# Annual Rock Requirement Estimate: Granular Roads Asset Management System (GRAMS) User Manual

**User Manual**
**December 2019**

IOWA STATE UNIVERSITY
Institute for Transportation

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**16. Abstract**

This user manual accompanies the Microsoft Excel-based Granular Roads Asset Management System (GRAMS) tool prepared for the Iowa County Engineers Association (ICEA). The tool and manual were developed under Iowa Highway Research Board Project TR-729, Development of Granular Roads Asset Management System.

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The GRAMS tool is designed to assist local agencies in making more reliable gravel loss estimates and consequently determining annual aggregate (rock) requirements for proper budgeting purposes. To gather information to develop the tool, a series of online and in-person meetings and interviews were conducted along with electronic mailing surveys.

When the user enters several input values, GRAMS generates a range of estimates for varying budget conditions and different levels of service. The tool is expected to help local agencies obtain consistency in terms of estimating gravel loss and determining aggregate (rock) requirements. As a result, agencies can better justify their granular road maintenance budget requests and management practices.

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# ANNUAL ROCK REQUIREMENT ESTIMATE: GRANULAR ROADS ASSET MANAGEMENT SYSTEM (GRAMS) USER MANUAL

**User Manual**
**December 2019**

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# 1. INTRODUCTION

The Iowa County Engineers Association (ICEA) Granular Roads Asset Management System (GRAMS) is a useful tool to estimate the annual rock requirements for efficient granular roadway network maintenance. It provides a quick estimation of annual rock and budget requirements using key parameters such as agency location, existing roadway inventory condition, rock quality, annual traffic, and engineering estimates. The GRAMS tool also approximates the risk level of the roadway system for various budget situations.

This manual provides step-by-step guidance for generating annual rock requirements using the GRAMS tool.

# 2. INITIAL SETUP

## 2.1 Security Warning

GRAMS is a Microsoft Excel-based tool that requires Excel macros to be enabled. Depending on the version of the operating system on which the tool is being used, various security warning messages may appear when the tool is first opened, as shown in Figure 1.

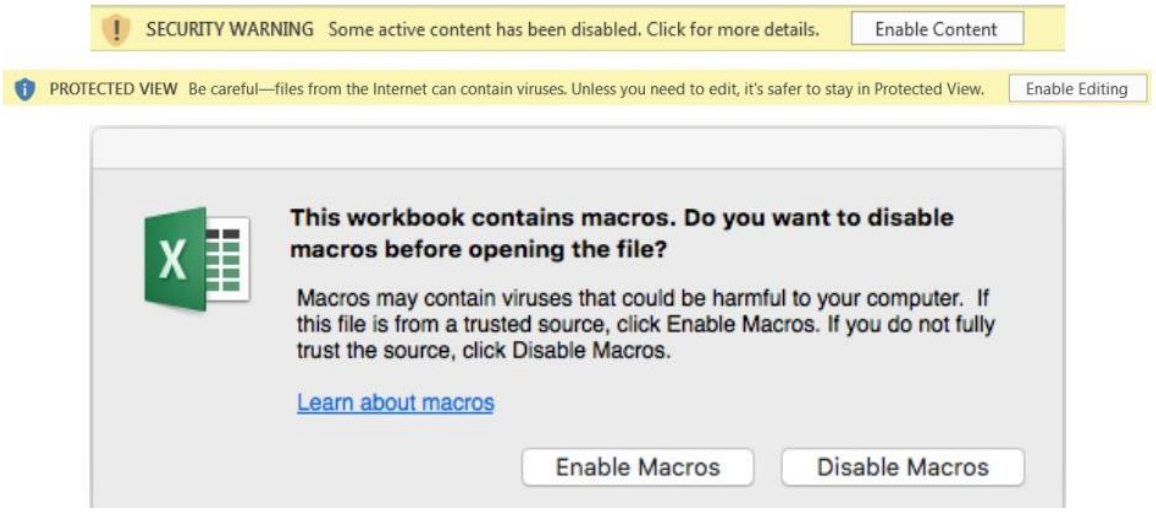


**Figure 1. Security warning notification**

Click either the **Enable Content**, **Enable Macros,** or **Enable Editing** button. Note that the user may not see any security warning if the computer is set up to enable macros automatically.

## 2.2 Launching the GRAMS Tool

An introduction sheet appears when the tool is first opened, as shown in Figure 2.

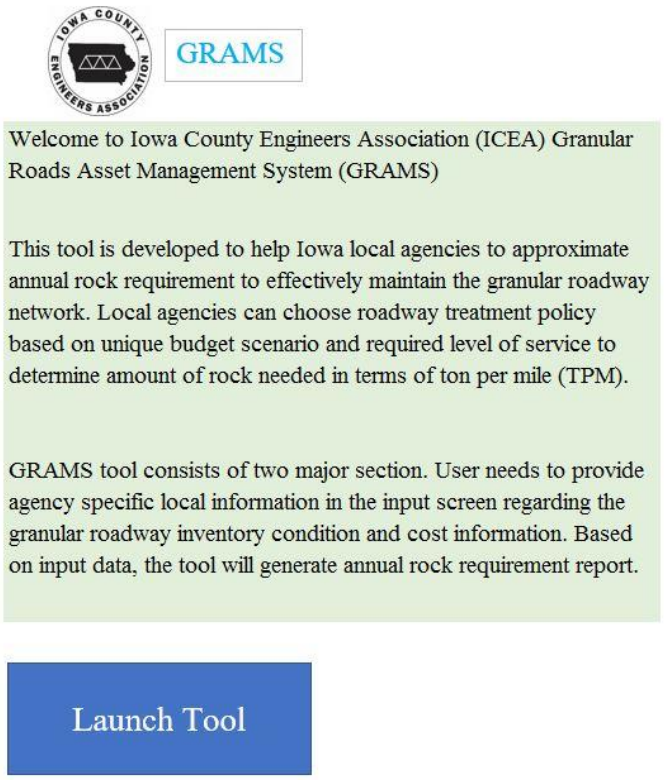


**Figure 2. Introduction sheet**

This sheet provides basic information on each sheet of the GRAMS tool. Click the **Launch Tool** button to see the specific parameters needed for estimation.

## 3. REQUIRED INPUT

### 3.1 Editing Guidelines

Light yellow colored cells indicate that user input is allowed, and light green colored cells indicate inputs calculated from historical data. The inputs based on historical data will automatically be generated after the user provides a county name.

**Please note:** All light green colored cells are accompanied by corresponding light yellow colored cells. The user has the option to gain administrative access when the user does not agree with the inputs calculated from the historical data. To override these inputs, the user is required to edit only the light yellow colored cells, as shown in Figure 3.


**Figure 3. Editing guidelines**

### 3.2 Input Parameters

The following input parameters are required to estimate rock requirements in the GRAMS tool:

- **County Information**
  - County Name
  - Granular Roadway Network Size
  - Average Width of Granular Roadway
  - Percentage of Roadway with Very Poor Drainage

- **Rock Quality Information**
  - Los Angeles (LA) Abrasion (%)
  - Fines Content (%)

- **Cost Information**
  - Material Cost
  - Crushing Cost
  - Hauling Cost
  - Transportation Cost
  - Placing, Grading, and Miscellaneous Cost

- **Level of Service Information**
  - Thickness for 50% Level of Service

After clicking the **Launch Tool** button, the user sees the **Input Screen** sheet shown in Figure 4.

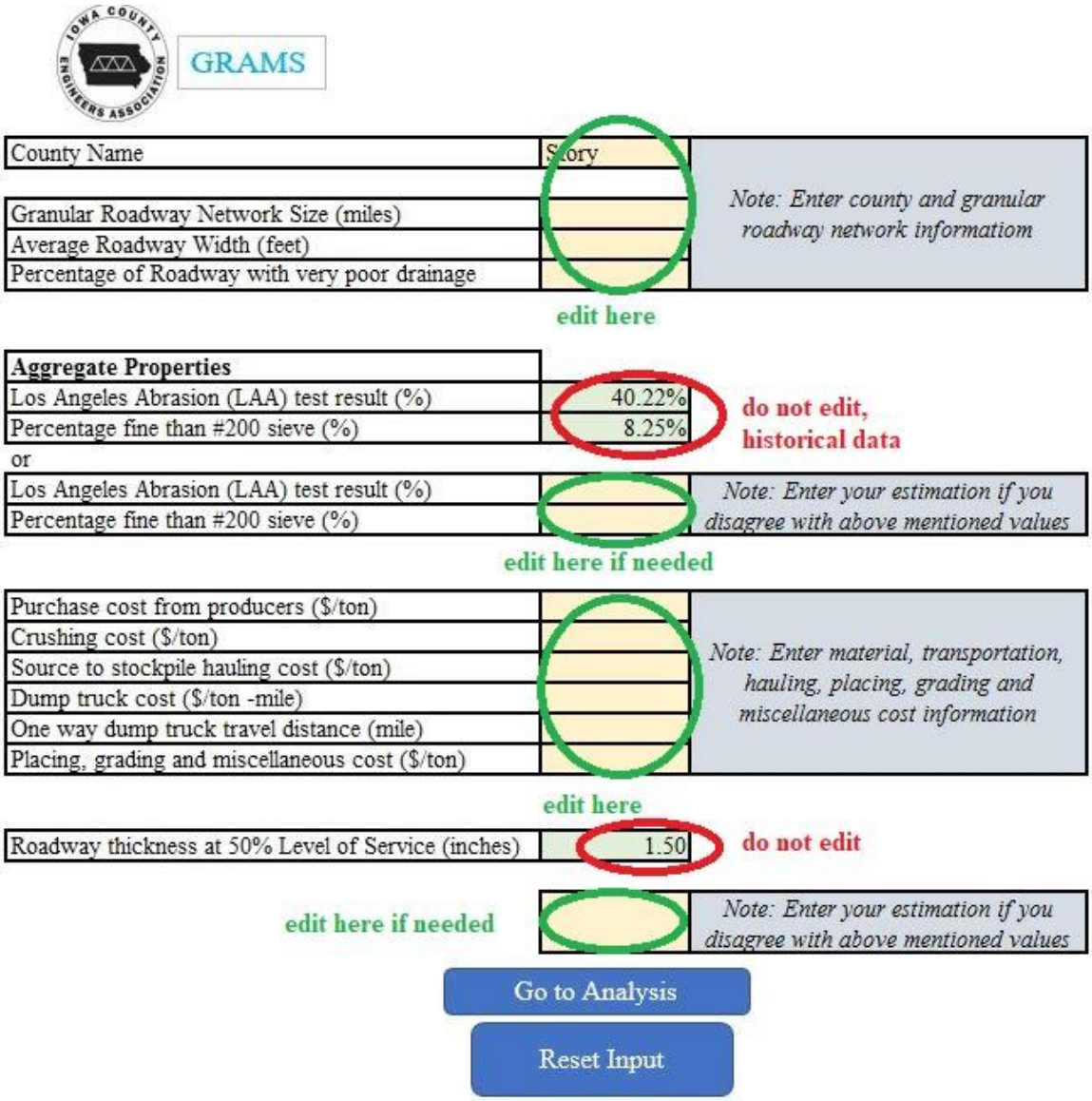


**Figure 4. Input screen sheet**

Within this sheet, the user can provide county, rock quality, cost, and level of service information. After inputting this information, click the **Go to Analysis** button to access the **Rock Requirement Estimates** sheet. The user can click the **Reset Input** button to clear all of the values entered.

## 4. ROCK REQUIREMENT ESTIMATES

In the **Rock Requirement Estimates** sheet, the roadway inventory condition must be entered manually to estimate the rock requirements, as shown in Figure 5. The user can also provide an annual gravel loss estimation if needed.

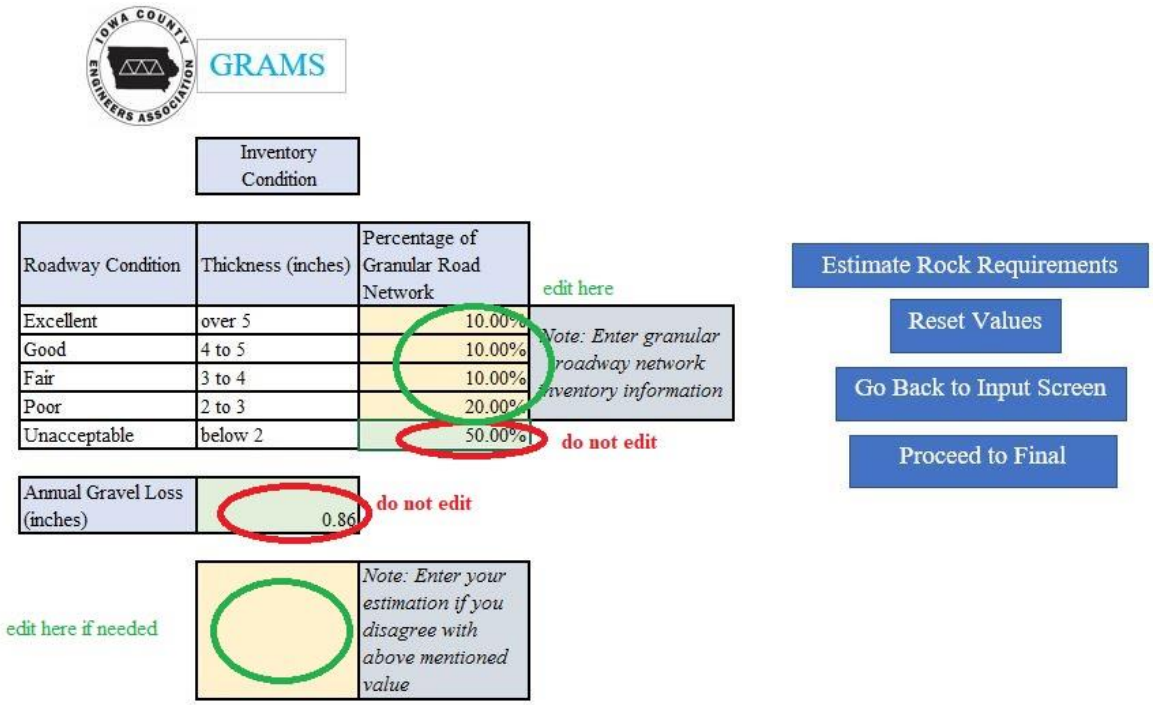


**Figure 5. Inventory condition**

Clicking the **Estimate Rock Requirements** button will generate the rock requirements, as shown in Figure 6.

| Minimum Resurfacing Required (miles) | 5.21 |
|---|---|

| Range of Options | Aggregate Type 1 |
|---|---|

| Ton per Mile (TPM) | Rock Quantity (Ton) | Annual Cost ($) | Material Cost ($) | Level of Service (%) | System Performance |
|---|---|---|---|---|---|
| 100 | 30,000 | $330,000 | $90,000 | 53.01% | Marginal |
| 200 | 60,000 | $660,000 | $180,000 | 60.92% | Fair |
| 300 | 90,000 | $990,000 | $270,000 | 68.41% | Fair |
| 400 | 120,000 | $1,320,000 | $360,000 | 75.20% | Good |
| 500 | 150,000 | $1,650,000 | $450,000 | 81.13% | Very Good |

**Figure 6. Rock requirement estimates**

Here, the Minimum Resurfacing Requirements cell approximates the length of the roadway network, for which a thickness of less than 2 inches is assumed. In the range of options, the annual budget in terms of the total cost and material cost is shown, along with the risk level.

After reviewing this information, click the **Proceed to Final Report** button. The user can click the **Reset Values** button to clear all of the values entered and click the **Go Back to Input Screen** button to change the input values.

## 5. FINAL REPORT

In the final report, Graphs A and B simulate what-if scenarios for the budget and the percentage of the system at risk when 100% of the granular roadway network is maintained annually, as shown in Figures 7 and 8 for the total and material costs, respectively.

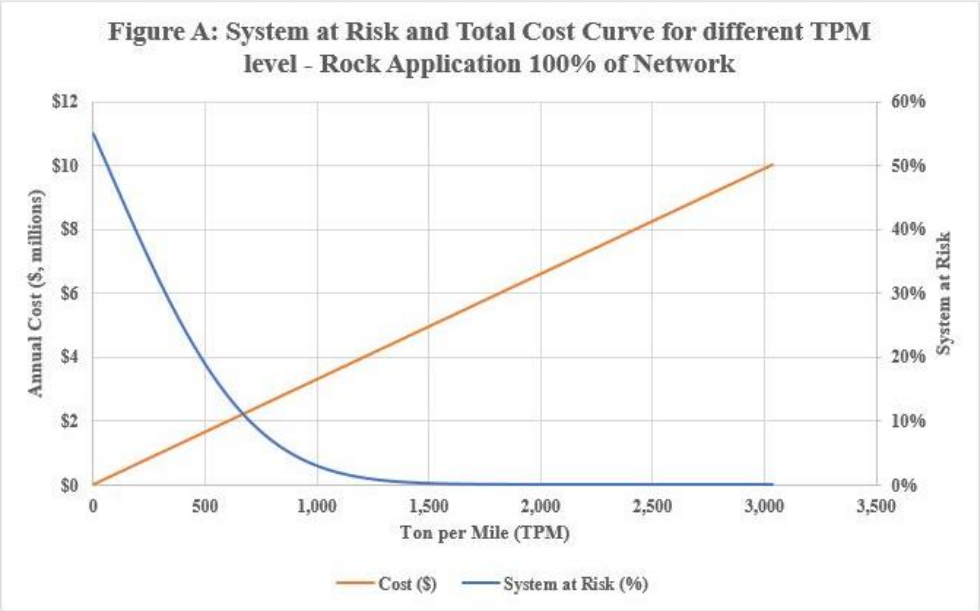


**Figure 7. Total cost and risk curves for 100% network maintenance**

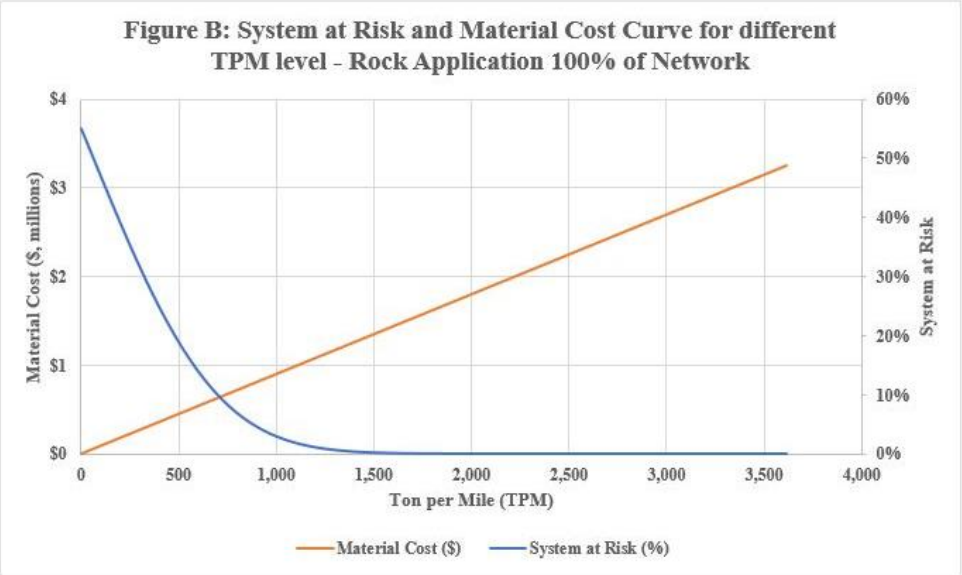


**Figure 8. Material cost and risk curves for 100% network maintenance**

A summary of Graphs A and B is also tabulated for convenience, as shown in Figure 9.

GRAMS

| County | Story |
|---|---|
| Most Critical System Size (miles) | 5.21 |

| Range of Options | |
|---|---|
| Rock Application Case (miles) | 300.00 |

| Ton per Mile (TPM) | Rock Quantity (Ton) | Total Cost ($) | Material Cost ($) | Level of Service (%) | System Performance |
|---|---|---|---|---|---|
| 100 | 30,000 | $330,000 | $90,000 | 53.01% | Marginal |
| 200 | 60,000 | $660,000 | $180,000 | 60.92% | Fair |
| 300 | 90,000 | $990,000 | $270,000 | 68.41% | Fair |
| 400 | 120,000 | $1,320,000 | $360,000 | 75.20% | Good |
| 500 | 150,000 | $1,650,000 | $450,000 | 81.13% | Very Good |

**Figure 9. Summary of cost and risk for 100% network maintenance**

The user can define how much of the roadway network will be maintained in a given year in the light yellow colored cell shown in Figure 10.

| | Range of Option | |
|---|---|---|
| Rock Application Case | 50% | edit here |
| Miles | 150.00 | |

**Figure 10. User-defined maintenance range**

Graphs C and D provide the percentage of the system at risk, the budget, and the rock requirement estimations for the user-defined roadway maintenance level, as shown in Figures 11 and 12 for the total and material costs, respectively.

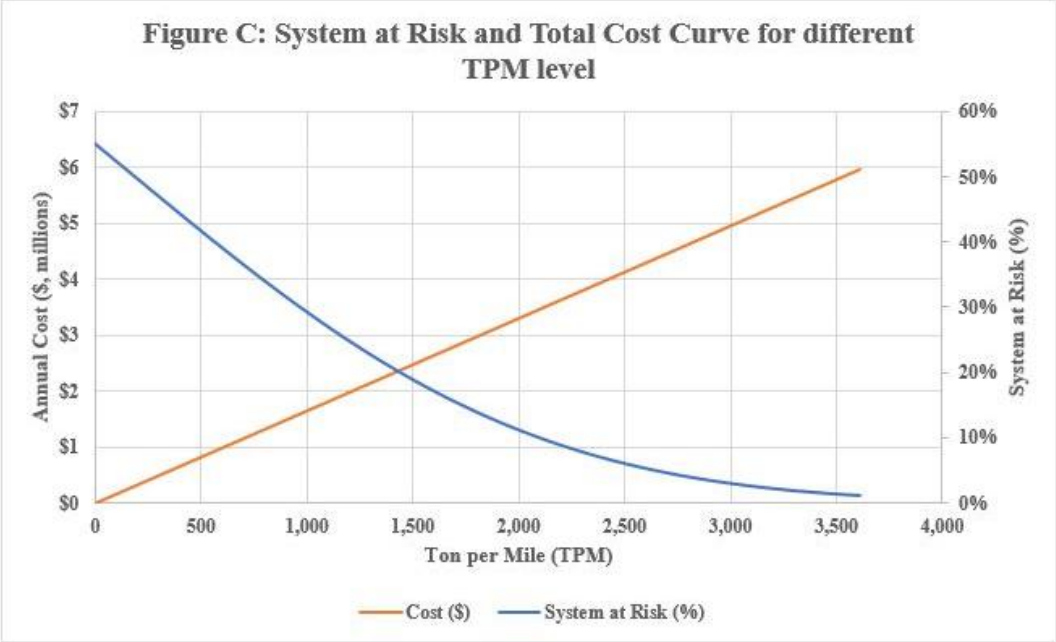


**Figure 11. Total cost and risk curves for user-defined network maintenance level**

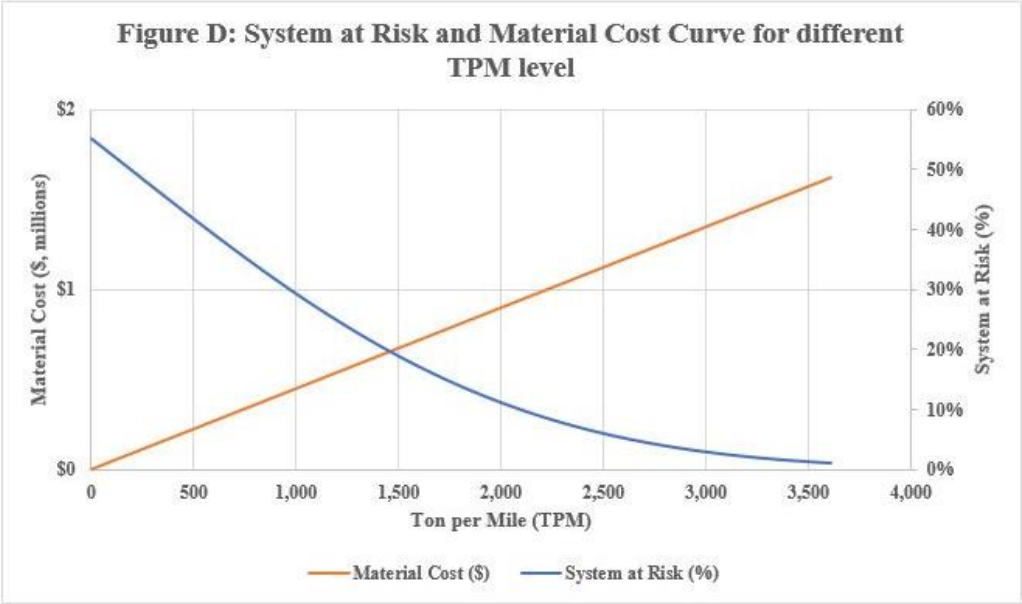


**Figure 12. Material cost and risk curves for user-defined network maintenance level**

Graph E, shown in Figure 13, simulates a time series curve to predict when the roadway system will collapse under the scenario in which no maintenance activity is performed.

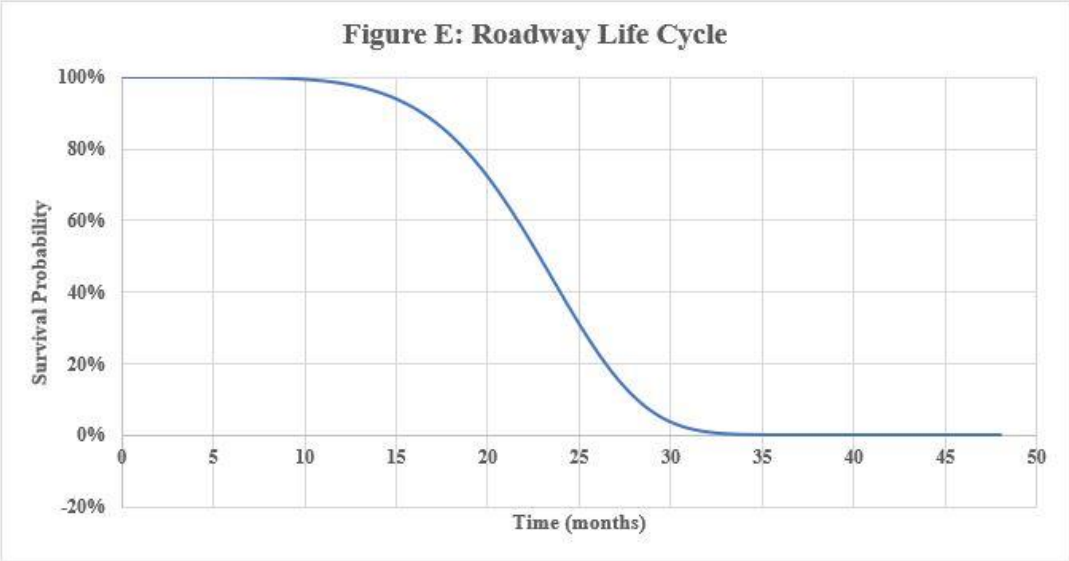


**Figure 13. Roadway network life cycle**

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