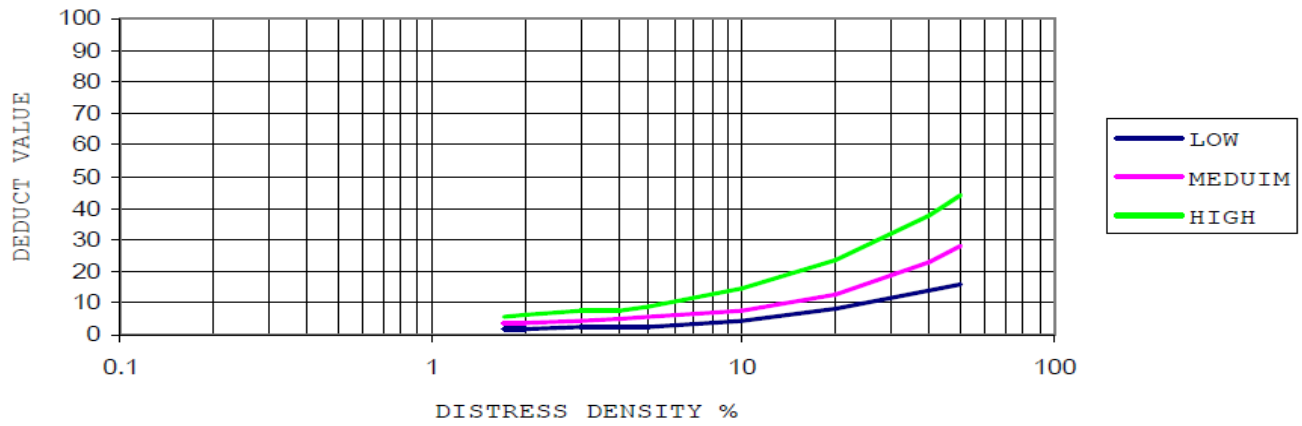


FIG 9: LONGITUDINAL & TRANSVERSE CRAKING

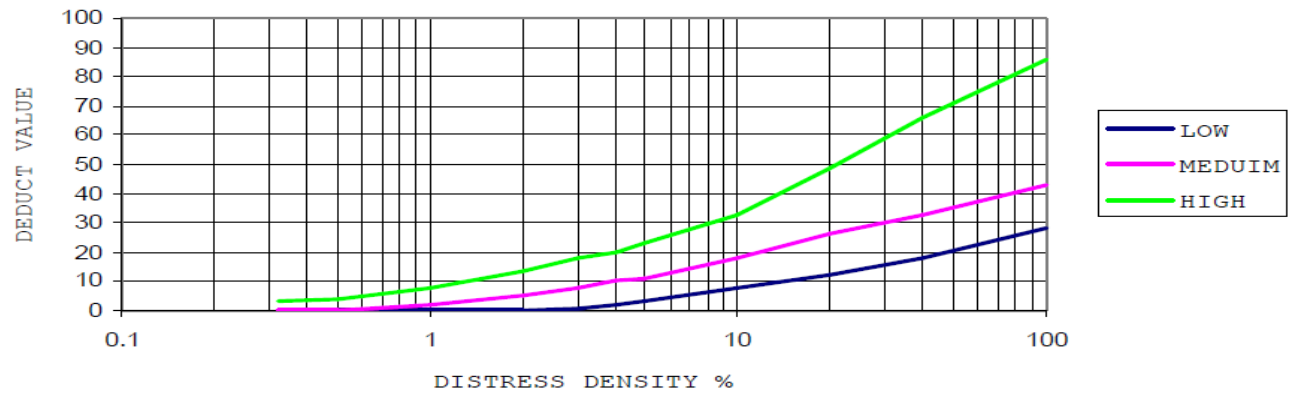


FIG 10: PATCHING

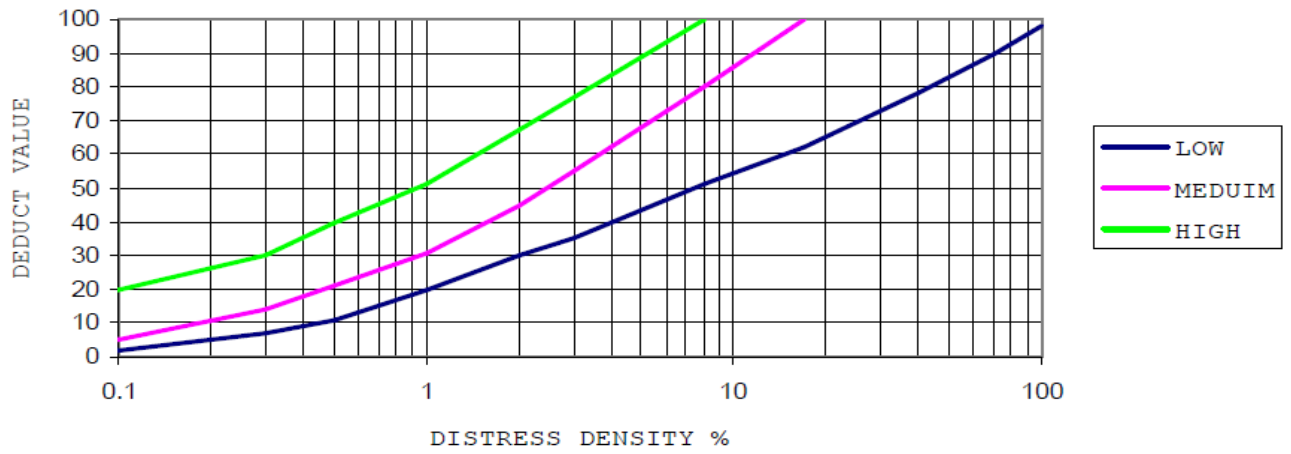


FIG 11: POLISHING

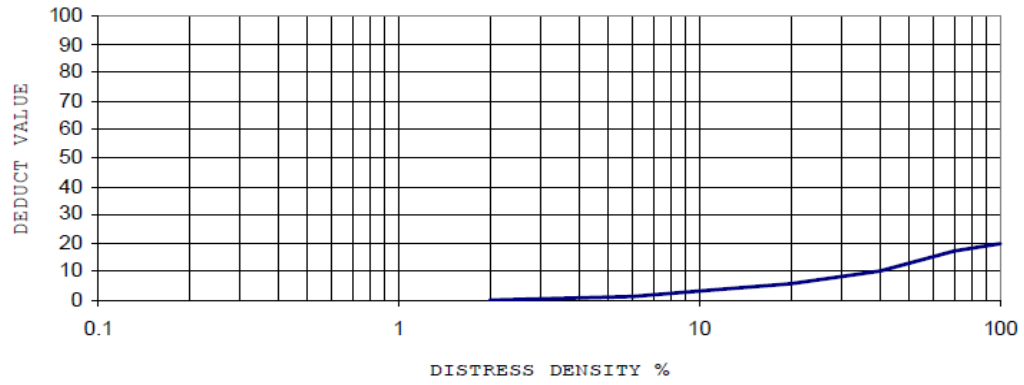


FIG 12: POTHOLES

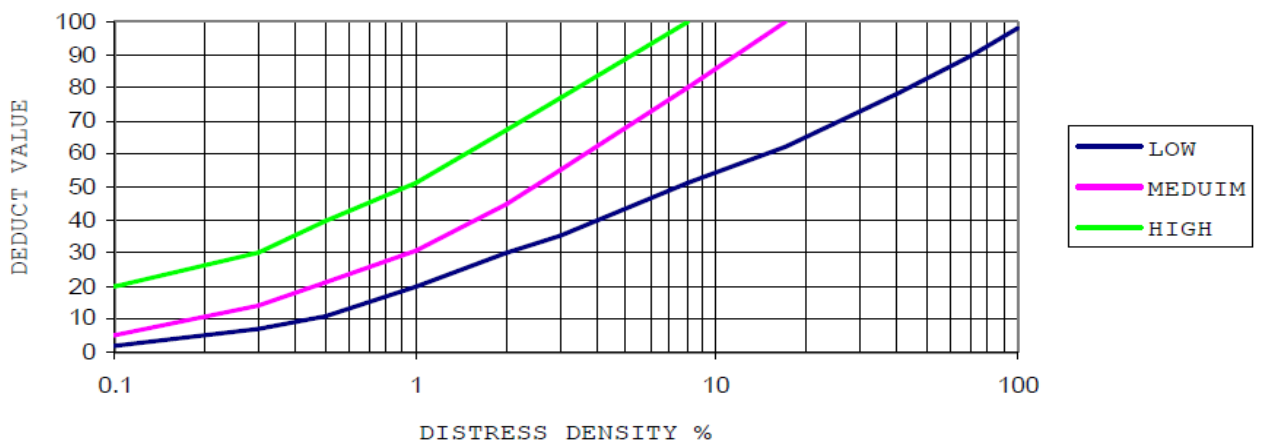


FIG 13: RAIL ROAD CROSSING

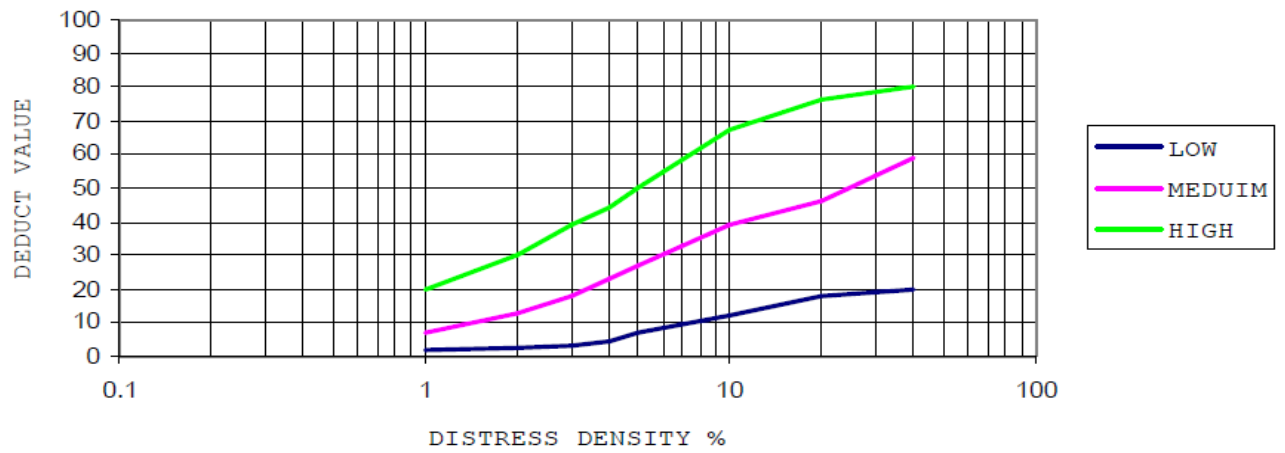


FIG 14: RAVELLING

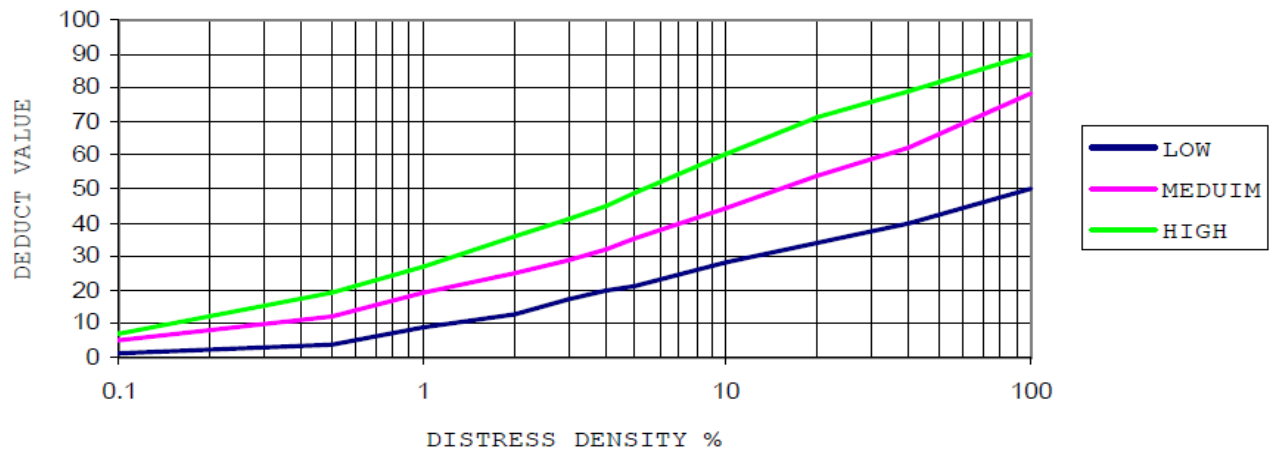


FIG 15: REFLECTION CRACKING

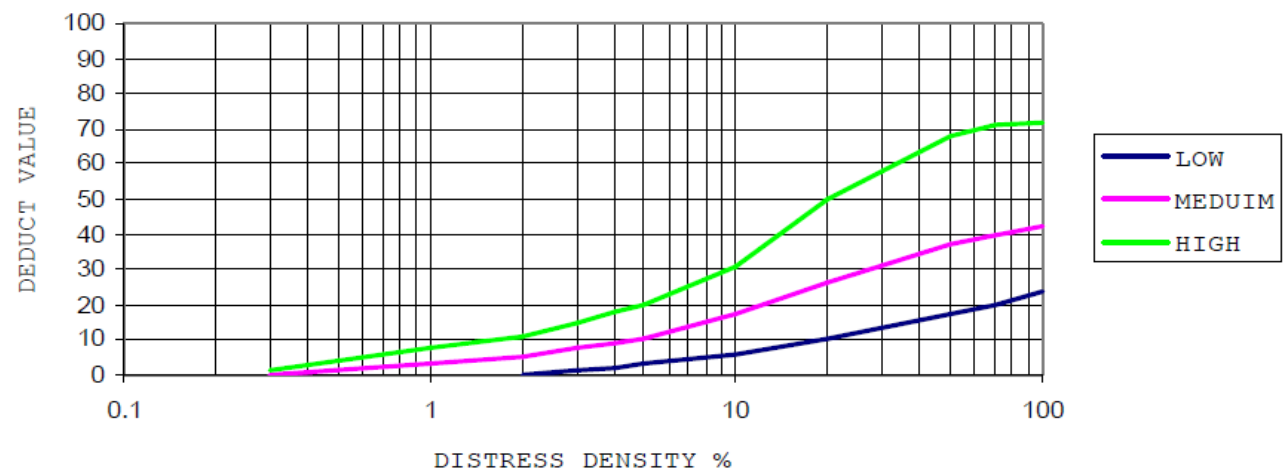


FIG 16: RUTTING

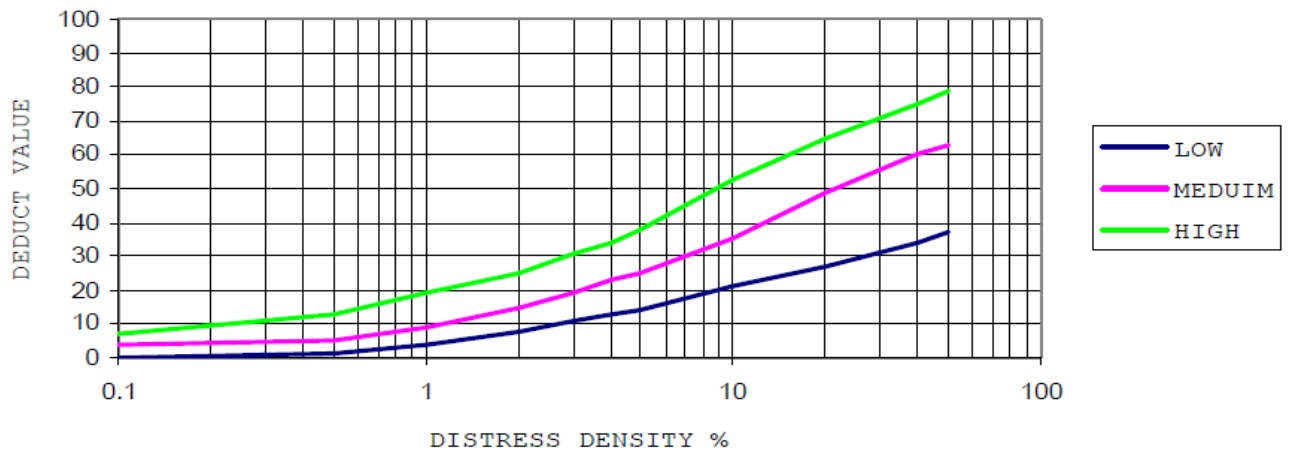


FIG 17: SHOVING

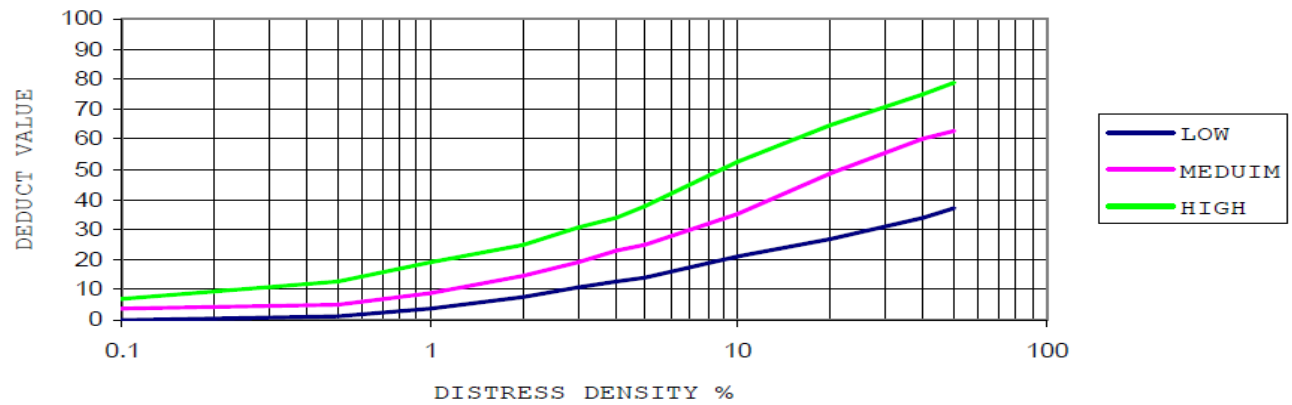


FIG 18: SLIPPAGE CRACKS

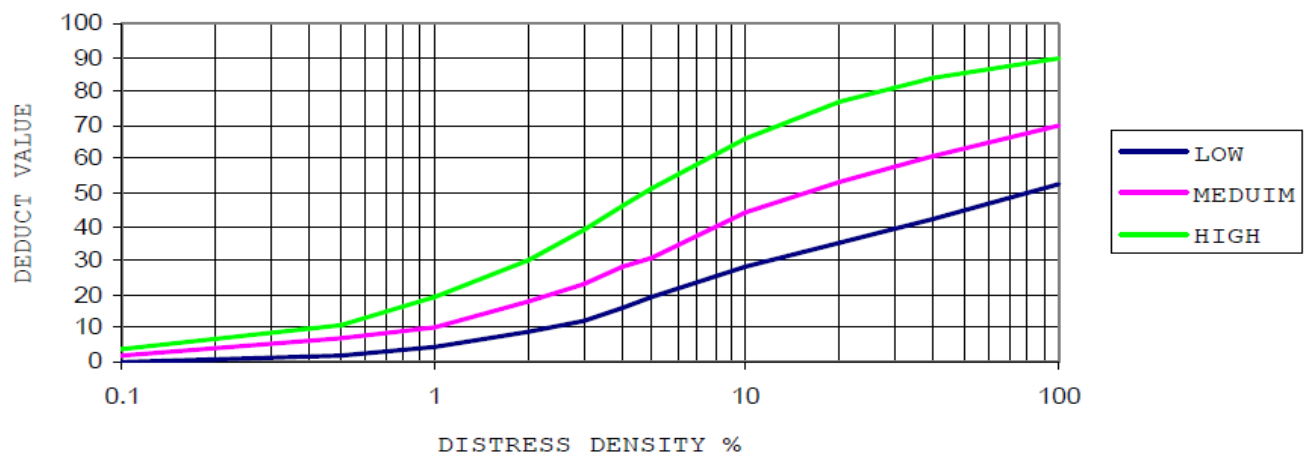


FIG 19: SWELLING

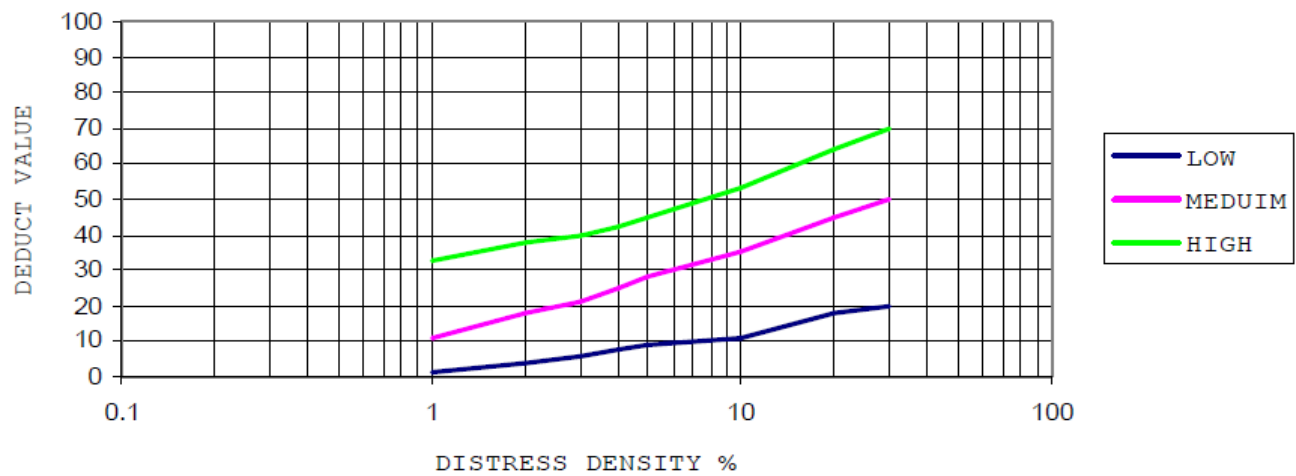


Fig 20 corrected deduct value curve

