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Simplified Operational Procedures for Screening and Appraisal

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H. L. Beenhakker is regional and rural transport adviser in the Transportation Department of the World Bank; A. M. Lago, president of Ecosometrics, Inc., of Bethesda, Maryland (U.S.A.), is a consultant to the Transportation Department.

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Abstract

This paper suggests simple operational approaches to the screening and economic appraisal of road components of rural roads and rural development projects. It is based on a review of appraisal and preparation documents of 15 "traditional" Bank rural roads projects and 5 rural development projects with rural road components, as well as relevant literature. The objective is to simplify screening and appraisal methods without reducing their reliability to unacceptable levels. The proposed screening methods are based on the principles of discriminant analysis and a process of finding a quick and rough estimation of an economic return. Discriminant analysis is a simple statistical technique to classify rural roads or groups of interdependent rural roads into two sets: likely feasible and unfeasible ones. Simplified economic appraisal procedures are presented in increasing order of complexity. If a proposed investment passes the test of a simple method, no further analysis is needed. If it does not pass this appraisal, the use of a more time-consuming method is recommended. In other words, the simplest method becomes the final appraisal if as a result of its application a proposed investment is accepted.

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Summary

i. This paper suggests some simple operational approaches to the screening and economic appraisal of road components of rural roads (RRs) and rural development (RD) projects. It is based on a review of appraisal and preparation documents of 15 "traditional" Bank RRs projects and 5 RD projects with RR components, as well as relevant literature. The objective is to simplify screening and appraisal methods without reducing their reliability to unacceptable levels.

ii. Most screening methods heretofore used are not very reliable and efficient. The reliability of any particular screening method is defined as the probability that it will accept when it should accept, and it will reject when it should reject, a proposed investment for further analysis. "Should accept" and "should reject" are defined as acceptance and rejection decisions based on economic analysis.

iii. The use of screening methods which are based on a combination of political, social and economic factors is not recommended since they may accept a large number of RR candidates, which are subsequently rejected in the economic appraisal. Prescreening based on social and political factors followed by screening based on economic criteria is preferred. Such prescreening procedures depend on the specific preferences and priorities a government organization or financial institution attaches to certain investments. There is no Bank policy on the use of prescreening methods based on non-economic factors.

iv. The use of two alternate screening methods based on economic criteria is suggested. The first one, which is based on the principles of discriminant analysis, is recommended when it is proposed to improve a large number of low-standard RRs to the level of all-weather, unpaved RRs which would have their principal impact in the agricultural sector. Discriminant analysis is a simple statistical technique for classifying RRs or groups of interdependent RRs in two sets: likely feasible and unfeasible ones. For other situations, a second screening method is suggested. This method consists of a quick and rough estimation of cost and net benefit streams of a proposed investment and obtaining a rough estimate of its economic return (ER) from an available table. The reliability of both methods has been assessed by subjecting the results of their use in a sample of 110 RRs from the aforementioned 20 Bank projects to various tests. As a result, their reliability is estimated to be close to 90%.

v. An attempt was made to use regression analysis to develop equations, based on the sample data, that would permit the estimation of an ER for RRs, interdependent RRs, or investment packages of interdependent RRs and agricultural components, by using a limited number of variables. The method assumes that a relationship exists between the ER and appropriately defined measures of key variables. Although some of the equations developed provided reasonably reliable estimates in terms of the reliability as defined in para. (ii), the standard error of the estimates was too high for the equations to be used as acceptable proxy measures of the ER for project components. It is therefore concluded that regression analysis can only produce satisfactory results in the context of a particular country, where a more homogeneous group of RR candidates and more homogeneous agricultural production patterns should result in a significantly lower standard error. Of course, regression analysis would only make sense in situations where a very large number of road links need to be evaluated, so that correct decisions could be confidently predicted on the basis of an adequate sample.

vi. The simplified economic appraisal procedures are based on the principles of the consumer surplus (CS) method, producer surplus (PS) method or combinations thereof. The CS approach stresses the quantification of road user savings and is best suited for cases where the existing or normal traffic, or its projected growth, is substantial and the estimated transport cost savings are a reliable measure of project benefits. The PS approach stresses the assessment of economic activity, particularly agricultural production, in the RR's zone of influence. It is best suited for situations where there are reasonably accurate data regarding boundaries of the zone of influence, prices and yields of agricultural products produced in this area, and the agricultural potential. Both in the literature and in practice considerable confusion exists as to whether the CS or PS method results in more accurate estimates of ERs. This paper demonstrates that both methods will result in the same ER when correctly used.

vii. The first proposed simplification is to determine the ER for groups of RRs rather than for individual RRs. This is legitimate if the proposal satisfies the following conditions:

1. The per km cost of construction or improvement of each of the RRs belonging to the group is equal to or less than US$10,000 equivalent;

2. The variation of the per km cost of construction among the RRs belonging to the group is less than US$2,000.

If the appraisal is to be made by the PS method (or a combination of PS and CS) the project must in addition satisfy the following conditions:

3. The RRs which constitute a group are located in areas where proposed agricultural investments are interdependent with each other; and

4. The RRs which constitute a group are located in areas where farms with typical farm budgets are evenly distributed so that present and future values of agricultural production in these areas can be assumed to be the same.

viii. Eight simplified economic appraisal procedures are presented in increasing order of complexity. There is not much difference in time required to carry out the sixth, seventh, or eighth simplified method; the difference between these methods pertains to different requirements for input data rather than degree of complexity. If a proposed investment passes the test of a simple method, no further analysis is needed. If it does not pass this appraisal, the use of a more time-consuming method is recommended. In other words, the simplest method becomes the final appraisal if as a result of its application a proposed investment is accepted. In still other words, to save time one accepts a project component or group of interdependent components if its "simple" ER exceeds the opportunity cost of capital. "Simple" ER is defined as an ER based on a significant portion of quantifiable benefits rather than all. Simple ERs are, therefore, understatements of actual ERs.

ix. The definition of the reliability of a simplified method is similar to the definition of the reliability of a screening method; it is the probability that it will accept when it should accept, and it will reject when it should reject a proposed investment. "Should accept" and "should reject" refer to decisions based on an actual ER or an ER obtained with a complete economic analysis. The reliability of individual simplified procedures is of little interest if the aforementioned approach is followed. The reliability of the approach is as good as the reliability of the most complex methods proposed. These methods, which are the last three presented, are also based on a number of simplifications and were found to have a reliability of about 95%. These more complex methods also provide a practical tool for examining alternative road and agricultural investment strategies to determine an optimal investment package for the zone of influence of a RR or group of interdependent RRs.

x. The majority of RRs reviewed for this study had actual ERs which significantly exceeded prevailing opportunity costs of capital. Consequently, a significant portion of time devoted to economic analyses would have been saved had this paper's approach been followed, since the simple ERs computed with one of the simplified methods would, in many cases, have been larger than the applicable opportunity costs of capital.

xi. The text presents the eight simplified economic appraisal procedures in the form of simple step-by-step procedures. The theoretical background of the procedures as well as that of discriminant analysis is given in annex form.

xii. The Bank's practice in the appraisal of RRs projects is to determine the ER for each RR or groups of interdependent RRs. In the appraisal of RRs in RD projects, however, one often establishes only one ER for the entire investment including all roads and agricultural components such as irrigation works, supply of inputs, extension services and credit in all project areas. There is no prima facie evidence that roads in proposed RD projects should be subjected to screening and appraisal methods different from those used in typical RR projects. In both types of projects proper attention should be given to interdependence among transport and agricultural components. With the exception of RRs for which the conditions of para. vii are satisfied, ERs are to be established for individual RRs, groups of interdependent RRs, or investment packages consisting of interdependent RR and agricultural components. Assuming interdependence among project components of a RD project without testing it may result in the financing of RRs in RD projects which would have been rejected had they been part of a RRsproject.

xiii. This paper does not claim to present an exhaustive set of methods useful for any conditions prevailing in RRs and RD projects; no guideline can be a substitute for imagination and resourcefulness on the part of professionals involved in project preparation. However, these professionals may find the experience with RRs screening and appraisal analyzed helpful in their work.

xiv. The paper also briefly mentions suggestions for improvements in preparation activities other than screening and appraisal. These suggestions are based on similarities and differences observed during the review and pertain to (a) accuracy of vehicle operating and construction costs, (b) consideration of the nature of crops during the selection of road standards, (c) state of project preparation before Board presentation, (d) policy questions to be raised during appraisal and/or sector work, and (e) testing of interdependency among project elements.

xv. Except for Annexes L and N, which consist of tables to be used in connection with two proposed simplified appraisal methods, all annexes present material for those interested in the "nuts and bolts." Their reading is not a prerequisite to the understanding of screening and simplified appraisal methods discussed in the text.

I. INTRODUCTION

1. Preamble. Many governments, particularly those of countries in Sub-Saharan Africa, are faced with the problems of how to reduce time and costs of the appraisal of RRs. This problem is especially acute since most developing nations have limited qualified staff and a large number of kilometers of RRs to be improved or built. In addition, the experience of various staff members from transport and agricultural divisions of the Bank indicates that a more efficient approach to the appraisal of RRs is highly desirable. The appraisal of RR investments can simply not demand the same amount of time as that of large irrigation works or highways.

2. Projects Reviewed. The screening and simple appraisal methods presented in this paper are primarily a combination and further development of methods discussed in appraisal reports and other preparation documents related to 15 RR projects and five RD projects. Of the 15 RR projects reviewed (Annex A) for this study, one included agricultural investments as part of the project, six were designed at least partly in support of Bank-financed agricultural projects, seven relied exclusively on government assurances that agricultural investments would be made in the project areas, and one did not require complementary investments. The five RD projects reviewed included both agricultural and RRs investments. The methods presented may be used in the appraisal of both RRs and RD projects [1/] with RR components.

3. Selection, Screening, Evaluation, Ranking. The preparation of RR components in a Bank project may include the following steps:

(a) selection of the RR "candidates";

(b) prescreening of the candidates based on criteria other than economic ones, such as social and/or political considerations;

(c) screening of the candidates based on economic criteria;

(d) ranking of the candidates; and

(e) economic appraisal of the candidates.

4. Selection of Candidate Roads. RR "candidates" are simply a collection of RRs which local, provincial or central government organizations propose for improvement or construction. Annex B describes ways these organizations can play a role in the selection. Depending on local conditions and government policies, steps (b) and (d) may be eliminated. Carrying out steps (c) and (e) is recommended to (i) save time of analyses

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1/ RD projects refer to projects with one or more agricultural components and RR components; in the Bank they may be classified as RD projects, agriculture, irrigation or forestry projects.

and (ii) arrive at economically viable investments, respectively. Each of the aforementioned five phases may apply to individual RRs, groups of interdependent RRs, or a package of interdependent agricultural and RRs investments.

5. Prescreening the Candidates. Prescreening procedures usually combine some political and social criteria and, sometimes, include general guidelines to reduce the risk that RRs which are not likely to be economically viable are selected for further consideration. Examples of prescreening criteria are:

- distribution of farm sizes (for instance, RRs in areas with a predominance of large farms are excluded);
- density of RR network (for example, distances between parallel RRs should not be less than 3 km);
- connection to all-weather roads;
- connection to towns, municipal centers, etc.; and
- access to health, education, and/or public administration centers.

Such prescreening methods do not provide any guarantee that the RRs selected will be economically viable. Thus, further analysis is required when governments and/or financing institutions are concerned with the economic viability of investments.

6. Annex C describes an interesting example of prescreening methods. 2/ This paper does not give any further attention to prescreening procedures, since they depend on the specific preferences and priorities of specific governments. There is no Bank policy on the use of prescreening methods based on non-economic factors.

7. Screening Candidates. Application of screening methods based on economic criteria to RR candidates is necessary if one wishes to save time and costs of analyses by rejecting project components which are not likely to be economically viable. Screening methods based on economic criteria may be applied after the use of prescreening procedures, or after the selection of RR candidates (first step) if a prescreening method is not used. Based on a testing of the reliability of various screening methods, Section II recommends the use of a screening method based on the principles of discriminant analysis and another one which involves the quick and rough estimation of an ER. The reliability of any particular screening method is defined as the probability that a project component will be accepted or rejected for further analysis when the component should correctly be so accepted or rejected. "Should accept" and "should reject" are defined as acceptance and rejection decisions based on an economic analysis.

2/ See C. Carnemark, J. Biderman and D. Bovet, The Economic Analysis of Rural Road Projects, Annex 3, World Bank Staff Working Paper No. 241, 1976, for another example of a prescreening method.

8. Ranking Candidates. Ranking of project component candidates is sometimes done after having carried out the screening process based on economic criteria or the appropriate economic appraisal step when the total costs of implementing a set of RRs and agricultural improvements exceed the available budget. The ranking may be based on weighted or unweighted socio-political criteria or technical factors similar to those used in prescreening procedures. Alternatively, the candidates may be ranked in descending order of ERs as computed by one of the methods in Section III, and go down this list until the point where the available budget is exhausted. It can be shown, however, that the process of ranking investment packages simply in their descending order of ERs, NPVs, or B/C ratios does not guarantee the implementation of an optimal combination of such packages where a given capital constraint does not permit the undertaking of all proposed projects. By optimal combination is meant that combination of investment proposals which has a maximum value of total discounted net benefits. Only the use of heuristic, linear, integer, or dynamic programming procedures 3/ can provide such an optimal combination. The application of these methods to the analysis of RRs, while intellectually satisfying, would be time-consuming and costly and is not recommended in the conditions found in most Bank borrowing countries. There is no specific Bank policy with regard to the use or otherwise of ranking procedures.

9. Economic Appraisal of the Candidates. A set of simplified economic appraisal methods in increasing order of complexity, is presented in Section III below. The operational principle inherent is that where a proposed investment passes the test of a simple method then no further analysis is required provided the decision body using the method is willing to accept the reliability of the approach. The use of a more time-consuming method is recommended only when an investment does not pass a simple appraisal method. The use of these methods is recommended to save time and cost in the appraisal of RRs and RD projects. The definition of the reliability of a simple method is similar to the definition of the reliability of a screening method (para. 7); it is the probability that it will accept when it should accept, and it will reject when it should reject a proposed investment. "Should accept" and "should reject" refer to decisions based on an actual ER or an ER obtained with a complete economic analysis.

3/ See H. L. Beenhakker, Handbook for the Analysis of Capital Investments, Chapter 4 (Greenwood Press, Westport, Connecticut, London, 1976) for a description of these procedures and problems related to ranking based on ERs, NPVs or B/C ratios.

10. Consumer Surplus vs. Producer Surplus. The consumer surplus (CS) approach to the economic evaluation of RRs stresses the quantification of road user savings. 4/ This method, which is sometimes referred to as the vehicle operating cost (VOC) savings method, is best suited for cases where the existing or normal traffic, or its projected growth, is substantial and the estimated transport cost savings are a reliable measure of project benefits. The producer surplus (PS) or value added approach 5/ to the economic analysis of RRs stresses the assessment of economic activity, particularly agricultural production, in the RR's zone of influence. The PS method is best suited for situations where there are reasonably accurate data regarding boundaries of the zone of influence, prices and yields of agricultural products produced in this area, and the agricultural potential. It has the advantage that it is intuitively more satisfying to non-economists; however, it cannot be applied to non-agricultural traffic. Both in literature and in practice considerable confusion exists as to whether the CS or PS method results in more accurate estimates of ERs. It can be shown that both methods will result in the same ER if available data regarding existing and future traffic, its mix, VOCs, boundaries of the zone of influence, prices and yields of agricultural products, etc., are of the same accuracy (Annex D). The simplified economic appraisal procedures of Section III are based on the principles of the CS method, PS method or combinations thereof. Section IV describes variations in VOCs observed in the analysis of the 20 projects reviewed, together with other observed similarities and differences. The large variations in VOCs indicate that the PS method has a wider potential use than the CS method.

11. RR's Zone of Influence. The PS approach establishes an investment package of agricultural and RR investments in the zone of influence of a RR or group of interdependent RRs. These zones of influence are determined by (i) the RR network around the road(s) being analyzed, (ii) the distance between farms and local markets, (iii) the terrain, and (iv) the means of transport used such as headloading, pack animals, animal-drawn carts, agricultural pickups, trucks, passenger cars, and buses. Mathematical expressions have been developed for computing the area of a zone of influence. 6/ These expressions require input data which may not be easily available and become rather complex without making a number of simplifying assumptions such as a situation where only one crop is produced in the zone of influence, no variations in topography, and zero impact of other existing or planned transport links in the vicinity of the RR(s) being analyzed. The method followed in the preparation of the RR appraisals reviewed under the present study is, therefore, preferred. This method establishes the

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4/ See H. G. van der Tak and Anandarup Ray, The Economic Benefits of Road Transport Projects, World Bank Staff Occasional Paper No. 13, 1971, for a review of this methodology.

5/ See C. Carnemark et al., op. cit., and H. L. Beenhakker and A. Chammari, Identification and Appraisal of Rural Roads Projects, World Bank Staff Working Paper No. 362, 1979, for reviews of various aspects of the PS approach.

6/ See, for instance, C. Carnemark et al., ibid. Annex 4.

boundaries of zones of influence by examining the terrain (for instance, presence of rivers, mountains, valleys), RRs network, and present patterns of travel and transport. This methodology could be improved by conducting sample interviews of people moving over a RR to be improved or expected to move over a new RR, or by the use of aerial photography or ERTS imagery when available.

12. As stated earlier, the main objective of this paper is to arrive at a more simple and less time-consuming approach to the appraisal of RRs. The approach used was to develop procedures that use only part of the data normally available for appraisal. If using only part of the data can produce the same conclusions regarding economic viability of a project as would have been obtained using more complex procedures and all the ex-ante data, time and cost savings will result.

13. First Simplification. The first proposed simplification is to determine the ER for groups of RRs rather than for individual RRs. This is legitimate if the proposal satisfies the following conditions:

1. The per km cost of construction or improvement of each of the RRs belonging to the group is equal to or less than US$10,000 equivalent;

2. The variation of the per km cost of construction among the RRs belonging to the group is less than US$2,000.

If the appraisal is to be made by the PS method (or a combination of PS and CS) the project must in addition satisfy the following conditions:

3. The RRs which constitute a group are located in areas where proposed agricultural investments are interdependent with each other; and

4. The RRs which constitute a group are located in areas where farms with typical farm budgets are evenly distributed so that present and future values of agricultural production in these areas can be assumed to be the same.

The threshold of US$10,000 per km is based on the principle that the cost of investment for these RRs is so low compared with per km costs of other RRs or highways that their evaluation does not warrant the costs and time required for the computation of ERs of individual RRs; the threshold of US$2,000 per km reduces the risk of "mixing in" of productive and unproductive elements.

For instance, if two RRs with costs of construction of $10,000 per km and $5,000 per km were grouped for purposes of the ER calculation, it is possible that both roads would be accepted for implementation, while the one costing $10,000 per km would not be accepted on its own "merits" or separate ER. Although RRs satisfying the aforementioned conditions are not necessarily interdependent, they may be treated in the same way as interdependent groups of RRs when applying the techniques proposed in Sections II and III.

II. SCREENING RURAL ROADS

14. Purpose. Screening methods include a variety of techniques of great simplicity and speed of application. The object is to arrive at an initial sifting of RRs, groups of interdependent RRs, or investment packages consisting of interdependent RRs and agricultural investments prior to an economic appraisal. Screening of potential project components is therefore based on fairly limited information about them.

15. It is not advisable to combine political, social and economic factors in one screening method if agricultural and/or RR components selected with this method are subsequently to be subjected to an economic appraisal since such an approach may be time-consuming. This is so since such screening may accept a large number of RR candidates, which are subsequently rejected in the economic appraisal. Prescreening based on social and political factors (paras. 5 and 6) followed by screening based on economic criteria is therefore preferred. The screening methods discussed here are based on economic criteria only, since the overall objective of this paper is to save time and costs of preparation of RRs and RD projects. Only two of the projects reviewed had screening methods based solely on economic criteria. These methods (Annexes E and F) are not presented here since they rely on country specific data and relationships, which restricts their use on a worldwide basis.

16. Quantitative Approach. Quantitative methods, such as regression or discriminant analysis, provide relatively simple and inexpensive techniques for developing screening procedures for RRs and RD projects. By definition these procedures predict the outcome of a full economic appraisal for each RR, group of interdependent RRs, or investment packages consisting of interdependent RR and agricultural components, by using a limited number of variables for which data can be readily collected. The variables normally considered and tested in this study were basically of three types: (1) measures of producer surplus (PS) effects (such as agricultural value added, increased agricultural production, increased land brought under cultivation, area of cultivated land served); (2) measures of consumer surplus (CS) effects (such as vehicle operating cost savings for normal traffic, possibly divided into passenger and goods traffic); and (3) costs of RRs and agricultural investments. The relationships to be tested can be expressed in the general form:

EF is a function of PS/C and CS/C or

$$EF = f(PS/C, CS/C) \qquad \qquad \text{...........(1)}$$

where EF = economic feasibility of a RR, group of interdependent RRs, or investment package of interdependent RR and agricultural investments,

PS = producer surplus (value added of future, agriculture production),

CS = consumer surplus (vehicle operating cost savings due to improved or new RR(s)), and

C = cost of RR(s) and agricultural investments.

Expression (1) should not be interpreted as double counting benefits because it refers to both PS and CS. The following paragraphs show that one of the proposed screening methods considers benefits related to PS and CS at different points in time of the investment's expected life.

17. In RRs projects without agricultural components, the above term C represents the cost of constructing and maintaining a RR or group of interdependent RRs. If such projects complement ongoing agricultural projects, the costs of existing agricultural investments are sunk costs and therefore should not be taken into account in expression (1). The only PS value to be considered in this case is the value which could not be realized without the improved or new RR or group of interdependent RRs. Costs and benefits of components of planned (future) agricultural projects which are dependent on RR components of a proposed RR project should be considered together, regardless of potential source of financing. This situation calls for the formulation of investment packages consisting of interdependent RR(s) and agricultural components.

18. In this study, a number of possible screening procedures based on variations of expression (1) were developed and tested on a worldwide sample of 110 RRs with or without agricultural components dependent on RRs, drawn from Bank project files. About half of these 110 RRs represented RRs without dependent agricultural investments. Some of these procedures, especially the simpler ones, proved to have an unacceptably low reliability in terms of their ability to predict the outcome of a full economic appraisal. Discriminant analysis was the most successful method and provides the tool which is recommended here for use in screening components of RRs and RD projects by staff of government organizations and the Bank involved in the preparation of these projects. The method is described below while details are provided in Annex G. The use of another screening method (para. 24) which involves a quick and rough approximation of an ER, is recommended for situations where large amounts of passenger and non-agricultural traffic are expected to generate most of the benefits. Screening based on the principles of regression analysis is described in Annex H. Its intended use on a worldwide basis is very limited. Annex I describes the data base used for testing these approaches.

19. Discriminant Analysis Approach. Discriminant functions can be used to classify RRs, interdependent groups of RRs, or investment packages of RR and agricultural investments into one of two groups, defined as feasible and unfeasible. For the purpose of this analysis, the criterion of feasibility was first defined for a country with a prevailing opportunity cost of capital of 12%. To find out whether a project component is feasible or not, one first computes S_1 and S_2 values with the help of the following equations:

$$S_1 = -98.54 + 113.60\,x + 256.82\,y + 0.32\,z \qquad \text{.........(2)}$$

$$S_2 = -359.66 + 451.75\,x + 745.35\,y + 0.81\,z \qquad \text{.........(3)}$$

where x = incremental agricultural value added in the year of full production divided by the present value of costs of investments and maintenance of RR and agricultural components,

y = opening year benefits stemming from savings in vehicle operating costs accruing to normal traffic, divided by the present value of costs of investments and maintenance of RR and agricultural components, and

z = initial or preproject net value in US dollars' equivalent of agricultural production per hectare of cultivated area in the road's zone of influence.

Another way of stating expressions (2) and (3) is:

$$S_1 = -98.54 + 113.60 \left[\text{Incremental agricultural value added in year of full production} \div \text{Present value of investment and maintenance costs of RR and agricultural components}\right]$$

$$+ 256.82 \left[\text{Opening year benefits from VOC savings accruing to normal traffic} \div \text{Present value of investment and maintenance costs of RR and agricultural components}\right]$$

$$+ 0.32 \left[\text{Initial net value of agricultural production per ha}\right]$$

$$S_2 = -359.66 + 451.75 \left[\text{Agricultural value added in year of full production} \div \text{Present value of investment and maintenance costs of RR and agricultural components}\right]$$

$$+ 754.35 \left[\text{Opening year benefits from VOC savings accruing to normal traffic} \div \text{Present value of investment and maintenance costs of RR and agri-cultural components}\right]$$

$$+ 0.81 \left[\text{Initial net value of agricultural production per ha}\right]$$

The figures of equations (2) and (3) are to be interpreted as relative weights given to the main criteria used to determine whether an investment is economically feasible. They are derived from statistical comparisons and analysis.

20. The comments on C and expression (1) of para. 17 apply equally to the costs of investments and maintenance in expressions (2) and (3). Maintenance costs are defined as the incremental maintenance costs during the expected life of the project component(s) when comparing the situations with and without the project. To simplify one may ignore maintenance costs if their present value is small (about 15%) relative to the present value of investment costs. Such simplification is not likely to influence the decision as to whether a project component is feasible or not. If maintenance costs are not small compared to costs of investment and if project components of an investment package have different expected lives, it is suggested for simplicity to consider maintenance costs only during the period corresponding to the shortest expected life of the project components.

21. For a country with an opportunity cost of capital of 12%, a project component or group of interdependent components is feasible if the S_1 value is smaller than the S_2 value; otherwise it is unfeasible. In other words, if the S_1 value is equal to or greater than the S_2 value, the project component(s) are unfeasible. Expressions (4) and (5), (6) and (7), and (8) and (9) represent S_1 and S_2 values for countries with prevailing opportunity costs of capital of 10%, 14%, and 16%, respectively.

Opportunity cost of capital 10%:

$$S_1 = -95.78 + 94.68\ x + 182.08\ y + 0.30\ z \quad \text{.........(4)}$$

$$S_2 = -287.81 + 353.17\ x + 661.46\ y + 0.65\ z \quad \text{.........(5)}$$

Opportunity cost of capital 14%:

$$S_1 = -105.83 + 129.61\ x + 276.92\ y + 0.35\ z \quad \text{.........(6)}$$

$$S_2 = -375.13 + 476.70\ x + 791.37\ y + 0.80\ z \quad \text{.........(7)}$$

Opportunity cost of capital 16%:

$$S_1 = -189.41 + 236.14\ y + 0.40\ q - 0.30\ z \quad \text{.........(8)}$$

$$S_2 = -221.61 + 427.67\ y - 0.02\ q + 1.00\ z \quad \text{.........(9)}$$

Where q = present value of costs of investments and maintenance of RR and agricultural components divided by the equivalent increase in area cultivated in hectares; this increase is defined as the increase in cultivated land in the year of full production of the with-project situation (as compared to the without-project situation) plus the ratio of the difference in with- and without-project yields to without-project yields multiplied by the cultivated area (hectares) in the without-project situation, in the year of full production,

and all other variables are as defined in para. 19.

Another way of stating expressions (8) and (9) is:

$$S_1 = -189.41 + 236.14 \left[\text{Opening year benefits from VOC savings accruing to normal traffic} \div \text{Present value of investment and maintenance costs of RR and agricultural components} \right]$$

$$+ \; 0.40 \left[\text{Present value of investment and maintenance costs of RR and agricultural components} \div \text{Equivalent increase in area cultivated in ha} \right]$$

$$- \; 0.30 \left[\text{Initial net value of agricultural production per ha} \right]$$

$$S_2 = -221.61 + 427.67 \left[\text{Opening year benefits from VOC savings accruing to normal traffic} \div \text{Present value of investment and maintenance costs of RR and agricultural components} \right]$$

$$- \; 0.02 \left[\text{Present value of investment and maintenance costs of RR and agricultural components} \div \text{Equivalent increase in area cultivated in ha} \right]$$

$$+ \; 1.00 \left[\text{Initial net value of agricultural production per ha} \right]$$

22. Reliability. The reliability (para. 7) of the discriminant analysis approach was found to be high; it resulted in 87% correct decisions. In addition, the method is conservative in that it has an extremely low probability (less than 1%) of accepting a project component that should be rejected. Practically all of the incorrect decisions resulting from the test on a sample of 110 RRs (para. 18) were of the type where an actually feasible project component would have been classified in the unfeasible group, as shown in the following.

Decision Based on			
Screening		Complete Economic Analysis	
Accept	Reject	Accept	Reject
66	44	78	32

The sensitivity of S_1 and S_2 to variations in one or more of the dependent variables of expressions (2) through (9) should be assessed if the accuracy of data required for these variables is being questioned.

23. The use of S_1 and S_2 values is recommended as a preliminary screening measure in cases where a large number of low-standard rural roads are proposed for improvement to all-weather, unpaved standards. The sample from which these values were determined was heavily weighted toward roads whose principal impact would be felt in the agricultural sector. Thus these values should be used with caution in situations where large amounts of passenger or non-agricultural commodity traffic are expected to account for most of the benefits. The screening based on discriminant analysis is also not recommended when full production occurs either before year 4 or after year 10 following the opening of the road. Finally, this screening has not been tested for penetration roads (roads proposed to "open" areas which in the without-project situation are isolated or do not have any road connection), since required information on such roads is not available. In such situations the use of the screening method described below, which requires a few more input data and is based on simplification of a project's net benefit streams, may be preferable.

24. Rough ER Approximation. This method was originally developed for finding the starting point for an ER calculation of a given cash flow if the ER is to be found by trial and error. 7/ It has, however, good potential for screening of RRs, groups of interdependent RRs, or investment packages consisting of interdependent RR and agricultural components. The screening involves the approximation of the ER of a project component or group of interdependent components. The component "passes" the screening or is selected for further analysis if the approximated ER equals or exceeds the opportunity cost of capital.

25. The approximate ER is read from one of two tables each of which represents variations of standardized cost and net benefit streams. In other words, standardized cost and net benefit streams are selected as an approximation to the cost and benefit streams of project component(s) to be screened. The first standardized cost and net benefit streams consist of

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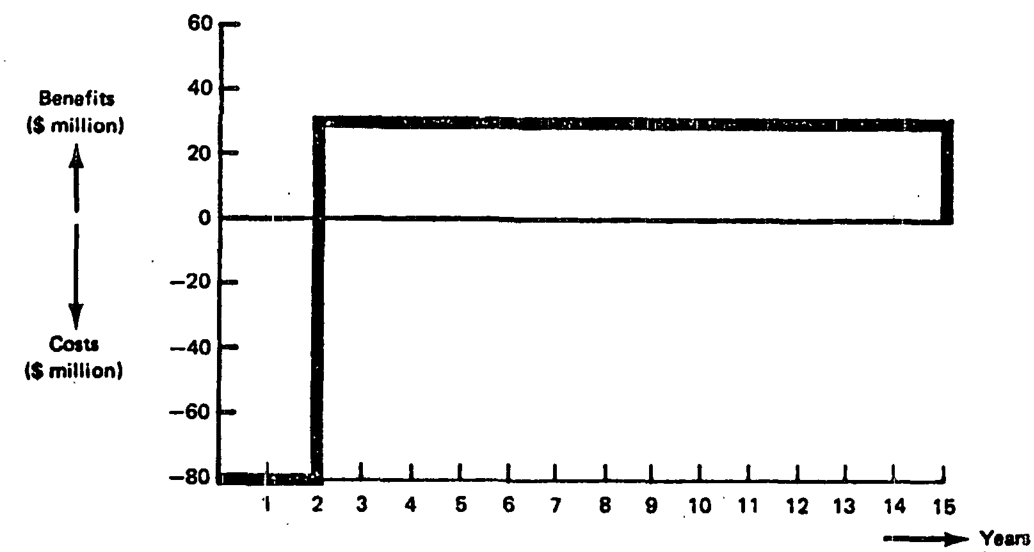
7/ Walter Schaefer-Kehnert, How to Start an Internal Rate of Return Calculation, EDI Training Materials, Course Note Series, CN30, October 1981.

uniform or rectangular functions of costs and benefits as presented in Figure 1. This figure portrays a situation where costs of investment ("negative cash flow") of project component(s) are $80 million in each of the first two years of implementation and annual net benefits ("positive cash flow") amount to $35 million during years 3 through 15.

Figure 1: Uniform Cost and Net Benefit Streams



26. Table 1 presents ERs for variations of the cost and net benefit streams of Figure 1, where the variations consist of combinations of uniform costs incurred over a period from one to five years, and uniform benefits incurred over periods of 5, 10 and 20 years.

Table 1: ER of Uniform Cost and Net Benefit Streams

No. of Years with Investment Costs	No. of Benefit Years	Average Annual Net Benefits as % of Investment Costs							
		10	20	30	40	50	60	80	100
1	5	-	0	15	29	41	53	75	97
	10	0	15	27	38	49	59	80	100
	20	8	19	30	40	50	60	80	100
2	5	-	0	13	23	33	47	56	69
	10	0	13	24	32	40	48	61	73
	20	7	18	26	34	41	48	61	73
3	5	-	0	11	20	27	33	45	54
	10	0	12	21	28	34	40	50	58
	20	7	16	24	30	36	41	50	59
4	5	-	0	9	17	23	28	37	45
	10	0	11	19	25	30	35	42	49
	20	7	15	22	27	32	36	43	50
5	5	-	0	8	15	20	25	32	38
	10	0	10	17	22	27	31	37	42
	20	6	14	20	24	29	32	38	43

27. To explain the use of Table 1, consider the following simple example:

	Year				
	1	2	3	4	5-14
Investments Costs ($ million)	25	25	25	25	
Net Benefits ($ million)					50

Thus, investment costs are incurred over a period of four years ($25 million per year) and annual net benefits amount to $50 million during years 5 through 14. One determines the sum of investment costs or $100 million; average annual net benefits or $50 million, and average annual net benefits as a percentage of investment costs or 50%. Table 1 indicates that these cost and benefit streams have an ER of 30%. If cost and benefit streams are indeed uniform functions, this ER is exact rather than an approximation.

28. If cost and net benefit streams are not uniform, an approximate ER to be used for screening (para. 24) can still be obtained from Table 1. Take the following example:

	Year							
	1	2	3	4-7	8-10	11-14	15	16
Investment Costs ($ thousand)	954	530	131					
Net Benefits ($ thousand)				456	340	456	307	153

The sum of investment costs equals $1,615 thousand. Average annual net benefits amount to $394 thousand and represent 24% of $1,615 thousand. The approximate ER is obtained by computing the arithmetic average of the following four ER values read from Table 1:

	Number of Benefit Years	Average Annual % Net Benefits 20	30
Number of Years with Investment Costs = 3	10	12	21
	20	16	24

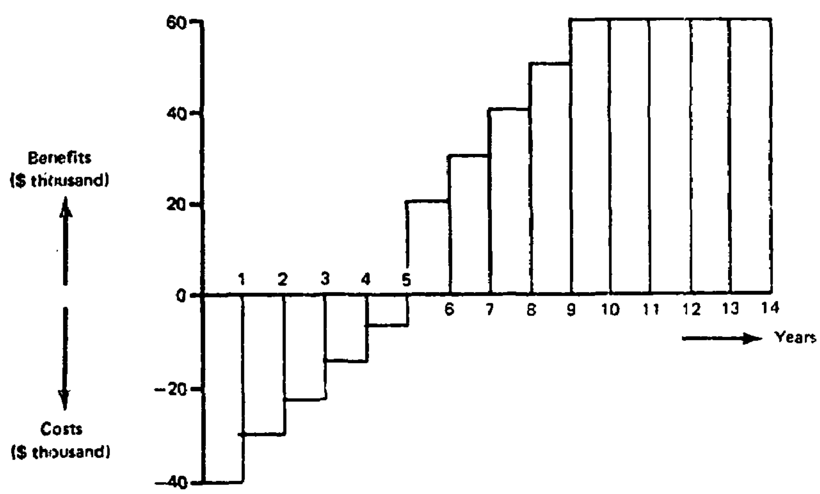
The average of 12, 16, 21 and 24% amounts to 18%, which is the value of the approximated ER.

29. If the cost and benefit streams to be analyzed are very uneven in the sense that investment costs are high at the beginning and then decline, and that annual net benefits gradually build up over a number of years before they stabilize, the ER can be considerably lower than shown in Table 1. The use of Table 2 is recommended to approximate these conditions. Table 2 is based on standardized cost and net benefit streams which assume a linear decline of the costs during a period ranging from one to five years followed by a linear buildup of annual net benefits over the first five years that follow. Figure 2 portrays an example of such standardized cost and net benefit streams.

Table 2: ER of Standardized Uneven Cost and Net Benefit Streams

No. of Years with Invest. Costs	No. of Benefit Years	Average Annual Net Benefits as % of Investment Costs							
		10	20	30	40	50	60	80	100
1	5	-	0	12	22	30	38	52	64
	10	0	12	21	28	34	40	50	59
	20	7	16	23	28	34	38	47	55
2	5	-	0	10	19	25	30	40	49
	10	0	11	18	24	29	34	42	48
	20	6	14	20	25	29	33	40	46
3	5	-	0	9	15	21	25	33	40
	10	0	10	16	21	26	29	36	41
	20	6	13	18	23	26	29	35	40
4	5	-	0	7	13	18	22	28	34
	10	0	9	15	19	23	26	31	36
	20	6	12	17	21	24	26	31	35
5	5	-	0	7	12	16	19	25	29
	10	0	8	13	17	21	23	28	32
	20	5	12	16	19	22	24	28	31

Figure 2: Standardized Uneven Cost and Net Benefit Streams



30. To illustrate the use of Table 2 as a tool to establish an approximate ER for screening purposes, consider the following example:

	Year								
	1	2	3	4	5	6	7	8-10	11-15
Investment Costs ($ thou.)	11,200	2,806	402						
Net Benefits ($ thou.)				3,189	6,795	7,997	4,497	7,997	12,000

Thus, the sum of investment costs equals $14,408 thousand, average annual net benefits amount to $8,872 thousand and represent 62% of $14,408 thousand. According to Table 2, the ER should be about 29%.

31. When deciding whether Table 1 or 2 should be used, a simple inspection will indicate whether the cost and net benefit streams to be analyzed are closer to a uniform or uneven distribution. A figure laying between Table 1 and Table 2 values for ER may be chosen if the cost and net benefit streams are in between the two standardized cost and net benefit streams.

32. Reliability. The reliability of the screening method which uses Table 1 or Table 2 depends on how close the underlying standardized cost and net benefit streams are to the cost and benefit streams to be analyzed. It is amazing how close the results often are, even with cost and benefit streams which do not appear to be very close to the standardized ones. For example, the actual ERs pertaining to the examples of paras. 28 and 30 amount to 18% and 29%, respectively. The use of Tables 1 and 2 is not recommended when annual net benefits decrease over time, since the approximated ER would in most cases be too much undervalued and therefore too many project components which deserve further analysis would be rejected. Fortunately, RRs and RD projects do not often have project components with decreasing annual net benefits.

33. Regression Analysis Approach. An attempt was made to use regression analysis to develop equations, based on the sample data, that would permit the estimation of an ER for RRs, interdependent RRs, or investment packages of interdependent RR and agricultural components, by using a limited number of variables. The method assumes that a relationship exists between the ER and appropriately defined measures of key variables. Although some of the equations developed provided reasonably reliable estimates in terms of the reliability as defined in para. 7, the standard error of the estimates was too high for the equations to be used as acceptable proxy measures of the ER for project components (Annex H). It is therefore concluded that regression analysis can only produce satisfactory results in the context of a particular country, where a more homogeneous group of RR candidates and more homogeneous agricultural production patterns should result in a significantly lower standard error. Annex J presents an example of how screening methods can be developed using regression analysis. Of course, regression analysis would only make sense in situations where a very large number of road links need to be evaluated, so that correct decisions could be confidently predicted on the basis of an adequate sample.

III. SIMPLE ECONOMIC APPRAISAL METHODS

34. Purpose. This section presents simple appraisal methods in increasing order of complexity. There is not much difference in degree of complexity of the last three methods presented; the difference between these methods pertains to different input requirements. If a proposed RR, group of interdependent RRs or investment packages of interdependent RR and agricultural components passes the test of a simple appraisal method, no further analysis is required unless the analyst wishes to know the percentage points by which an ER exceeds the opportunity cost of capital. In other words, to save time one accepts a project component or group of interdependent components if its "simple" ER exceeds the opportunity cost of capital. "Simple" ER is defined as an ER based on a significant portion of quantifiable benefits rather than on all. Simple ERs are all understatements of actual ERs. If project component(s) do not pass a simple appraisal, the use of a more time-consuming method is recommended.

35. The reliability (para. 9) of individual simple methods is of little interest if the aforementioned approach is followed. The reliability of the approach is as good as the reliability of the most complex methods (paras. 61, 62 and 66) proposed. These methods, which are also based on a number of simplifications, were found to have a reliability of about 95%.

36. It is of interest to note that the majority of RRs reviewed for this study had actual ERs which significantly exceeded prevailing opportunity costs of capital. Consequently, a significant portion of time devoted to economic analyses would have been saved had the approach described below been followed. It is suggested that in addition to the simple ERs for project components, the actual ER for an entire RRs or RD project (i.e., not individual components) be computed when this approach is followed. In addition, the carrying out of sensitivity testing as normally done in appraisals may be done to test the sensitivity of simple ERs of project components. One should use a more time-consuming method if as a result of such testing a component is rejected. The reader may decide that some of the methods described below are so simple (e.g., simplified methods I, II, and III) that it is not worthwhile to first screen project components with one of the proposed methods of Section II.

37. Simplified Method I. This method is a simplified version of the consumer surplus (CS) approach. Its use is recommended in deciding whether an existing RR should be improved, wherever (i) existing traffic is significant, (ii) potential producer surplus benefits are insignificant, (iii) traffic is expected to grow at a constant rate, and (iv) traffic composition is not going to change significantly. Traffic composition is the composition of types of vehicles such as private cars, motorcycles, horse- or ox-drawn vehicles, buses and cycles.

38. Table 3 is a tool for determining whether a particular RR improvement satisfies the condition that the ER equals the opportunity cost of capital (i) of 12% or more. It is assumed in this table that the average daily traffic (ADT) grows at a rate (g) of 5% per annum in the with-project situation and that the expected life of the RR (N) is 10 years. The condition about the ER is then satisfied for any RR having vehicle operating

costs (VOC) and VOC savings (VOCS) as shown in the extreme left-hand columns; per kilometer costs of investment (CI) as shown in the top row of the table, and actual ADT no less than what is shown at the intersection of the appropriate VOCS row and the appropriate CI column. The improvement costs are defined as the present value of construction and incremental maintenance costs. Para. 20 mentions that maintenance costs may be ignored if their present value is less than 15% of the present value of the construction costs. The following example illustrates the use of Table 3. Suppose a decision is to be made about the economic viability of a proposed RR with the following characteristics:

CI	=	$25,000
VOC	=	$ 0.50
VOCS	=	25%
g	=	5%
i	=	12%
N	=	10 years
ADT	=	95 (actual)

The above ADT of 95 is compared with the ADT of Table 3 which pertains to g = 5%, VOC = $0.50, and VOCS = 25%. The proposed RR is economically viable if the actual ADT (95 in the example) is equal to or greater than the ADT obtained from Table 3 (77 in the example); otherwise it is not. Thus the RR of the example is feasible. Interpolation between CI, VOC and VOCS values of Table 3 may be required if the actual figures are not found in the table.

39. The ADT figures represent passenger cars, vans, medium and large trucks, buses, motorcycles, and animal-drawn vehicles. The VOC figures to be used are weighted averages of VOC of vehicles observed on the existing RR. Annex K shows ranges of CI and VOC values observed during the study. Annex L presents tables similar to Table 3 for combinations of variations in i ranging from 10% to 18%, variations in g ranging from 5% to 15%, and values of N equal to 10 and 15, while Annex M describes the manner in which these tables have been developed.

40. The tables of Annex L cannot be directly applied if costs of RR improvements occur over more than one year. In this case, the cost in each year must be adjusted to determine its worth in a base year. This is achieved by calculating its worth in the year just before benefits start accruing (year of opening).

41. Simplified Method II. Wouters' 8/ tables provide a simple way by which, with an acceptable degree of approximation, the ER of a proposed RR improvement can be established. The tables show ERs for benefit streams growing at compound rates varying between 5% and 20% and for periods of 10, 15, 20, 25, 30 and 40 years (Annex N). Use of the tables is recommended if (i) existing traffic is significant, (ii) potential producer surplus benefits are insignificant, and (iii) net benefits stemming from the improved RR are expected to grow at a given compound rate.

8/ V. Wouters, Internal Rates of Return Tables, World Bank, December 1967.

Table 3

Critical Values of Average Daily Traffic 1/
N-10, g=5, i-12

VOC ($/KM)	VOCS 2/ X	CI ($/KM) 8000	10000	18000	20000	25000	35000	50000	75000	125000	200000	250000
0.10	0.05	615	768	1383	1536	1920	2689	3841	5761	9602	15363	19204
0.10	0.10	307	384	691	768	960	1344	1920	2881	4801	7682	9602
0.10	0.15	205	256	461	512	640	896	1280	1920	3201	5121	6401
0.10	0.25	123	154	277	307	384	538	768	1152	1920	3073	3841
0.10	0.35	88	110	196	219	274	384	549	823	1372	2195	2743
0.10	0.50	61	77	138	154	192	269	384	576	960	1536	1920
0.10	0.75	41	51	92	102	128	179	256	384	640	1024	1280
0.25	0.05	246	307	553	615	768	1075	1536	2305	3841	6145	7682
0.25	0.10	123	154	277	307	384	538	768	1152	1920	3073	3841
0.25	0.15	82	102	184	205	256	358	512	768	1280	2048	2561
0.25	0.25	49	61	111	123	154	215	307	461	768	1229	1536
0.25	0.35	35	44	79	88	110	154	219	329	549	878	1097
0.25	0.50	25	31	55	61	77	108	154	230	384	615	768
0.25	0.75	16	20	37	41	51	72	102	154	256	410	512
0.50	0.05	123	154	277	307	384	538	768	1152	1920	3073	3841
0.50	0.10	61	77	138	154	192	269	384	576	960	1536	1920
0.50	0.15	41	51	92	102	128	179	256	384	640	1024	1280
0.50	0.25	25	31	55	61	77	108	154	230	384	615	768
0.50	0.35	18	22	40	44	55	77	110	165	274	439	549
0.50	0.50	12	15	28	31	38	54	77	115	192	307	384
0.50	0.75	9	10	18	20	26	36	51	77	128	205	256
1.00	0.05	61	77	138	154	192	269	384	576	960	1536	1920
1.00	0.10	31	38	69	77	96	134	192	288	480	768	960
1.00	0.15	20	26	46	51	64	90	128	192	320	512	640
1.00	0.25	12	15	28	31	38	54	77	115	192	307	384
1.00	0.35	9	11	20	22	27	38	55	82	137	219	274
1.00	0.50	6	8	14	15	19	27	38	58	96	154	192
1.00	0.75	4	5	9	10	13	18	26	38	64	102	128
2.00	0.05	31	38	69	77	96	134	192	288	480	768	960
2.00	0.10	15	19	35	38	48	67	96	144	240	384	480
2.00	0.15	10	13	23	26	32	45	64	96	160	256	320
2.00	0.25	6	8	14	15	19	27	38	58	96	154	192
2.00	0.35	4	5	10	11	14	19	27	41	69	110	137
2.00	0.50	3	4	7	8	10	13	19	29	48	77	96
2.00	0.75	2	3	5	5	6	9	13	19	32	51	64
4.00	0.05	15	19	35	38	48	67	96	144	240	384	480
4.00	0.10	8	10	17	19	24	34	48	72	120	192	240
4.00	0.15	5	6	12	13	16	22	32	48	80	128	160
4.00	0.25	3	4	7	8	10	13	19	29	48	77	96
4.00	0.35	2	3	5	5	7	10	14	21	34	55	69
4.00	0.50	2	2	3	4	5	7	10	14	24	38	48
4.00	0.75	1	1	2	3	3	4	6	10	16	26	32

1/ It is clear that the situations with some of the high ADTs and high costs of construction reported in this table are the exception for RRs and RD projects; these situations have been included since they were observed in a few cases of the 20 projects reviewed.

2/ 0.05, 0.10, etc., mean a 5 percent, 10 percent, etc., saving in VOC of first column.

42. The procedure for determining the ER with the help of Wouters' tables, consists of the following steps:

Step 1: calculate the ratio C/B_1, where C = the cost of RR improvement [9]/ and B_1 = the first year benefits or benefits in the base year;

Step 2: refer to the appropriate compound growth rate -- that is, the rate at which net annual benefits are assumed to be growing;

Step 3: locate the value closest to C/B_1 in the appropriate expected life column;

Step 4: read off the corresponding ER.

43. Table 4 shows one of the tables of Annex N. To illustrate its use, consider a road authority that is examining the gravelling of a RR at a cost of $110,000. It estimates that this will save about $10,000 initially in VOC and these savings will increase each year at 5% per annum over an assumed 15-year life of the road. Thus, C/B_1 = 11; Table 4 shows for C/B_1 = 11.2679 an ER of 9%.

Table 4: ER for Net Benefits Growing at 5% Compound Rate

ER \ N	= 10 yrs	15 yrs	20 yrs	25 yrs	30 yrs	40 yrs
1	12.4587	20.7554	30.8305	43.0650	57.9219	97.8713
2	11.7691	19.0636	27.4958	37.2431	48.5107	76.5920
3	11.1327	17.5552	24.6260	32.4105	40.9806	60.8032
4	10.5444	16.2073	22.1477	28.3793	34.9162	48.9670
5	10.0000	15.0000	20.0000	25.0000	30.0000	40.0000
6	9.4955	13.9163	18.1324	22.1533	25.9881	33.1335
7	9.0275	12.9413	16.5027	19.7435	22.6925	27.8180
8	8.5927	12.0622	15.0759	17.6936	19.9674	23.6580
9	8.1884	11.2679	13.8225	15.9414	17.6991	20.3664
10	7.8118	10.5487	12.7177	14.4365	15.7986	17.7335
11	7.4608	9.8962	11.7408	13.1379	14.1961	15.6046
12	7.1331	9.3028	10.8741	12.0121	12.8361	13.8651
13	6.8269	8.7622	10.1028	11.0315	11.6748	12.4291
14	6.5405	8.2687	9.4143	10.1737	10.6770	11.2318
15	6.2723	7.8174	8.7978	9.4199	9.8146	10.2240
16	6.0209	7.4037	8.2440	8.7546	9.0649	9.3680
17	5.7849	7.0239	7.7452	8.1651	8.4095	8.6346
18	5.5632	6.6746	7.2946	7.6405	7.8334	8.0011
19	5.3547	6.3526	6.8864	7.1718	7.3245	7.4498
20	5.1585	6.0555	6.5155	6.7515	6.8726	6.9665
21	4.9736	5.7806	6.1778	6.3732	6.4693	6.5399
22	4.7991	5.5261	5.8693	6.0314	6.1080	6.1612
23	4.6345	5.2899	5.5870	5.7216	5.7827	5.8229
24	4.4789	5.0703	5.3278	5.4399	5.4887	5.5192
25	4.3318	4.8660	5.0894	5.1828	5.2219	5.2451
26	4.1925	4.6755	4.8696	4.9476	4.9789	4.9966
27	4.0605	4.4976	4.6664	4.7317	4.7569	4.7704
28	3.9353	4.3313	4.4783	4.5329	4.5532	4.5636
29	3.8166	4.1755	4.3037	4.3495	4.3659	4.3738
30	3.7037	4.0294	4.1414	4.1798	4.1931	4.1992

9/ See para. 38 for the treatment of maintenance costs; alternatively, annual incremental maintenance costs may be deducted from annual benefits.

44. Martinez [10/] has developed a variation of the Wouters' tables. His tables show ERs for net benefit streams growing at compound rates varying between 1% and 35%, for expected lives of 20, 25 and 30 years and construction periods of 1, 2, 3, 4 and 5 years, so that the adjustment mentioned in para. 40 can be avoided. However the tables are not available for expected lives shorter than 20 years. Instead of Annex N one may use Malone's graphical method [11/] to determine the ER if the aforementioned C/B_1 ratio, the expected life N, and the growth rate of g are given. Figure 3 presents Malone's method; the instructions given on this figure are self-explanatory.

45. Simplified Method III. This method, which is a simplified version of the producer surplus (PS) approach, as well as Methods IV, V, VI, VII, and VIII is based on the following simplifying assumptions:

(a) negligible salvage values of investments of the investment package;

(b) no distinction between production patterns on farms of different size in road's zone of influence;

(c) no distinction between farmgate prices of on-farm consumption and prices of exports from the road's zone of influence; and

(d) no consideration of on-farm consumption by animals.

With the possible exception of items (c) and (d), the effect of the above assumptions on the ER of project component(s) is to understate it. The effect of assumptions (c) and (d) could be either an understatement or overstatement of the simple ER. In the projects reviewed the effect of all four assumptions on the actual ERs was negligible.

46. Method III assumes that in addition to assumptions (a) through (d):

(i) local market prices in the with- and without-project situations remain the same;

(ii) the VOC savings related to non-agricultural traffic are negligible;

(iii) on-farm (home) consumption in the with- and without-project situations is negligible;

(iv) the value of production of the crops in the zone of influence in the with-project situation increases at a linear rate until it levels off ("full production"), while the corresponding value in the without-project situation either remains constant during the project's expected life or also increases at a linear rate until it levels off; and

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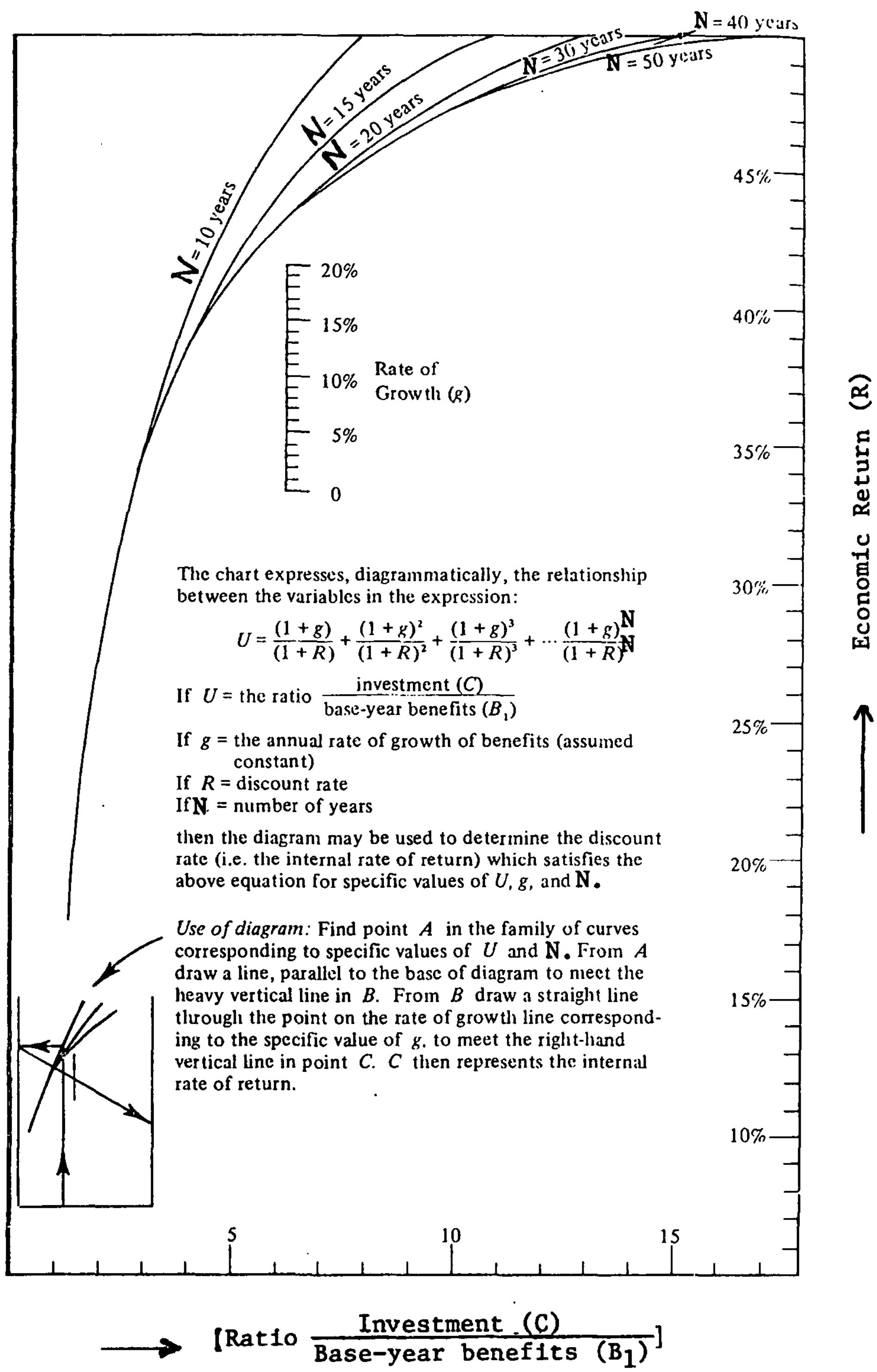
10/ M. Martinez, Benefit-Cost Calculations: Tables for Internal Rates of Return and Sensitivity Tests, World Bank, January 1979.

11/ P. O. Malone, Graphical Presentation of the Relations between C/B_1, N, g and ER, EDI, World Bank, December 1967.

Figure 3: Graphical Presentation of the Relations between C/B_1, N, g and ER



Source: EDI (World Bank) Training Materials.

(v) full production in the without-project situation is reached before or at the same time full production in the with-project situation is reached (this is normally the case).

Thus, Method III should not be used in situations where existing traffic on the RR(s) is significant and agricultural production is marginal. A slightly different variation of this method was used in the appraisal of the Bihar Rural Roads Project.

47. Table 5 shows a crop's present unit value (CPV) as a function of years to achieve full potential benefits, project components' expected lives (N), and simple ERs. The table is used by first determining the value of agricultural production when full production is reached in the with-project situation, the corresponding value in the without-project situation, and the difference between these values. Calling this difference the approximate value added (AVA) one next establishes the ratio C/(AVA) where C is the present value of investment and maintenance costs of project components. The ER may now be obtained from Table 5 by locating the value closest to this ratio in the appropriate "years to achieve full potential agricultural benefits" column; the ER which corresponds to this value is read off in the first column of Table 5. Annex M discusses the manner in which CPV factors have been derived and the justification for their use.

48. The procedure for determining the ER with the help of Table 5, consists of the following steps:

Step 1: establish for each crop in the zone of influence in the without- and with-project situations the year during which full production is reached and call these years P_1 and P_2, respectively;

Step 2: determine for each crop in the zone of influence in the without-project situation the production in year P_1 by computing the product of "area cultivated with the crop" times "its yield";

Step 3: determine for each crop in the zone of influence in the with-project situation the production in year P_2 by computing the sum of "unimproved area cultivated with the crop" times "its yield" and "improved area cultivated with the crop" times "its yield";

Step 4: with the prevailing local market price, annual production of Step 2 and annual cost of production, calculate for each crop its net value in year P_1, and obtain the sum Z_1 of these values;

Step 5: with the prevailing local market price, annual production of Step 3, and annual cost of production, calculate for each crop its net value in year P_2, and obtain the sum Z_2 of these values;

Step 6: select the largest P_2 value from the P_2 values established in Step 1 and call it P;

Table 5: Crop's Present Unit Values as a Function of Years to Achieve Full Potential Benefits (CPV) for N = 5, 10, 15, 20 and 25

YEARS TO ACHIEVE FULL POTENTIAL AGRICULTURAL BENEFITS (P)

	1	2	3	4	5	6	7	8	9	10	15	20
					N=5							
10%	3.8	3.3	2.9	2.5								
11%	3.7	3.2	2.8	2.4								
12%	3.6	3.2	2.7	2.4								
13%	3.5	3.1	2.7	2.3								
14%	3.4	3.0	2.6	2.2								
15%	3.4	2.9	2.5	2.2								
16%	3.3	2.8	2.5	2.1								
17%	3.2	2.8	2.4	2.0								
18%	3.1	2.7	2.3	2.0								
					N=10							
10%	6.1	5.7	5.3	4.9	4.5	4.1	3.8	3.5	3.2			
11%	5.9	5.4	5.0	4.6	4.3	3.9	3.6	3.3	3.0			
12%	5.7	5.2	4.8	4.4	4.0	3.7	3.4	3.1	2.8			
13%	5.4	5.8	4.6	4.2	3.8	3.5	3.2	3.0	2.7			
14%	5.2	4.8	4.4	4.0	3.7	3.4	3.1	2.8	2.5			
15%	5.0	4.6	4.2	3.8	3.5	3.2	2.9	2.7	2.4			
16%	4.8	4.4	4.0	3.7	3.3	3.0	2.8	2.5	2.3			
17%	4.7	4.2	3.8	3.5	3.2	2.9	2.6	2.4	2.2			
18%	4.5	4.1	3.7	3.3	3.0	2.8	2.5	2.3	2.1			
					N=15							
10%	7.6	6.7	6.7	6.3	5.9	5.6	5.3	5.0	4.6	4.4	3.2	
11%	7.2	6.3	6.3	5.9	5.6	5.2	4.9	4.6	4.3	4.0	2.9	
12%	6.8	6.0	5.9	5.6	5.2	4.9	4.6	4.3	4.0	3.8	2.7	
13%	6.5	5.6	5.6	5.2	4.9	4.6	4.3	4.0	3.7	3.5	2.5	
14%	6.1	5.3	5.3	4.9	4.6	4.3	4.0	3.7	3.5	3.2	2.3	
15%	5.8	5.0	5.0	4.7	4.3	4.0	3.7	3.5	3.2	3.0	2.2	
16%	5.6	4.8	4.8	4.4	4.1	3.8	3.5	3.3	3.0	2.8	2.0	
17%	5.3	4.5	4.5	3.2	3.8	3.6	3.3	3.1	2.8	2.6	1.9	
18%	5.1	4.3	4.3	3.9	3.6	3.4	3.1	2.9	2.7	2.5	1.8	
					N=20							
10%	8.5	8.1	7.6	7.2	6.9	6.5	6.2	5.9	5.6	5.3	4.1	
11%	8.0	7.5	7.1	6.7	6.3	6.0	5.7	5.4	5.1	4.8	3.7	
12%	7.5	7.0	6.6	6.2	5.9	5.5	5.2	4.9	4.7	4.4	3.4	
13%	7.0	6.6	6.2	5.8	5.4	5.1	4.8	4.6	4.3	4.0	3.1	
14%	6.6	6.2	5.8	5.4	5.1	4.8	4.5	4.2	4.0	3.7	2.8	
15%	6.3	5.8	5.4	5.1	4.7	4.4	4.1	3.9	3.7	3.4	2.6	
16%	5.9	5.5	5.1	4.8	4.4	4.1	3.9	3.6	3.4	3.2	2.4	
17%	5.6	5.2	4.8	4.5	4.1	3.9	3.6	3.4	3.1	3.0	2.2	
18%	5.4	4.9	4.5	4.2	3.9	3.6	3.4	3.1	2.9	2.7	2.0	
					N=25							
10%	9.1	8.6	8.2	7.8	7.4	7.1	6.7	6.4	6.1	5.8	4.7	3.8
11%	8.4	8.0	7.6	7.2	6.8	6.4	6.1	5.8	5.5	5.3	4.2	3.3
12%	7.8	7.4	7.0	6.6	6.2	5.9	5.6	5.3	5.0	4.8	3.7	3.0
13%	7.3	6.9	6.5	6.1	5.8	5.4	5.1	4.9	4.6	4.4	3.4	2.7
14%	6.9	6.4	6.0	5.7	5.3	5.0	4.7	4.5	4.2	4.0	3.1	2.4
15%	6.5	6.0	5.6	5.3	4.9	4.6	4.4	4.1	3.9	3.6	2.8	2.2
16%	6.1	5.7	5.3	4.9	4.6	4.3	4.0	3.8	3.6	3.4	2.5	2.0
17%	5.8	5.3	5.0	4.6	4.3	4.0	3.7	3.5	3.3	3.1	2.3	1.8
18%	5.5	5.0	4.7	4.3	4.0	3.7	3.5	3.3	3.0	2.9	2.1	1.7

Step 7: establish the ratio "maintenance and investment costs of project components" over the "difference between Z_2 and Z_1 values" and call it C/AVA;

Step 8: read off the ER in the first column of Table 5 by locating the value closest to the C/AVA value in the column corresponding to the P value of Step 6.

49. The following example is presented to elucidate the use of the above step-by-step procedure. The construction of a 30 km gravel road and small irrigation works is proposed in a zone of influence of 6,500 ha. The opportunity cost of capital is 12%. Present values of costs of construction and maintenance of the road and irrigation works amount to $1.20 and $0.20 million, respectively; each of these components has an expected life of 10 years. Table 6 gives the crop area breakdown and the crops' yields for the without- and with-project situations. Local market prices of the products considered, wheat and tomatoes, are $150 and $60 per ton respectively. Costs of wheat production per hectare are $80 for unimproved production and $90 for improved agricultural production technology. Similarly, the costs of production of tomatoes per hectare are $520 with unimproved and $550 with improved production technology.

50. The computation of the ER proceeds as follows: Columns (20) and (21) of Table 6 present the sum of net agricultural production values for the two crops. The sixth year corresponds to the year where both with-project production values are at maximum or full production. Therefore year P = 6 (Step 6) and the net value added for that year is $0.52 million. The ratio of the present value of costs to value added benefits in year P is given by $\frac{1.40}{0.52} = 2.69$ (Step 7). Searching in Table 5 under the column P = 6, the nearest value to the ratio is 2.8 which corresponds to an ER = 18%. This simple ER is an understatement.

51. The step-by-step procedure does not call for the computation of all values of columns (7) through (10), and (16) through (21) of Table 6. These values are only needed for the years mentioned in Step 1. The other values are only presented because they pertain to examples of other simplified methods described below.

52. The comments about costs of investments and maintenance and project components with different expected lives made in paras. 17 and 20 apply equally to Simplified Method III. A further simplification may be introduced in carrying out the step-by-step procedure of this method by applying it first to the major crops in the zone of influence. If an acceptable simple ER is obtained, computations related to other minor crops can be omitted; otherwise they have to be carried out to check the resulting ER. While following this further simplification, one should, however, take into account costs of agricultural investments for both major and minor crops.

53. Simplified Method IV. Except for assumptions (iv) and (v) of para. 46, this method is based on the assumptions of paras. 45 and 46. The resulting simple ER is therefore less at risk of understating the actual ER than the simple ER obtained with Method III. Use of Method IV is not

Table 6: Crop Area Breakdown, Yields and Production Values

	WHEAT									TOMATOES											
Year	w/o Proj. Areas (000ha)	w/Project Areas (000 ha) Unimp	Imp	Yields (ton/ha) Unimp	Imp	Production (000tons) w/o	With	Production Value (000$) w/o	With	w/o Project Areas (000ha)	w/Project Areas (000 ha) Unimp	Imp	Yields (ton/ha) Unimp	Imp	Production (000tons) w/o	With	Production Value (000$) w/o	With	Prod. Value (all crops) (000$) w/o	With	Value Added (all crops) (000$)
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)	(17)	(18)	(19)	(20)	(21)	(22)
1	4.00	4.00	1.00	0.56	0.90	2.240	3.140	16	61	0.30	0.30	0.16	9.11	15.0	2.733	5.133	8	64	24	125	101
2	4.50	3.50	2.00	0.59	0.90	2.655	3.865	38	120	0.30	0.20	0.18	9.55	20.0	2.865	5.980	16	130	54	248	194
3	4.50	3.10	2.40	0.61	1.00	2.750	4.291	53	180	0.30	0.20	0.28	10.00	20.0	3.000	7.600	24	198	77	378	301
4	4.85	2.00	3.50	0.63	1.00	3.055	4.760	70	239	0.40	0.10	0.39	10.00	20.0	4.000	8.800	32	261	102	500	398
5	4.90	1.00	4.70	0.65	1.00	3.190	5.350	87	300	0.50	0.00	0.50	10.00	20.0	5.000	10.000	40	325	127	625	498
6	5.00	0.00	6.00	0.70	1.00	3.500	6.000	125	360	0.50	0.00	0.50	10.00	20.0	5.000	10.000	40	325	165	685	520
7	5.00	0.00	6.00	0.70	1.00	3.500	6.000	125	360	0.50	0.00	0.50	10.00	20.0	5.000	10.000	40	325	165	685	520
8	5.00	0.00	6.00	0.70	1.00	3.500	6.000	125	360	0.50	0.00	0.50	10.00	20.0	5.000	10.000	40	325	165	685	520
9	5.00	0.00	6.00	0.70	1.00	3.500	6.000	125	360	0.50	0.00	0.50	10.00	20.0	5.000	10.000	40	325	165	685	520
10	5.00	0.00	6.00	0.70	1.00	3.500	6.000	125	360	0.50	0.00	0.50	10.00	20.0	5.000	10.000	40	325	165	685	520

Note: Column 7 = Column (2) x Column (5)
" 8 = Column (3) x Column (5) + Column (4) x Column (6)
" 9 = Column (7) x $150 - Column (2) x $80
" 10 = Column (8) x $150 - Column (3) x $80 - Column (4) x $90
" 16 = Column (11) x Column (14)
" 17 = Column (12) x Column (14) + Column (13) x Column (15)
" 18 = Column (16) x 60 - Column (11) x $520
" 19 = Column (17) x 60 - Column (12) x $520 - Column (13) x $550
" 20 = Column (9) + Column (18)
" 21 = Column (10) + Column (19)
" 22 = Column (21) - Column (20)

recommended if existing traffic on RR(s) is significant and agricultural production is marginal.

54. The annual benefits B stemming from investments in RR and agricultural components in a zone of influence with one agricultural crop are given by: [12]

$$B = P_m(Q_2 - Q_1) - C_2 - Q_2k_2 + C_1 + Q_1k_1 \quad \ldots\ldots\ldots\ldots\ldots\ldots(10)$$

where P_m = crop's local market price ($ per ton),

Q_2, Q_1 = annual production of crop in with- and without-project situation, respectively (tons),

C_2, C_1 = economic cost of producing Q_2 and Q_1, respectively ($),

k_2, k_1 = economic costs of transport over the RR in the with- and without-project situation, respectively ($ per ton).

Another way of stating expression (10) is:

[Crop's annual value added] = [Local market price] x [Crop's annual incremental production] - [Crop's annual incremental production costs] - [Crop's annual incremental transport costs]

55. To determine the simple ER one has to (i) compute the crop's net annual value for each year of the expected life and (ii) carry out similar computations for all other crops in the zone of influence. Once all benefit streams and costs of investment and maintenance of RR(s) and agricultural components have been established, the simple ER is computed in a manner similar to the conventional ER computations. Since techniques for calculating ERs are well known they are not illustrated here. The simplification referred to in para. 52 may also be introduced in Method IV.

56. The step-by-step procedure for determining the benefit streams required for the computation of the simple ER is as follows:

Step 1: determine for each crop in the zone of influence in the without-project situation the annual production during the

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12/ See Annex M for derivations of expressions (10) and (11); Annex 1 of Staff Working Paper 362 (H. L. Beenhakker and A. Chammari, October 1979) is reproduced as Annex O of this paper, since Annex M uses some of the results of this Annex 1.

expected life by computing the product of "area cultivated with this crop" times "its yield";

Step 2: determine for each crop in the zone of influence in the with-project situation the annual production during the expected life by computing the sum of "unimproved area cultivated with the crop" times "its yield" and "improved area cultivated with the crop" times "its yield";

Step 3: with the prevailing local market price and annual production of Steps 1 and 2, calculate annual production values in the without- and with-project situations and consequent annual incremental production values;

Step 4: for each crop in the zone of influence, determine annual incremental agricultural production costs during the expected life;

Step 5: for each crop in the zone of influence, determine the annual incremental transport costs during the expected life; and

Step 6: estimate annual incremental road maintenance costs (routine and periodic).

Results of Steps 3 through 6 together with costs of investments of RR(s) and agricultural components are all the data necessary to establish the simple ER. Further simplifications in carrying out the steps may be introduced by doing the calculations only for every 2 or 3 years of the expected life and obtaining values for intervening years by interpolation.

57. The following example illustrates the use of the step-by-step procedure. The construction of a 30 km gravel road and wells together with a strengthening of extension services is proposed in a zone of influence of 6,500 ha. Costs of constructing the road and wells amount to $1.00 and $0.20 million, respectively. The expected life of these components is 10 years. Table 6 gives the crop area breakdown and the crops' yields, while Table 7 shows the crops' annual production costs, including costs of extension services, costs per ton of transport, and road maintenance costs in the with- and without-project situations. The costs of per ton of transport in columns (8) and (9) have been arrived at by multiplying the length of the road (30 km) by the per ton-km transport costs in the without- and with-project situations ($0.29 and $0.11, respectively). Results of:

Step 1 are shown in columns (7) and (14) of Table 6,
Step 2 are shown in columns (8) and (15) of Table 6,
Step 3 are shown in columns (20), (21) and (22) of Table 6,
Step 4 are shown in columns (6) and (7) of Table 7,
Step 5 are shown in columns (14) and (15) of Table 7,
Step 6 are shown in column (18) of Table 7.

The investment costs of $1.00 and $0.20 million and cost and benefit streams obtained from carrying out Steps 3 through 6 result in an ER of 30.99%.

Table 7: Annual Agricultural Production, Transport and Road Maintenance Costs

Year	Agricultural Production Costs ('000$) a/ Without-Situation		Agricultural Production Costs ('000$) a/ With-Situation		Incremental Agricultural Production Costs ('000$)		Transport Costs $ per ton km		Agricultural Transport Costs ('000$) Without-Situation		Agricultural Transport Costs ('000$) With-Situation		Incremental Agricultural Transport. Costs ('000$)		Road Maintenance Costs ('000$)		Incremental Road Maintenance Costs ('000$)
	Wheat	Tomatoes	Wheat	Tomatoes	Wheat	Tomatoes	Without	With	Wheat	Tomatoes	Wheat	Tomatoes	Wheat	Tomatoes	Without	With	
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)	(17)	(18)
1	328.00	156.60	423.00	245.40	95.00	88.80	8.70	3.30	19.49	23.77	10.36	16.94	-9.13	-6.83	0	0	0
2	369.00	156.60	477.00	230.40	108.00	73.80	8.70	3.30	23.10	24.93	12.75	19.73	-10.35	-5.20	0	0	0
3	369.00	156.60	482.20	259.80	113.20	103.20	8.70	3.30	23.93	26.10	14.16	25.08	-9.77	-1.02	0	10	10
4	397.70	208.80	896.50	268.65	98.80	59.85	8.70	3.30	26.58	34.80	15.71	29.04	-10.87	-5.76	0	10	10
5	401.80	261.00	528.50	277.50	126.70	16.50	8.70	3.30	27.75	43.50	17.66	33.00	-10.09	-10.50	0	10	10
6	410.00	261.00	570.00	277.50	160.00	16.50	8.70	3.30	30.45	43.50	19.80	33.00	-9.78	-10.50	0	25	25
7	410.00	261.00	570.00	277.50	160.00	16.50	8.70	3.30	30.45	43.50	19.80	33.00	-10.65	-10.50	0	10	10
8	410.00	261.00	570.00	277.50	160.00	16.50	8.70	3.30	30.45	43.50	19.80	33.00	-10.65	-10.50	0	10	10
9	410.00	261.00	570.00	277.50	160.00	16.50	8.70	3.30	30.45	43.50	19.80	33.00	-10.65	-10.50	0	10	10
10	410.00	261.00	570.00	277.50	160.00	16.50	8.70	3.30	30.45	43.50	19.80	33.00	-10.65	-10.50	0	25	25

Note: Column (6) = Column (4) - Column (2)
Column (7) = Column (5) - Column (3)
Column (10) = Column (7) of Table 6 times Column (8)
Column (11) = Column (16) of Table 6 times Column (8)
Column (12) = Column (8) of Table 6 times Column (9)
Column (13) = Column (17) of Table 6 times Column (9)
Column (14) = Column (12) - Column (10)
Column (15) = Column (13) - Column (11)
Column (18) = Column (17) - Column (16)

a/ The agricultural production costs include both the agricultural production costs of Table 6 and the annual cost of the extension services. The annual costs of extension services per hectare are $2 for unimproved production and $5 for improved production technology.

58. Simplified Method V. Except for assumptions (iii), (iv) and (v) of para. 46, this method is based on the assumptions of paras. 45 and 46. Method V, unlike Method IV, thus allows for a home consumption in the with- and without-project situations. Home consumption was included in the economic analysis in one of the 20 projects reviewed. Consideration of home consumption may be important if subsistence farming prevails in the without-project situation while exports from the RRs' zones of influence are expected in the with-project situation.

59. If home consumption is taken into account, the value of B of expression (10) has to be reduced by:

$$(H_1k_1 - H_2k_2) \qquad \text{...................(11)}$$

where H_1H_2 = on-farm (home) consumption of an agricultural crop produced in the area of influence, in the without- and with-project situation, respectively (tons), and

k_1k_2 = economic costs of transport over the RR in the without- and with-project situation, respectively ($ per ton).

Method V requires the following step in addition to steps 1 through 6 of Method IV:

Step 7: for each crop in the zone of influence, determine the difference between the products of "annual home consumption" times "economic costs of transport" in the without- and with-project situations.

Results of Steps 3 through 6 of para. 56, the above Step 7 together with costs of investments of RR(s) and agricultural components are all the data needed to establish the simple ER.

60. To determine home consumption, the population in the zone of influence is first determined. Referring to the example of para. 57, suppose the area of influence has a base population of 60,000 which is growing at a rate of 2.5% per annum and has a per capita home consumption of 15 kg and 12 kg of wheat and 0.5 kg and 0.3 kg of tomatoes in the without- and with-project situation, respectively. Table 8 shows the results of Step 7 applied to this example.

Table 8: Annual On-Farm (Home) Consumption, H_1k_1, and H_2k_2

Year	Population ('000)	Wheat On Farm Consumption ('000 tons) Without (H_1)	With (H_2)	Tomatoes On Farm Consumption ('000 tons) Without (H_1)	With (H_2)	Wheat 1/ H_1 k_1 (000 $)	H_2 k_2 ('000$)	(H_1k_1 H_2k_2) ('000$)	Tomatoes 1/ H_1k_1 ('000 $)	H_2 k_2 ('000 $)	(H_1 k_1 - H_2 k_2) ('000 $)
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
1	60.00	0.90	0.90	0.03	0.03	7.83	2.97	4.86	0.26	0.10	0.16
2	61.50	0.92	0.92	0.03	0.03	8.00	3.04	4.96	0.26	0.10	0.16
3	63.00	0.95	0.76	0.03	0.02	8.26	2.51	5.75	0.26	0.07	0.19
4	66.20	0.99	0.79	0.03	0.02	8.61	2.61	6.00	0.26	0.07	0.19
5	67.80	1.02	0.81	0.03	0.02	8.87	2.67	6.20	0.26	0.07	0.19
6	69.50	1.04	0.83	0.03	0.02	9.05	2.74	6.31	0.26	0.07	0.19
7	71.30	1.07	0.86	0.04	0.02	9.31	2.84	6.47	0.35	0.07	0.28
8	73.10	1.10	0.88	0.04	0.02	9.57	2.90	6.67	0.35	0.07	0.28
9	74.90	1.12	0.90	0.04	0.02	9.74	2.97	6.77	0.35	0.07	0.28
10	76.80	1.15	0.92	0.04	0.02	10.01	3.04	6.97	0.35	0.07	0.28

1/ k_1 and k_2 values are given in Columns (8) and (9) of Table 7, respectively.

Note: Column 7 = Column (3) times Column (8) of Table 7
Column 8 = Column (4) times Column (9) of Table 7
Column 10= Column (5) times Column (8) of Table 7
Column 11= Column (6) times Column (9) of Table 7
Column (9) = Column (7) - Column (8)
Column (12) = Column (10) - Column (11)

Columns (9) and (12) indicate that, unless the population in the zone of influence is large, the effect of on-farm consumption on the simple ER is small. The ER of 30.17% is slightly lower than computed in para. 57.

61. Simplified Method VI. Except for assumptions (ii) through (v) of para. 46, this method is based on the assumptions of para. 45. In other words, the VOC savings related to non-agricultural traffic are not negligible. Consequently, annual savings from this source have to be added to the cost and benefit streams established by Steps 1 through 6 of Method IV and Step 7 of Method V. Naturally Step 7 may be omitted if the effects of home consumption on the ER are insignificant. The manner in which VOC savings are computed is not discussed here, since this is done elsewhere in the literature. 13/

62. Simplified Method VII. This method is based on the same assumptions as those underlying Method VI. The difference between Methods VI and VII is that number VI uses local market prices while number VII uses farmgate prices in the without-project situation. We define:

P_m = local market price of an agricultural product ($/ton),

P_1 = farmgate price of an agricultural product in the without-project situation ($/ton),

P_2 = farmgate price of an agricultural product in the with-project situation ($/ton),

F_1 = freight rate for transporting one ton of agricultural products over the RR in the without-project situation ($/ton), and

F_2 = freight rate for transporting one ton of agricultural products over the RR in the with-project situation ($/ton).

Note that $P_m = P_2 + F_2 = P_1 + F_1$.

To use the farmgate price in the without-project situation rather than the local market price, one replaces P_m by P_1 in expression (10) and adds $F_1(q_2 - q_1)$ where q_2 and q_1 are the quantities of an agricultural product "exported" from the zone of influence (Annex M). Thus $q_2 = Q_2 - H_2$ and $q_1 = Q_1 - H_1$.

63. The step-by-step procedure consists of Steps 1 through 6 of Method IV (para. 56) with P_m replaced by P_1, followed by Step 7 of Method V (para. 59) if home consumption is significant, followed by the determination of the VOC savings related to non-agricultural traffic of Method VI, followed by Step 8. The determination of VOC savings may be skipped if non-agricultural traffic is insignificant.

Step 8: for each crop in the zone of influence determine the product of "freight rate for transporting one ton of agricultural products on the RR in the without-project situation" times "annual incremental exports from the zone of influence."

13/ See, for instance, H. G. van der Tak and Anandarup Ray, ibid.

Referring to the example of paras. 57 and 60, suppose the freight rate per ton km in the without-project situation amounts to $0.36, or $10.8 per ton over the 30 km RR. Table 9 shows the results of Step 8 applied to this example.

64. Note that $P_m = P_2 + F_2 = P_1 + F_1$ may be expanded by defining:

r_2, r_1 = trucker's profit related to his transporting one ton over the RR in the with- and without-project situation, respectively ($ per ton),

so that $P_m = P_2 + F_2 = P_1 + F_1 = P_2 + k_2 + r_2 = P_1 + k_1 + r_1$, where k_1 and k_2 are as defined in para. 59. It is evident that P_1 in Method VII may be replaced by $(P_m - F_1)$, $(P_2 + F_2 - F_1)$, $(P_m - k_1 - r_1)$, or $(P_m + k_2 + r_2 - k_1 - r_1)$. The method has been described in terms of P_1 since information about P_1 is generally more readily available than information about F_2, r_1 and r_2.

65. Compared with the first five simplifying methods, Methods VI and VII, including Step 7 and VOC savings of non-agricultural traffic, are based on the smallest number of simplifying assumptions. They also offer the additional advantage of providing a practical tool for examining alternative road and agricultural investment strategies to determine an optimal investment package. In most cases the difference between their resulting ERs and actual ERs is expected to be insignificant. The actual ERs of the 20 projects reviewed were the same as the ERs computed by Methods VI and VII.

66. <u>Simplified Method VIII</u>. This method, which is based on the assumptions of para. 45, allows for a difference in local market prices in the without- and with-project situations. This difference may occur when the quality of agricultural products in the with-project situation is better than that in the without-project situation. The difference may also occur when increases in production due to significant agricultural investments in RRs' zones of influence are so substantial that they may affect the prices of agricultural products in a country. Price effects caused by a project, which are often included in the definition of externalities, are the exception. Such effects were not observed in the 20 projects reviewed. To allow for the aforementioned difference in local market prices, one defines:

P_{m1} = local market price of an agricultural product in the without-project situation ($/ton);

P_{m2} = local market price of an agricultural product in the with-project situation ($/ton).

Note that $P_{m1} = P_1 + k_1 + r_1$, and

$$P_{m2} = P_2 + k_2 + r_2,$$

where P_1, P_2, k_1, k_2, r_1 and r_2 are as defined above.

Table 9: $F_1(Q_2 - q_1)$

Year	Wheat Exports ('000 tons)		Tomato Exports ('000 tons)		Incremental Exports ('000 tons)		$F_1(q_2 - q_1)$	
	Without	With	Without	With	Wheat	Tomatoes	Wheat	Tomatoes
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
1	1.34	2.24	2.70	5.10	0.90	2.40	9.72	25.92
2	1.74	2.95	2.84	5.95	1.21	3.11	13.07	33.59
3	1.80	3.53	2.97	7.58	1.73	4.61	18.68	49.79
4	2.07	3.97	3.97	8.78	1.90	4.81	20.52	51.95
5	2.17	4.54	4.97	9.98	2.37	5.01	25.60	54.11
6	2.36	5.17	4.96	9.98	2.81	5.02	30.35	54.22
7	2.43	5.14	4.96	9.98	2.71	5.02	29.27	54.22
8	2.40	5.12	4.96	9.98	2.72	5.02	29.38	54.22
9	2.38	5.10	4.96	9.98	2.72	5.02	29.38	54.22
10	2.35	5.08	4.96	9.98	2.73	5.02	29.48	54.22

Note: Column (2) = Column (2) of Table 7 - Column (3) of Table 8
Column (3) = Column (4) of Table 7 - Column (4) of Table 8
Column (4) = Column (3) of Table 7 - Column (5) of Table 8
Column (5) = Column (4) of Table 7 - Column (6) of Table 8
Column (6) = Column (3) - Column (2)
Column (7) = Column (5) - Column (4)
Column (8) = Column 6 times $10.8
Column 9 = Column 7 times $10.8

67. Ignoring for the time being home consumption and VOC savings related to non-agricultural traffic, the annual benefits B stemming from investments in RR and agricultural components in a zone of influence with one agricultural crop are given by:

$$B = P_{m2}Q_2 - P_{m1}Q_1 - C_2 - Q_2k_2 + C_1 + Q_1k_1 \ldots\ldots\ldots\ldots\ldots\ldots (12)$$

where all terms are as defined earlier. Note that the difference between expressions (10) and (12) relate to local market prices. The step-by-step procedure for determining the benefit streams required for the computation of the simple ER is, with the following exception, like the one described in para. 56 under Method IV. The exception is that Step 3 of this procedure reads as follows:

Step 3: With the prevailing local market prices P_{m1} and P_{m2} and annual production of Steps 1 and 2, determine annual production values in the without- and with-project situations and consequent annual incremental production values.

The procedures described under Method V to allow for home consumption and Method VI to allow for VOC savings related to non-agricultural traffic remain unchanged (paras. 59 and 61).

68. If the analyst is reluctant to make the assumptions underlying Method VIII or the assumptions of para. 45, the use of the Rural Roads Computer Program [14/] is recommended. This program also provides a RR network analysis, an examination of the links between savings in transport costs and improved farmgate prices, an aggregation of benefits by beneficiary groups, and the determination of optimal investment years. It is, however, more time-consuming to use than the eight methods described here, since computer data files have to be prepared.

69. Sequence of Simplified Methods. To save time, it is important to know which simplified method to start with and in what sequence to try other methods. For instance, it would not make sense to start with Methods I or II if existing traffic is insignificant and significant producer surplus benefits are anticipated. Alternatively, it would not be wise to start with Method III if significant VOC savings related to non-agricultural traffic are expected. If one foresees significant consumer and producer surplus benefits, the first simplified method to be used should be Method VI. In situations where only significant producer surplus benefits are expected, and on-farm consumption is insignificant, the sequence of Methods III, IV, and VII without VOC savings related to non-agricultural traffic may be right. Table 10 summarizes the assumptions made in each of the methods.

14/ H. L. Beenhakker and A. Chammari, ibid.

Table 10: Simplified Methods and Underlying Assumptions

(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
	Simplified Method 1/							
Assumption	I	II	III	IV	V	VI	VII	VIII
Significant existing traffic	X	X						
Constant growth rate of traffic	X							
No change in traffic composition	X							
Potential producer surplus benefits insignificant	X	X						
Constant growth rate of net benefits stemming from rural road improvement		X						
Full production in the without-project situation is reached before or at the same time full production in the with-project situation is reached			X					
Negligible salvage values of investments of the investment package			X	X	X	X	X	X
No distinction between production patterns on farms of different size in road's zone of influence			X	X	X	X	X	X
No distinction between farmgate prices of on-farm consumption and prices of exports from the road's zone of influence			X	X	X	X	X	X
No consideration of on-farm consumption by animals			X	X	X	X	X	X
Local market prices in the with- and without-project situations remain the same			X	X	X	X	X	
VOC savings related to non-agricultural traffic insignificant			X	X	X			
On-farm consumption in the with- and without-project situations negligible			X	X				
Value of production of the crops in the zone of influence in the with-project situation increases at linear rate until it levels off ("full production") while the corresponding value in the without-project situation either remains constant during the project's expected life or also increases at a linear rate until it levels off.			X					

1/ A check in one of the columns 2-9 means that the assumption of column (1) is made.

IV. SIMILARITIES AND DIFFERENCES

70. Purpose. This section discusses similarities and differences observed in the review of the 20 projects listed in Annex A and suggests areas for improvement or further analysis. The reader is reminded that the principal objective of the study was the development of simple operational approaches to screening and appraisal which save time for the project analyst. Consequently, the areas for improvement discussed below are not necessarily exhaustive but only those suggested by the study.

71. VOC Savings. Annex K shows a wide variation in VOC savings reported in the feasibility reports analyzed. These variations reflect to some extent differences between the Kenya VOC tables developed by the Transport and Road Research Laboratory [15/] and earlier tables developed by de Weille, [16/] Bonney and Stevens, [17/] and others. For earth and gravel roads these tables show large differences in VOCs.

72. There is, therefore, a need for analyzing VOC savings to be had from improved earth and gravel RRs. Such an analysis should also cover the effects of possible shifts from animal-drawn carts to motorized vehicles after road improvements have been implemented.

73. Construction Costs. The feasibility reports also showed significant discrepancy in per kilometer costs of regravelling and paving (bituminous surface treatment) of RRs (Annex K). Costs of regravelling per kilometer range from $8,000 to $25,000 and the per kilometer costs of treating a gravel road with a bituminous surface range from $100,000 to $200,000. Most of the discrepancy is probably explained by factors such as topography, soil conditions, wage levels, fuels, and location of the source of building materials. However, the variations may also imply differences in design standards for RRs with about the same ADT among countries.

74. Another conclusion from the review is that more attention might be given in the selection of road improvements to the nature of the crops in a zone of influence. Some projects propose the same road standards for zones growing crops susceptible to damage such as tomatoes, peaches and pears as for other regions where the crops are damage-resistant.

15/ S. W. Abayanayaka et al., Tables for Estimating Vehicle Operating Costs in Developing Countries, TRRL Report 723, Transport and Road Research Laboratory, 1976.

16/ Jan de Weille, Quantification of Road User Savings, World Bank Occasional Paper No. 2, The John Hopkins Press, 1966.

17/ R. S. P. Bonney & N. F. Stevens, Vehicle Operating Costs on Bituminous, Gravel and Earth Roads in East and Central Africa, Road Research Technical Paper No. 76, Road Research Laboratory, Ministry of Transport, London. Her Majesty's Stationery Office, 1967, p. 22.

75. State of Project Preparation. The state of preparation of engineering work at the point of appraisal varies between RRs and RD projects. In RRs projects, the engineering work for the first year's program has normally been completed at the time of appraisal. In RD projects, it is often done after a Bank loan or credit is granted. Moreover, in some RD projects the exact location and alignment of RRs is not established during appraisal. The implementation of RR improvements in RD projects is therefore often behind schedule with the result that disbursements are delayed. The minimum requirement is that the engineering necessary for the first year's program, which may be limited in scope (para. 76), is completed before Board presentation (OMS 2.28). This should be sufficient for starting construction and should also provide an adequate basis for the cost estimate of the project.

76. For many simple RR improvements it may be enough to complete limited engineering work provided that design standards, construction procedures, and reliable historical data (updated) for representative items are available at the time of appraisal. "Final" engineering as appropriate to such cases would normally be performed only shortly before construction starts (OMS 2.28).

77. Maintenance Costs. Tests performed on the sample of 110 RRs (para. 18) revealed that in most situations it may be possible to ignore RR maintenance costs without significantly affecting the economic feasibility of a proposed RR. The improvement of only one out of the 110 RRs examined ceased to be economically viable when maintenance costs were included.

78. Prescreening. Some of the projects reviewed used a prescreening technique based on a combination of social, political, technical and economic factors. This practice is not to be recommended if project components subjected to such prescreening are subsequently subjected to an economic evaluation (para. 15) since it may be time-consuming. This is so since the prescreening may accept a large number of RR candidates, which are subsequently rejected in the economic appraisal. A more efficient approach starts with prescreening based on social, technical and political criteria followed by screening on the basis of economic criteria.

79. Agricultural Response Rates. Only two projects among those reviewed (Benin and Tunisia RRs projects) analyzed the response of the farmers in the zone of influence to improved RRs or lower freight cost. The reason is that little is known about the quantitative relation between changes in transport cost and in production. Policy questions about the distribution of transport benefits among farmers, truckers and final consumers were often inadequately considered in the projects. The distributional aspect of projects does require consideration if one wants to bring about a more equal distribution of income and a better response rate on the part of farmers. Related questions to be raised at the policy level include:

- are transport services fully competitive or hampered by regulation?

- are crop prices adequate?

- what is the land tenure situation? and

- how is access to credit and what are its terms and conditions?

80. Employment Benefits. The treatment of these effects varies among the projects. In the majority of cases these effects were ignored. Some projects count them directly as benefits stemming from participation in RR construction by locals; others apply shadow pricing to the labor employed in road construction.

81. Interdependencies. The Bank's practice in the appraisal of RRs projects is to determine the ER for each RR, as was done in the 15 RRs projects reviewed. In the appraisal of RRs in RD projects the practice is to establish an ER for the entire investment including all roads and agricultural components such as irrigation works, supply of inputs, extension services and credit in all project areas. The latter practice may have resulted in Bank financing of RRs in RD projects which would have been rejected had they been part of a RR project. The reason for the difference in these practices is based on the argument that the establishment of separate ERs for the roads components of a RD project requires arbitrary decisions on how to attribute essentially joint results to different investment components.

82. The basis for this argument is often weak or non-existing. Project elements, including RRs, should constitute an economically viable package of investment and production techniques through their appropriate design, standards and synergism. A project may consist of one or more of such packages. In addition, a project may, together with other ongoing or planned projects, constitute a set of economically viable packages. RRs of a RD project should not, however, a priori, be thought of as being interdependent among each other and agricultural components as well. Neither is it necessarily true that a RR component of an investment package which constitutes part of a RD project is dependent on agricultural components of this package. Clear cases of interdependence among RR and agricultural components are (i) the construction of irrigation canals and dams together with that of RRs to maintain the irrigation works, (ii) the construction of all-weather RRs in areas where agricultural investments are proposed and where the present condition of such RRs would impede farm operations during the rainy season, and (iii) the improvement of RRs in areas with proposed investments for the production of perishable products such as tomatoes, peaches, pears, etc. Assuming interdependency without testing it may lead to the "mixing in" of production elements with elements which by themselves would not offer an acceptable ER.

83. CPN 2.01 describes the manner in which interdependency among project elements should be tested. First, one has to carefully specify the interrelationships between the various components. Next, an identification of all feasible and meaningful combinations of project components is called

for. If, for instance, there are three components, A, B, and C, the maximum number of options to choose from are A, B, C, A+B, B+C, A+C, and A+B+C. Next, the net present value (NPV) or ER of each feasible combination is computed to determine whether it is economically viable. 18/ There is no apparent reason why the identification of feasible combinations of project elements of a RD project should differ from such identification in RRs projects. The identification of feasible project combinations of RD projects or RRs projects complementing ongoing or planned agricultural projects calls for the consideration of possible interdependency among RRs, among agricultural components, and among RR and agricultural components. For RRs and RD projects covering large areas, such consideration should start with a breakdown of subareas.

18/ CPN 2.01 points out that the use of the ER does not necessarily lead to the choice of the optimal combination if this choice is based on the highest ER value.

DATA SOURCES REVIEWED

This annex reports the main data sources used in the analysis. The documents reviewed are classified into three major groups:

1. Data Sources for Selecting the Sample of 110 Rural Roads Analyzed in the Study.

2. World Bank Documents.

3. Other Pertinent Documents.

1. Data Sources for Selecting Sample of 110 Rural Roads

Country		Documents
Honduras	•	Gitec Consult GMBH. Report on the Preparation of Rural Roads Components of the Proposed Eighth Highway Project. Prepared for the Honduras Ministry of Communications, Public Works and Transport. Tegucigalpa, D.C., Honduras. January 1980 (2 vols.)
Brazil	•	BNDE-BIRD-DNER-Estado da Bahia. Secretaria Dos Transportes e Comunicacoes. Coordenacao Dos Transportes, Consorcio Rodoviario. Rodovias Vicinais. Estudo de Viabilidade Tecnico-Economica: Avaliacao Economica: Region Cacaueira. Vol. II. Tomo 3.1.2 1979.
India	•	Government of Bihar. Rural Engineering Organization, Advance Planning Wing. World Bank data. Bihar, India. May 1978.
	•	Computer Printouts of Selected Roads in the Bihar files.
Colombia	•	Republica de Colombia, Ministerio de Obras Publicas y Transportes. Fondo Nacional de Caminos Vecinales, Oficina de Planeacion. Caminos para la Integracion Nacional: Estudios de Seleccion. Bogota, Colombia, 1981.

Country		Documents
Indonesia	.	World Bank data. Indonesia Rural Roads Development. December 10, 1981.
Tunisia	.	BCEOM-SCET International. Projet de Pistes Agricoles (Identifications et Factibilites). Rapport Regional II. Volume 15, Rapport de Synthese. Republique Tunisienne, Ministere de l'Equipement, Direction des Ponts et Chaussees, Tunis, Octobre 1980.
	.	Computer Printouts of the Economic Analysis of Rural Roads.
Benin	.	Scott Wilson Kirkpatrick & Partners. Benin Rural Feeder Roads. Evaluation Report of the Proposed Road Projects for Construction Program of 1980. December 1979.
Philippines	.	World Bank data. Working Papers on Economic Evaluation of Project (undated).

2. World Bank Documents

(1) Rural Roads Projects

Benin	.	World Bank data. Feeder Roads Project, People's Republic of Benin. May 10, 1977.
Brazil	.	World Bank data. Second Feeder Roads Project, Brazil. June 6, 1979.
Cameroon	.	World Bank data. Feeder Roads Project, United Republic of Cameroon. November 15, 1977.
Colombia	.	World Bank data. Rural Roads Project, Colombia. March 9, 1981.

Country		Documents
Ecuador	.	World Bank data. Sixth Highway Project, Ecuador. May 30, 1980.
Ethiopia	.	World Bank data. Sixth Highway Project, Ethiopia. March 31, 1975.
Honduras	.	World Bank data. Eighth Highway Project, Honduras. August 16, 1980.
India	.	World Bank data. Bihar Rural Roads Project, India. October 10, 1980.
Indonesia	.	World Bank data. Rural Roads Development Project, Indonesia. December 10, 1981.
Kenya	.	World Bank data. Rural Access Roads Project, Republic of Kenya. June 3, 1976.
Malawi	.	World Bank data. Fourth Highway Project, Malawi. December 22, 1980.
Philippines	.	World Bank data. Rural Roads Improvement Project, Philippines. April 30, 1980.
Senegal	.	World Bank data. Feeder Roads Project, Senegal. March 4, 1976.
Tunisia	.	World Bank data. Rural Roads Project, Tunisia. June 2, 1978.
Upper Volta	.	World Bank data. Rural Roads Project, Upper Volta. June 6, 1975.

(2) Rural Development Projects with Major Road Components

Brazil	.	World Bank data. Second Rural Development Project, State of Minas Gerais, Brazil. May 30, 1980.

Country		Documents
India	•	World Bank data. Maharashtra Irrigation II Project, India. September 13, 1979.
Korea	•	World Bank data. Rural Infrastructure Project, Korea. February 15, 1976.
Morocco	•	World Bank data. Fes-Karia Tissa Agricultural Project, Kingdom of Morocco. June 12, 1978.
Philippines	•	World Bank data. Rural Infrastructure Project I, Philippines. March 23, 1978.

3. Other Pertinent Documents

Kenya	•	Republic of Kenya. Ministry of Works. Roads Department. Selection and Evaluation Criteria for Rural Access Roads. Report No. P-05-78. A discussion paper presented at the Annual Review and Evaluation Meeting of the Rural Access Roads Programme in Nairobi, Kenya. March 13-22, 1978.
	•	Republic of Kenya. Ministry of Works. Roads Department. Rural Access Roads Programme. Evaluation of Roads in Nakuru. Nairobi, Kenya. August 1977.

Country		Documents
Colombia	•	Republica de Colombia. Ministerio de Obras Publicas y Transportes. Fondo Nacional de Caminos Vecinales. Oficina de Planeacion. Metodologia y Criterios para la Seleccion de Caminos. Doc. O.P. No. 031. Bogota. September 1980.
Indonesia	•	Republic of Indonesia. Ministry of Public Works. Directorate General CIPTA KARYA. Direktorat Tata Kota dan Tata Daerah. Working Papers prepared by ENEX and BIEC International Inc. • Working Paper No. 12. Level of Access (November 1980). • Working Paper No. 13. Level of Service (November 1980). • Working Paper No. 15. A Simplified Procedure for Screening and Ranking Rural Road Programmes (June 1981).
	•	Republic of Indonesia. Ministry of Public Works. Directorate General BINA MARGA. Directorate BINA Program JALAN. Attachment 3a. Manual: Procedures for Preparing Rural Road Programme Proposals at Kabupaten Level. January 1982.
Papua New Guinea	•	T.P. O'Sullivan and Partners, and GITEC Consult GMBH. Provincial Rural Transport Study. Interim Report (2 vols.) Independent State of Papua New Guinea, Department of Transport and Civil Aviation, June 1981.

LOCAL PARTICIPATION

1. The selection of specific rural road (RR) links to be included in a RRs or rural development (RD) project generally comes from one of two sources: (a) a technical study conducted by a project team, with or without the help of consultants; or (b) proposals put forward by local officials, agency representatives, or community groups. The 20 projects reviewed for this study were about equally divided between these two categories, based on data provided in Bank documents.

2. In some cases the selection of RRs to be improved was carried out by consultants, but the project provided technical assistance aimed at developing a capacity for project selection, screening and evaluation within the road-building agency. This approach was particularly prevalent in West Africa. In cases where communities or local officials were permitted to propose links for improvement, there were efforts to develop the capacity for technical and economic analysis of these proposals and their assimilation into a coherent work program at an appropriate level within the road-building agency. In rural infrastructure projects, funds were sometimes provided directly to communities for the construction or improvement of RRs which they would both plan and carry out. In this case, the technical analysis capability was to be developed within the planning institutions responsible for the disbursement of funds (usually the Ministry of Interior, Home Affairs or Local Government), rather than within the country's road-building agency.

3. The projects reviewed include projects in which roads were initially identified by locally elected authorities, committees of local agency representatives, regional cooperatives, and district planners. These projects are described in greater detail in the following paragraphs.

4. One of the best documented examples is the Kenya Rural Access Roads program. This program makes use of the District Development Committees (DDCs) established on an experimental basis under Kenya's Special Rural Development Program (SRDP) in the early 1970s. The DDCs include district political and planning officers and line agency representatives of the central government, as well as locally elected officials and tribal leaders. Within certain broad guidelines established by the Ministry of Works for prescreening of RRs, the DDCs annually propose a set of RR improvements to the District Engineer. The roads are screened for compliance with the Ministry of Public Works' guidelines, and those which pass are subjected to a summary technical and economic analysis. Roads are prioritized and programmed for improvement according to the constraints imposed by the

District Engineer's technical and financial resources. The resulting work program is then presented to the DDCs for approval, which can serve a valuable feedback function.

5. In India, RRs in the state of Bihar are initially selected for improvement by Block Development Committees. These proposals are forwarded to the State Planning Department, where they presumably receive an informal political/social prescreening. Approved projects go to the Rural Engineering Organization (REO), a branch of the Rural Department, for technical and economic analysis. High priority projects then go into the REO's work program to the extent resources will allow.

6. The Rural Roads project in Tunisia is designed to meet needs identified by permanent interagency planning committees at the provincial level. Regional Agricultural Development Commissions (CRDA) recommend RR improvements to the provincial heads of the Ministry of Public Works (MPW). Those proposals are forwarded to the central headquarters of MPW and analyzed there by its Directorate of Road Studies which develops a work program for the entire country for approval by an interministerial coordinating committee at the national level.

7. In Indonesia, decisions on RR improvements are made by planners at the provincial and district levels. Selection of potential RR components is the responsibility of district planners in consultation with local political authorities. Provincial planners will then evaluate the proposals and allocate the available funds. This system contrasts with the INPRES road program in Indonesia, under which funds are given directly to communities for minor RR improvements, which are sometimes carried out on a self-help basis.

8. The Cameroon Feeder Roads project envisaged selection of road links for the second, third and fourth year programs by the staff of the implementing agencies for the Bank and other donor-financed agricultural development projects to be served by the road. In one case this would be a government regional authority (ZAPI East); in the other two cases the implementing agency would be a federation of cooperatives. The feasibility of this design for local participation in planning was never tested, since the government was unable to construct the first-year program which had been drawn up by central government planners.

9. In Honduras, the Eighth Highway project includes a RR component to be constructed using labor-based methods. A methodology for RR selection was developed by consultants, using information obtained through structured interviews with community officials. The first year's program was selected by the government in conjunction with consultants. Future work programs are

now based on community initiative developed by the road-building agency, using the same methodology. In other words, community input at the planning stage was limited to providing socio-economic data on road links already identified by government planners.

10. The Rural Roads project in Colombia operates on a somewhat similar set of principles. However, the initial source of RR proposals in this case is a list of petitions submitted by communities. This list is subjected to a prescreening by district officers of the road agency. Proposed improvements which pass this test are then investigated in detail, including interviews with local officials to obtain data for the economic evaluation. These interviews include data on the availability of local labor for construction.

11. Through two RRs projects in Brazil, the Bank has promoted the development of local capacity to select and prepare road components to a level where they would be eligible for Bank financing. Funds are provided to the National Development Bank for on-lending to communities which prepare acceptable proposals. The National Highway Department, through its state agencies, provides technical support to the National Development Bank in the evaluation of proposals and to communities in proposal preparation. The proposals are based upon a preliminary design of the RRs. Upon approval of a proposal, funds are made available to communities or groups of communities (consortia) to hire consultants for detailed design and construction supervision, and contractors to carry out the road works. Although, in this model the Development Bank and the road-building agencies retain substantial responsibility for the technical and economic aspects of project evaluation, responsibility for project implementation (and loan repayment) ultimately rests with the local communities.

12. Two projects have been going on simultaneously in the Philippines: (1) a rural roads project being implemented through the Ministry of Local Government; and (2) a rural infrastructure project, the roads component of which is being implemented by the traditional road-building agency. This apparently anomalous situation actually involves both institutions in collaboration, in a situation where neither one commands the necessary resources to do the job alone. In principle, the planning and financing of RR improvements should be the responsibility of the municipalities, with technical assistance from the Ministry of Local Government. In practice, the Ministry of Public Highways is the only agency with the required technical expertise. The Philippines appear to be still searching for a system that can assure centralized control over funds and yet be responsive to community needs and priorities.

13. In the first Korea Rural Infrastructure project, RR improvements and other investments such as minor irrigation, water supply, fuel-wood plantations and rural electrification are selected and carried out by communities with direct fiscal support from the government. The program is part of the Samaeul Undong or village self-help movement and is similar in some respects to Indonesia's INPRES road program. The Bank's efforts in this case were focussed on developing a capacity for subproject screening and evaluation within the Samaeul Guidance Division of the Ministry of Home Affairs. Although the program is viewed as successful, political priorities in the country changed and the RR component was dropped from the Second Rural Infrastructure Project for Korea.

14. Staff appraisal reports do not give sufficient information to assess in detail the extent to which community initiatives are relied upon to identify and screen RRs. There is a tendency in developing countries for planners to take over and "technify" the project selection process. Yet, in a situation of expanding needs and increasingly limited resources, community commitment will become an ever more essential factor in project implementation and in subsequent maintenance. Involvement at the planning stage can do much to prepare communities for realistic decision-making and mobilization of resources when improvements are implemented. It can also improve the project selection process, by providing quantitative and qualitative data on local conditions which are essential to the realization of expected benefits.

EXAMPLE OF A PRESCREENING METHOD

1. The prescreening method described below is one of the more ambitious attempts to develop proxy measures for rural roads screening. The method was originally developed for the low-standard, labor-intensive Pico y Pala (pick and shovel) RR improvements financed by USAID in Colombia. The Bank has accepted this methodology as a prescreening procedure for a RRs project in this country but requires that it be followed up with a simplified economic appraisal for roads to be financed under the project. Although prescreening based on a combination of social, technical and economic factors is not necessarily an efficient procedure (Section IV of text), the method is presented because of the interesting approach to criteria other than the economic one.

2. The prescreening methodology is based on the computation of three types of scores for each RR candidate: (1) a physical score (maximum score = 100 points) related to the factors that affect cost; (2) a social score (maximum score = 30 points) related to population density in the zone of influence and the distribution of land by size of holdings; and (3) an economic score (maximum = 84 points) related to agricultural production potential. A project is deemed feasible if:

$$\frac{\text{social score + economic score}}{\text{physical score}} \geq 1.0$$

RRs that achieve ratios above 1.0 are accepted for the simplified economic appraisal.

3. The economic score consists of points awarded for each of the following factors: (1) percentage of land to be brought under cultivation (10 points); (2) soil type (20 points); (3) use of agricultural credit (10 points); (4) use of technical assistance (3 points); (5) use of agricultural inputs (5 points); (6) providing service to towns and municipal capitals (5 points); (7) development plans for the area (14 points); (8) distance to market (7 points); and (9) percentage savings in vehicle operating costs (VOC) per kilometer (10 points). The social score includes density of population (15 points) and distribution of land by farm size (15 points).

4. A fairly complex set of factors goes into the computation of the physical score which is primarily based on technical and cost considerations. The physical score is calculated from the following factors: (1) earthmovement quantities (with the points varying from a minimum of 14 for movements less than 10,000 m^3 per kilometer in flat terrain to 47 points for movements of 25,000 m^3 per kilometer in mountain terrain); (2) culvert requirements (with a score of 2 points in flat terrain and 4 points in mountain terrain); (3) distance for the transport of gravel and other

materials (with a maximum score of 16 points for distances of more than 15 km and a minimum score of 6 points for distances less than 5 km); and (4) bridges, with 2 points being assessed per lineal meter of bridge or pontoon. In addition, there are limitations on the maximum length of the road (25 km), earthwork (25,000 m^3 per km), and bridge size (less than 25 meters) among others.

5. Social variables have a fairly important effect on the screening score since the economic score also includes social variables such as providing services to towns and municipalities (maximum score = 5 points) and plans for doing so in the future (maximum score = 5 points) as part of area development plans. Thus the overall score gives a maximum of 40 points out of 214 points to social factors.

6. It is noted that the allocation of points to factors such as percentage VOC savings can lead to incorrect decisions based on economic criteria since total VOC savings may depend more on volume of traffic, which is not considered in the prescreening, than on the percentage reduction in VOC. In addition, the economic score does not consider crop yields and values, which are often important factors for the economic evaluation. Experience with this prescreening shows that the method is not very successful in weeding out unfeasible RR components while it can reject feasible components.

CONSUMER SURPLUS VERSUS PRODUCER SURPLUS METHODS

1. This annex demonstrates that the use of the consumer surplus (CS) method and that of the producer surplus (PS) method will result in the same economic return (ER) provided available data regarding traffic, vehicle operating costs (VOC), prices, yields of agricultural products, etc., are of the same accuracy. To simplify the demonstration, we consider the situation where:

(i) one road exists between the marketplace and area of production;

(ii) one agricultural product is produced in this road's zone of influence;

(iii) all farms are located at one center, such that they face the same distance from the marketplace; and

(iv) the trucking industry is perfectly competitive.

2. The following notation is introduced:

P_m = local market price of agricultural product;

P_g = farmgate price of agricultural product;

k = economic transport cost (per ton-km);

F = freight rate (per ton-km);

r = profit of trucker per ton-km or (F-k);

L = distance between farms and marketplace (km);

C = total production cost;

M = marginal production cost; and

q = export of the agricultural product from the road's zone of influence (ton).

To show that the PS and CS methods result in the same ER, it is sufficient to demonstrate that producer surplus equals consumer surplus in farmers' transportation demand. What follows applies to both the without- and with-project situation.

3. Under the assumption of profit maximization, the farmers will export q* tons of output such that marginal production cost will equal farmgate price of output:

$$M = P_g \qquad \text{..........(1)}$$

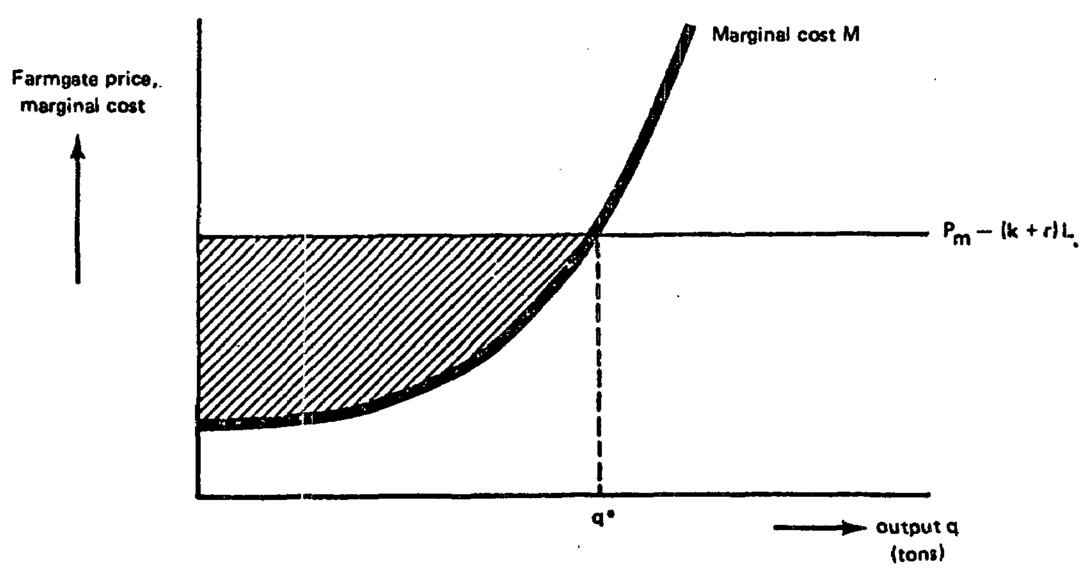
Note that $P_g = P_m - FL$ ....(2)

and $F = k + r$ ....(3)

and, therefore, $M = P_m - (k + r)L$ ....(4)

4. Figure 4 shows the determination of equilibrium output q*.

Figure 4: Production Equilibrium



Production surplus of farmers is represented by the shaded area above the marginal cost curve in Figure 4, but below the farmgate price $P_g = P_m - (k+r)L$. This area, which is referred to as PS, can be expressed by the following formula:

$$PS = [P_m^* - (k+r^*)L]q^* - \int_0^{q^*} M(q)dq = P_m^* q^* - (k+r^*)Lq^* - C(q^*) \qquad (5)$$

where P_m^* and r^* are P_m and r associated with output q^*. In addition to expression (5), total benefits of a rural road include the truckers' benefits ("normal profit"), or:

$$r^*(q^*+x^*)L \qquad (6)$$

where x^* is the volume of inputs transported into the zone of influence to produce output q^*. Combining equations (5) and (6) gives the total benefits B:

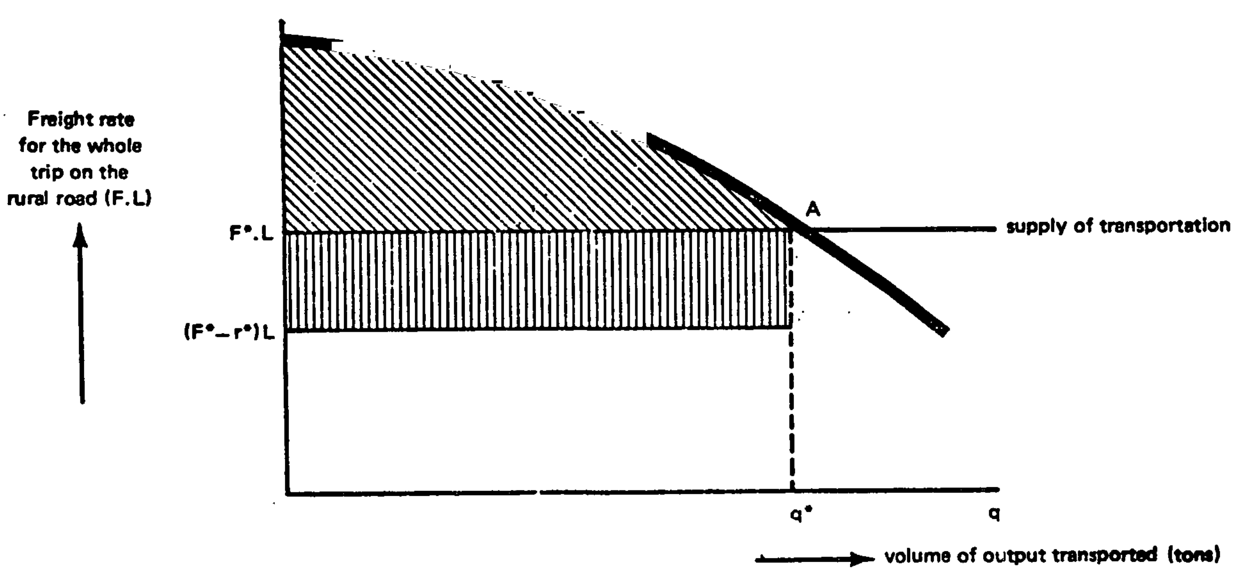
$$B = P_m^* q^* - (k+r^*)Lq^* - C(q^*) + r^*(q^*+x^*)L \qquad (7)$$

5. The equilibrium output, under the present assumptions, is equal to the equilibrium level of output transported and can be derived by using the farmers' transportation demand approach. From equations (1) and (2) follows:

$$F.L = P_m - M \qquad (8)$$

Equation (8) implies a downward sloping demand curve since $\frac{dF}{dq} = -\frac{M'}{L}$ where M' is the slope of the marginal cost curve of Figure 4. This downward sloping curve is portrayed in Figure 5.

Figure 5: Output Transportation Demand



6. The supply of transport services is infinitely elastic at freight rate F* and the equilibrium volume of farmers' transportation is determined at the intersection of supply and demand or point A of Figure 5. Note that q* of Figure 4 is identical to q* of Figure 5 since they are obtained as a solution to the same equation. The benefits to farmers are in Figure 5 represented by the shaded area below the demand curve and above the supply curve for transport. This area, which is referred to as CS, can be expressed by the following formula:

$$CS = \int_{0}^{q^*} (P_m - M)dq - F^*Lq^* = P_m^*q^* - C(q^*) - F^*Lq^* = P_m^*q^* - C(q^*) - (k+r^*)Lq^* \quad \ldots\ldots(9)$$

Additional benefits accrue to truckers in terms of normal profits. Profits on transportation of output are in Figure 5 represented by the vertically shaded area r*q*L. Profits on transportation of inputs into the zone of influence amount to r*x*L. Total benefits are:

$$B = CS + r^*q^*L + r^*x^*L \text{ or}$$

$$B = P_m^*q^* - C(q^*) - (k+r^*)Lq^* + r(q^*+x^*)L \quad \ldots\ldots\ldots\ldots\ldots\ldots(10)$$

7. Equations (5) and (9) confirm that the PS and CS are equivalent while equations (7) and (10) show that benefits accruing to farmers and truckers are the same with the PS and CS approaches. Assumptions (i) through (iv) of para. 1 were introduced to simplify the presentation. Following an argument similar to the one described above, one can, however, show that the CS and PS methods result in the same ER if these assumptions are relaxed.

8. Confusion about equality of CS and PS may arise if the supply curve for transportation of Figure 5 is estimated without using information on farmers' home consumption in both the without- and with-project situations. To allow for home consumption, identically the same correction has to be introduced into the expressions for PS (equation 5) and CS (equation 9) and, therefore, the equality between the two surpluses is maintained. Note that if home consumption is non-negligible and if it moves inversely with changes in farmgate prices and farmers' incomes (as determined by the project), the benefits of the project will be overestimated in both approaches (PS and CS) if the prediction of benefits is based exclusively on changes in farm outputs.

BRAZIL: SCREENING ON COST PER KILOMETER

1. An innovative screening method for RR components has been proposed in connection with the improvement to all-weather standards of RRs in Brazil. The proposed methodology for screening may be summarized as follows: (1) select RRs' zones of influences which are homogeneous with respect to crop patterns, farm sizes, yields and cultivated areas; (2) calculate the benefits, costs and economic rate of return (ER) for the package of improvements (RR and agricultural improvements), proposed for a group of homogeneous zones of influence; (3) normalize the flow of net benefits by imputing to each road the average value of net benefits per km of road; (4) estimate the "target" cost per kilometer corresponding to the benefits calculated in (3) evaluated at the prevailing opportunity cost of capital; and (5) accept those RRs of this group whose costs per kilometer are smaller than the target cost per kilometer estimated in (4), and reject those RRs whose costs exceed the target cost level.

2. This screening method is valid if truly homogeneous areas can be identified. The problem is that the requirement of homogeneity in the zone of influence is difficult to meet. In order to make a test of the proposed methodology it was decided to select road links in the same country, in areas with a single cash crop, and to subject them to the screening criteria. Seven Class F road links were selected from the files of the Second Feeder Roads Project in Brazil. Table 11 presents an overview of the roads selected, their costs and ERs as calculated in the feasibility study.

3. Application of the methodology to roads in the municipality of Una would result in a target cost per kilometer of US$53,563, corresponding to a 20% opportunity cost of capital, as shown below:1/

1/ A rather high opportunity cost of capital is assumed to show that the screening may lead to incorrect decisions with the available data. Incorrect decisions are, however, also possible with lower opportunity costs of capital.

Table 11: Overview of RRs in Selected Municipalities of the Cacao Region of the State of Bahia

Municipality	Road No.	Economic Return (FR)	Yields (Arrobas per ha)	Farm Size1/	Area of Influence Per km of Road: Total Area (km^2)	Agricultural Area (ha)	Population Served per RR km	Cost Per RR km US$
Itabuna	20	23.3%	37	Large	4.0	36.6	81.3	35,858
	21	70.5%	33	Small	1.7	85.7	33.9	24,035
Una	01	16.7%	45	Sm/Lg	5.2	32.4	76.1	40,692
	17	33.4%	40	Sm/Med	2.9	39.0	42.4	23,906
	18	70.3%	60	Medium	3.4	69.0	49.2	32,260
	19	19.7%	43	Unspecified	2.8	41.7	41.6	43,548
	22	23.4%	35	Small	4.1	48.5	59.3	36,157

1/ These farm size categories are undefined in the source document.

Source: BNDE-BIRD-DNER-ESTADO DA BAHIA. Secretaria Dos Transportes. Consorcio Rodoviario. Rodovias Vicinais Regiones Cacaveira e Leitera. Estudio de Viabilidad Tecnico Economica. 1980

UNA - RRs

Total net benefits to all roads (from project file data)	=	$11,417,600
Total road length	=	99 km
Net benefits per km	=	$115,329
Present value of costs per km at 20%	=	$53,563

With a 20% opportunity cost of capital, two roads (Nos. 01 and 19) would have been accepted using this methodology when in fact they should have been rejected. In the case of Itabuna a 20% opportunity cost of capital corresponds to a cost per km of US$55,202, which leads to a "correct" acceptance of both roads.

4. This method of screening will work in cases where the areas analyzed are truly homogeneous with respect to agricultural activity (crop patterns, yields, cultivated area per km of road, etc.). However, in practice finding these homogeneous areas is difficult. Caution should therefore be exercised when using this method.

INDIA: SCREENING ON A PROXY BENEFIT/COST RATIO

1. This annex describes a methodology developed in connection with the Rural Roads Project for the State of Bihar in India. Prescreening and a simplified economic appraisal method are used in this project; this appraisal is similar to Method III of the text.

2. The prescreening of the Bihar roads consists of a set of exclusionary criteria. That is all roads must (1) connect to a paved road, (2) connect to a nearby market, and (3) not fall within the zone of influence of another road (this requirement means that it should be 3-5 kilometers away from any other road), and (4) complementary investments in irrigation must be present or planned for the impact zone. The appraisal methodology then distinguishes two types of roads: (a) roads carrying motorized vehicle traffic; and (b) roads with no motorized vehicle traffic. The first group of roads is subjected to analysis on the basis of vehicle operating cost savings, while the latter group is assessed on the basis of producer surplus benefits.

3. For roads carrying motorized vehicle traffic, the following expression approximating the benefit/cost ratio at a 12% cost discount rate is computed:

$$R = \frac{(9.8)\ (365)\ (T)\ (S)}{5.66\ (C_m + 0.18\ C_c)}$$

where R = the ratio of approximate benefits to approximate costs,

T = annual average daily traffic (ADT),

S = average vehicle operating cost saving per vehicle-kilometer,

C_m = annual incremental maintenance cost per kilometer, and

C_c = construction cost per kilometer.

The present value factors used are as follows:

9.8 = the present value of a one-dollar benefit series growing at 5% annually during a ten-year period and discounted at 12% interest rate, 0.18 = the capital recovery factor to annualize the construction costs, at a 12% discount rate over ten years,

5.66 = the present value factor for a one-dollar annuity at a 12% discount rate.

If the proxy benefit/cost ratio R is greater than or equal to 1.0, the road is accepted into the project.

4. In the case of roads with no traffic, only producer surplus benefits are considered in the following fashion:

$$R = \frac{A(P_I)\ (P_A)\ (V)\ (0.70)\ (P_V)}{5.66\ (C_m + 0.18\ C_c)}$$

where R = the ratio of approximate benefits to approximate costs,

A = area of the road's zone of influence (in hectares) per kilometer of road,

P_I = proportion of arable land that is irrigated,

P_A = proportion of land in the influence area that is arable,

V = incremental agriculture value added per hectare in year of full maturity (net of annual irrigation and maintenance costs),

P_V = present value factor corresponding to the number of years required for the project to achieve its full maturity, and C_m and C_c as defined above.

The factor of 0.70 corresponds to the assumption that only 70% of the total production potential of the road's zone of influence will be achieved within the project's time frame. If the proxy benefit/cost ratio R is greater than or equal to 1.0, the road is accepted into the project.

5. The simplified appraisal method has been developed over time through a trial and error approach. Difficulties were encountered in the early phases due to an underestimation of the costs of complementary investments. This problem, while crucial to the project's overall viability, does not affect the validity of the appraisal method as long as it is consistently applied in all cases. The method is the one case in current Bank practice which appears to be closely linked to the concept of economic feasibility, and which therefore should prove successful in predicting the outcome of the economic appraisal across a wide variety of project types.

SCREENING VIA DISCRIMINANT ANALYSIS

1. Introduction. This annex describes the results of economic and statistical analysis of the factors that affect the economic performance of rural roads. The purpose of the analysis is to identify those factors that accurately predict the economic return (ER) of a given rural road (RR). Following the methodology presented in Bank Staff Working Papers Nos. 241 and 362, the ER of a given rural road is primarily a function of three factors: (i) the producer surplus or net agricultural value added of the RR's zone of influence; (ii) the consumer surplus represented by the vehicle operating cost savings accruing to normal traffic on the RR; and (iii) the cost of the RR's improvements and any associated agricultural investments in the RR's zone of influence. These three factors may be combined in the following manner:

$$EF = f\left(\frac{PS}{C}, \frac{CS}{C}\right) \quad \text{.................(1)}$$

where EF = economic feasibility of a RR, group of interdependent RRs, or investment package of interdependent RR and agricultural investments,

PS = producer surplus benefits,

CS = consumer surplus benefits, and

C = cost of the RR(s) and any associated agricultural investments.

The screening methods described in this annex use functions derived from the above expression by applying proxy variables for the producer surplus, consumer surplus, and cost elements.

2. Producer Surplus Variables. The most important proxy variable for the producer surplus effect is the net agricultural value added in the last year of the analysis period (defined in this case as 10 years). However, other simpler expressions were tested as proxies for the producer surplus. These proxy variables include: (1) the increase in tons of agricultural products generated by year 10; (2) the increase in equivalent hectares brought into cultivation by the year 10 (defined as the increase in new cultivated land plus the ratio of the with-project value added per hectare to

without-project value added per hectare times the number of hectares under cultivation at the start of the project);[2/] (3) the initial agricultural area cultivated in the zone of influence; and (4) the population of the zone of influence.

3. Consumer Surplus Variables. The most important proxy variable for the consumer surplus effect is the opening year level of vehicle operating cost savings accruing to normal traffic. Other possible proxies for the consumer surplus include:

(1) passenger-kilometers and ton-kilometers of normal traffic;

(2) the initial level of average annual daily traffic on the road; and

(3) the population (as a proxy for passenger-kilometers) and the agricultural production tonnage (as a proxy for ton-kilometers) of the zone of influence.

4. Intervening Variables. Other variables may affect the role and function of rural roads in developing countries. These variables are called intervening variables. The sample of 110 RRs tested was separately stratified along each of these dimensions in order to test the sensitivity of each screening method to these variables. They include:

(1) Technology of agricultural production: traditional, semi-technified or technified. Operational measures used as proxies for this variable include with-project yields and net agricultural value added per hectare of cultivated land;

(2) Associated agricultural investments: (i) none; (ii) a minimum package of agricultural investments for the RR's zone of influence; or (iii) an integrated agricultural development program for the region in which the RRs are located;

(3) Type of agricultural crops produced: (i) tree crops; (ii) annual cash crops; or (iii) annual subsistence crops;

2/ Or alternatively this factor may be calculated as the increase in new hectares brought into cultivation plus the ratio of the increase in tons of production divided by the without-project yields in the zone of influence.

(4) Connection to the highway network: (i) a paved road; (ii) an all-weather road; or (iii) an earth road; and

(5) Road type: (i) a collector or arterial road; (ii) a feeder road; (iii) a farm-to-market road.

5. Data problems. Some of the sensitivity testing suggested above could not be carried out due to limited numbers of cases in the sample or lack of data needed to correctly classify specific roads. For example, feeder roads account for 96% of the sample, so that the effect of road type was not researched. Similarly the sample of roads with tree crop production is small; a separate analysis for this type of crop could, therefore, not be conducted.

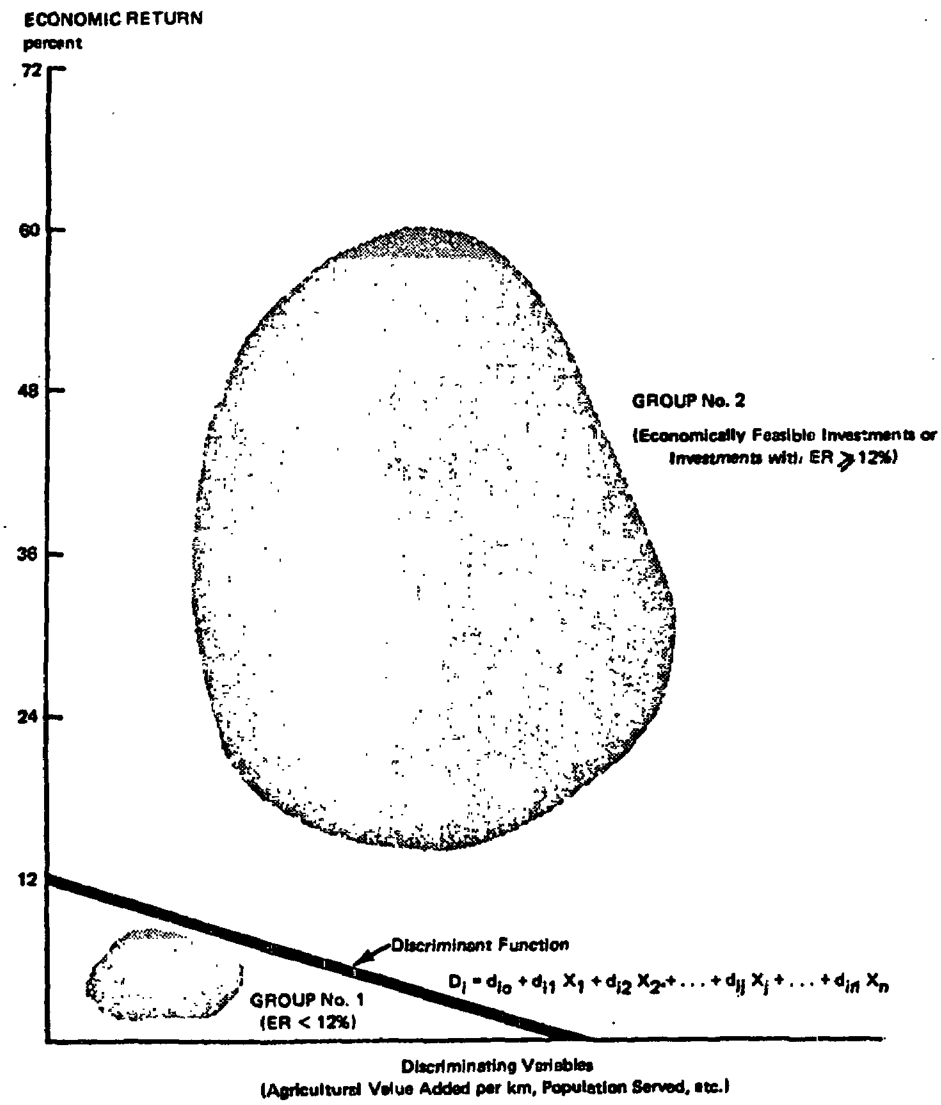
6. Background on Discriminant Analysis. Discriminant analysis is a powerful statistical technique used to distinguish between two or more groups of cases with respect to two or more variables simultaneously. In this study discriminant analysis is used to predict whether a given RR and associated agricultural investments in its zone of influence should be classified into the group of investments whose ER is less than the opportunity cost of capital (defined as unfeasible), or the group of roads whose ER is equal to or greater than the cost of capital (defined as feasible). The discriminant analysis performed in this study used four alternative values of the cost of capital (10%, 12%, 14% and 16%) in the development of predictive relationships for classifying rural roads into feasible or unfeasible groups.

7. At the outset, a set of explanatory variables that can aid in the classification of investments into the two groups (feasible vs. unfeasible) is defined. These explanatory variables, called discriminating variables, measure characteristics on which the two groups of investments are expected to differ. For instance, the groups of feasible vs. unfeasible investments may differ in their agricultural potential, or in their vehicle operating cost savings. The objective of discriminant analysis is to derive linear combinations of the discriminating variables, appropriately weighted, so that the maximum statistical differentiation between the two groups of investments is obtained. The discriminant functions, estimated from axioms derived from the principal axis theorem, are linear combinations of the type:

$$D_i = d_{io} + d_{i1} X_1 + d_{i2} X_2 + \ldots + d_{ij} X_j + \ldots + d_{in} X_n \quad \ldots\ldots\ldots\ldots(2)$$

where D_i is the discriminant analysis score, d_{ij} are the weight coefficients and X_j are the standardized values of the n discriminating variables. Figure 6 provides a graphic representation of a discriminant analysis problem.

Figure 6: Graphical Representation of Use of Discriminant Analysis for Rural Roads Screening



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8. In this study, discriminant analysis is used for classification purposes. By classification is meant the process of identifying the likely group membership of a rural road and associated agricultural investments in its zone of influence, if any, whose characteristics are reflected in the discriminating variables. This classification process is achieved through a series of classification functions, one for each group of investments (feasible or unfeasible). The classification functions are derived from the discriminant function (2). The resulting classification coefficients are multiplied by the values of the original variables and a classification score thus results. The investments are classified into the group (feasible or unfeasible) with the highest score. The classification functions for each group of investments are given by:

$$C_i = C_{io} + c_{i1} X_1 + c_{i2} X_2 + \ldots + c_{ij} X_j + \ldots + c_{in} Xn \qquad \ldots\ldots\ldots\ldots(3)$$

where C_i is the classification score for investment group i, c_{ij} represent the classification coefficients, and X_j are the discriminating variables.

9. Discriminant Analysis: Interpretation of Results and Tests of Significance. A series of tests of significance have been developed to test for the degree of discrimination achieved by the discriminant functions, specifically whether the unexplained differences between the groups after the estimation of the discriminant functions are the result of sampling or measurement errors rather than a truly different dimension.

10. The Canonical Correlation Coefficient. The canonical correlation coefficient is a measure of association which describes the degree of relatedness between the groups and the discriminant function. The canonical correlation coefficient varies between 0 and 1, its formula is given by:

$$r_i^* = \sqrt{\lambda_i \ (1 + \lambda_i)} \qquad \ldots\ldots\ldots(4)$$

where λ_i denotes the eigenvalue corresponding to the ith relevant discriminant function.

11. Wilks' Lambda Measure of Residual Discrimination. Given that the data on the groups of rural roads are from a sample rather than constituting the entire population, the sampling process may produce cases which show discrimination estimated when in fact there are no group differences in the underlying population.

12. The most common test for the statistical significance of the discriminant functions is the Wilks' lambda test of residual discrimination. By residual discrimination is meant the ability of the variables in the discriminant function to discriminate among groups beyond the information already extracted from the previous discriminant functions. If the residual discrimination is too small, then it is meaningless to derive any more functions even if they exist mathematically.

13. Wilks' lambda is a multivariate measure of group differences between the discriminating variables. It is computed as the product of several transformations of eigenvalues as follows:

$$\Lambda = \prod_{i=k+1}^{q} \frac{1}{1+\lambda_i} = \frac{1}{1+\lambda_{k+1}} \cdot \frac{1}{1+\lambda_{k+2}} \cdots\cdots \frac{1}{1+\lambda_q} \qquad \text{..........(5)}$$

where k represents the number of discriminant functions previously derived and the symbol $\prod$ denotes that the individual terms are to be multiplied to estimate the final product.

14. Wilks' lambda is an inverse measure. Values of lambda near the zero value denote high discrimination (i.e., the group centroids are greatly separated and very distinct relative to the amount of dispersion within the groups). When lambda equals 1.0, the group centroids are identical, denoting no group differences.

15. Test of Significance of Wilks' Lambda. The significance of Wilks' lambda can be tested by converting lambda into an approximation of either the chi-square or F distribution. The F-tables can then be used to determine the significance level. The formula for the testing is:

$$X^2 = -\left[m - \frac{(p+g)}{2} - 1\right] \log_e \lambda_k \qquad \text{..........(6)}$$

with (p - k) (g - k - 1) degrees of freedom, and

where m = total number of cases over all groups,

g = number of groups,

p = number of discriminating variables,

k = number of functions already derived,

λ_k = Wilks' lambda after k discriminant functions,

$\log_e$ = natural log.

16. The chi-square test provides information on whether the results came from a population which did have differences between the groups. However, the analysis described in this Annex, whose purpose is to derive simplified screening methods for rural roads, assumes that a single dimension can represent all the observed differences between the groups. It was decided at the outset not to develop a second discriminant function (i.e., add another dimension and thereby create a discriminant plane) on the assumption that it would not add any differences which we could confidently say exist in the population of rural roads. Given that only two groups of investments (feasible and unfeasible) are considered in this study, the above assumption is reasonable.

17. Results of the Discriminant Analysis. Five discriminant analysis equations were estimated -- corresponding to an opportunity cost of capital of 12% -- using the variables defined in Table 12. The results are presented in Table 13. These functions vary in the complexity of the information required. The discriminant function requiring the least data and complexity is No. 3, while the most complex function (requiring the estimation of full value added) is function No. 1. The canonical correlation coefficients of the five discriminant functions are very close in value, ranging from .54 (Equation 3) to .67 (Equation 5). This measure indicates a moderately strong association between the actual groups and the groups defined by the discriminant function in each case. The value of Wilks' lambda measures the statistical significance of a result based on sample data. In each case, these values indicate that the functions are statistically significant (i.e., there is a very low probability that these functions would be determined from the sample data in the case where there was actually no difference between the groups).

18. As may be seen from the reliability analysis presented in Table 14, the first discriminant function is the one that predicts most accurately the correct classification of unfeasible roads. It is in both the Bank's and the Borrower's interest that unfeasible roads be properly screened and excluded from further consideration. Therefore the use of the first discriminant function is recommended. As may be seen from Table 14, the various functional forms are almost indistinguishable in their overall accuracy, predicting correct decisions in 86%-87% of the cases.

19. The discriminant functions for prevailing opportunity costs of capital of 10%, 14% and 16% are in Tables 15, 17 and 19 respectively. The reliability of these functions is analyzed in Table 16 (for 10%), Table 18 (for 14%) and Table 20 (for 16%).

20. Regarding the evaluation of discriminant functions with opportunity costs of capital of 10% and 14%, whose parameters are presented in Tables 15 and 17, it is recommended that discriminant functions No. 1 (in both tables) be used for screening purposes. These functions No. 1 provide the best combination of forecasting accuracy of unfeasible roads with overall significance of the discriminant functions, significance attested by the canonical correlation coefficient and by the chi-square test.

21. With respect to the prediction of roads whose economic return is equal to or greater than 16%, equation No. 1 of Table 19 is recommended. This function's overall predictive performance is good and provides a good discrimination of unfeasible roads. Equation No. 3 of Table 19 outperforms all others in predicting unfeasible roads but at the cost of rejecting too many good roads. Equation 3 is also inferior to Equation No. 1 in terms of its canonical correlation coefficient.

22. Summary. The discriminant analysis results show that it is possible to predict the performance of rural roads with some minimum data requirements. Discriminant equations No. 1 of Tables 13, 15, 17 and 19 provide good results in the predictions of the feasibility of roads at different levels of opportunity costs of capital.

Table 12: Variable Definitions

Value Added	=	net agricultural value added (VA) in year of full production (with-project VA minus without-project VA)
Cost	=	present value of costs of the RRs (including construction and incremental maintenance costs) and agricultural components in the RRs' zone of influence
VOCS	=	opening year benefits stemming from savings in vehicle operating costs accruing to normal traffic
Net Value per Ha	=	without-project initial value of agricultural production per hectare of cultivated land in the zone of influence
Has. Served	=	number of cultivated hectares in the zone of influence in the without-project situation
Traditional Agriculture	=	a dummy variable taking the value of 1 if without-project initial yields are less than 1.5 tons per hectare of cultivated land, or if the without-project initial value added is less than US$150 equivalent per hectare; otherwise the value of this variable is 0
Δ Tons	=	increase in agricultural production (with- minus without-project) in the year of full production, expressed in tons
Pass-km	=	opening year passenger traffic in terms of passenger-kilometers
Ton-km	=	opening year goods traffic in terms of ton-kilometers

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Table 12: Variable Definitions

Tons per Ha.	=	initial productivity of agriculture in the zone of influence, defined as tons per hectare produced on cultivated land in the zone of influence of the road
Market	=	a dummy variable taking the value of 1 if the road provides direct access to a market less than 20 km away; otherwise taking a value of 0
Δ Ha.	=	equivalent increase in hectares of area cultivated. This increase is defined as the increase in newly cultivated land (with- minus without-project) in the year of full production plus the ratio of the "difference in with- and without-project yields to without-project yields" multiplied by the "cultivated area (hectares) in the without-project situation," in the year of full production
Net Value per Ton	=	without-project initial net value of the production in the zone of influence of the road divided by the agricultural production (in tons) in the zone of influence
ER	=	economic rate of return of a RR or group of interdependent RRs, plus associated agricultural investments (if any) in the zone of influence

Table 13: Discriminant Functions for Investments (i = 12%) 1/

Discriminating Variables (X_j) for Each Function	Unstandardized Discriminant Functions Coefficients (D_i)	Classification Function Coefficients		Evaluation Statistics		
		FOR ER ≤ 12%	FOR ER > 12%	Canonical Correlation Coefficient	WILKS LAMBDA	X^2
Discriminating Function No. 1						
Value added ÷ Cost	2.0225	1.1360	4.5175			
VOCS ÷ Cost	2.9219	2.5682	7.4534	0.5596	0.6869	49.21
Net Value per ha	0.002968	0.003158	0.008122			
Intercept (constant)	-1.9113	-0.9854	-3.5966			
Discriminating Function No. 2						
VOCS ÷ Cost	-1.2259	1.9426	3.8958			
Cost ÷ (Δ tons)	0.001139	0.002294	0.0004797	0.5898	0.6522	45.52
Net Value per ha	-0.003446	0.002726	0.008216			
Intercept (Constant)	0.1908	-2.1886	-1.9619			
Discriminating Function No. 3						
VOCS ÷ Cost	-1.347812	3.9908	5.8566			
Cost ÷ (Δ tons)	0.001193	0.002068	0.0004163	0.5358	0.7129	36.04
Traditional Agriculture	0.8244	3.1974	2.0561			
Intercept (constant)	-1.0048	-3.2013	-1.4095			

1/ i = opportunity cost of capital.

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Table 13: Discriminant Functions for Investments (i = 12%) 1/

Discriminating Variables (X_j) for Each Function	Unstandardized Discriminant Functions Coefficients (D_i)	Classification Function Coefficients		Evaluation Statistics		
		FOR ER < 12 %	FOR ER > 12%	Canonical Correlation Coefficient	WILKS' LAMBDA	X^2
Discriminating Function No. 4						
Cost ÷ (Δ tons)	-0.001137	0.002294	0.0004817			
Pass-km ÷ Cost	0.021791	0.063991	0.09872	0.5899	0.6519	45.34
Ton-km ÷ Cost	0.023147	-0.005186	0.031711			
Net Value per ha	0.0033583	0.002979	0.008692			
Intercept (constant)	-0.1980	-2.2074	-1.9919			
Discriminating Function No. 5						
VOCS ÷ Cost	0.8067	2.2713	3.8581			
Cost ÷ (Δ ha.)	-0.002609	0.005320	0.0001885	0.6696	0.5516	63.36
Net Value per ha	0.006812	-0.005387	0.008013			
Intercept (constant)	-0.1225	-2.4747	-1.9066			

1/ i = opportunity cost of capital.

Table 14: **Reliability and Prediction Errors of Discriminant Functions for Investments (i = 12%) 1/**

Discriminant Function No.	Actual Groups	No. of Cases	Predicted Group Membership ER < 12%	ER ≥ 12%	Percent Classified Correctly
No. 1	ER < 12%	32	31	1	97%
	ER ≥ 12%	78	13	65	83%
		110	44	66	87%
No. 2	ER < 12%	32	24	8	75%
	ER ≥ 12%	78	6	72	92%
		110	30	80	87%
No. 3	ER < 12%	32	23	9	72%
	ER ≥ 12%	78	5	73	94%
		110	28	82	87%
No. 4	ER < 12%	32	24	8	75%
	ER ≥ 12%	78	6	72	92%
		110	30	80	87%
No. 5	ER < 12%	32	23	9	72%
	ER ≥ 12%	78	6	72	92%
		110	29	81	86%

1/ i = opportunity cost of capital.

Table 15: Discriminant Functions for Investments (i = 10%) 1/

Discriminant Variables (X_i) for Each Function	Unstandardized Discriminant Functions Coefficients (D_i)	Classification Function Coefficients: FOR ER < 10%	Classification Function Coefficients: FOR ER ≥ 10%	Evaluation Statistics: Canonical Correlation Coefficient	Evaluation Statistics: Wilk's Lambda	Evaluation Statistics: X^2
Discriminant Function No. 1						
Value Added ÷ Cost	1.8552	0.9468	3.5316			
VOCS ÷ Cost	3.4406	1.8208	6.6145	0.5076	0.7422	31.74
Net Value per ha	0.002533	0.002998	0.006529			
Intercept/Constant	-1.7581	-0.9578	-2.8781			
Discriminant Function No. 2						
Value Added ÷ Cost	2.0826	1.6596	4.2974			
VOCS ÷ Cost	3.8733	4.7785	9.6843	0.4721	0.7770	26.87
Traditional Agriculture	-0.3974	3.3255	2.8221			
Intercept/Constant	-1.1574	-2.0939	-3.1223			
Discriminant Function No. 3						
VOCS ÷ Cost	1.3585	1.6081	3.9044			
Cost ÷ Δ ha	-0.002424	0.004936	0.000839	0.5815	0.6618	43.96
Net Value Per ha	0.005934	-0.003878	0.006152			
Intercept/Constant	-0.0660	-2.4368	-1.7693			

1/ i = opportunity cost of capital.

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Table 15: Discriminant Functions for Investments (i = 10%) 1/

Discriminant Variables (X_j) for Each Function	Unstandardized Discriminant Functions Coefficients	Classification Function Coefficients		Evaluation Statistics		
		FOR ER < 10%	FOR ER ≥ 10%	Canonical Correlation Coefficient	Wilk's Lambda	X^2
Discriminant Function No. 4						
Cost ÷ ΔTons	-0.001282	0.001848	0.000081			
Pass km ÷ Cost	0.0518	0.0782	0.1497	0.5036	0.7436	30.86
Ton km ÷ Cost	0.02123	0.006964	0.0362			
Net Value per ha	0.00130	0.002249	0.004042			
Net Value per ton	0.00495	0.003975	0.0108			
Intercept/Constant	-0.3968	-2.1400	-2.1688			
Discriminant Function No. 5						
Cost ÷ Has. Served	-0.00202	0.003391	0.000833			
Pass km ÷ Cost	0.0294	0.0598	0.0971	0.4719	0.7772	26.71
Ton km ÷ Cost	0.0241	-0.0114	0.0191			
Net Value per ha	0.0048	0.00109	0.00722			
Intercept/Constant	-0.3976	-1.7233	-1.7896			

1/ i = opportunity cost of capital.

Table 16: Reliability and Prediction Errors of Discriminant Functions for Investments (i = 10%) 1/

Discriminant Function No.	Actual Groups	No. of Cases	Predicted Group Membership ER < 10%	Predicted Group Membership ER ≥ 10%	Percent Classified Correctly
No. 1	ER < 10%	25	24	1	96.0%
	ER ≥ 10%	85	19	66	77.6%
		110	43	67	81.8%
No. 2	ER < 10%	25	24	1	96.0%
	ER ≥ 10%	85	18	67	78.8%
		110	42	68	82.7%
No. 3	ER < 10%	25	17	8	68.0%
	ER ≥ 10%	85	11	74	87.1%
		110	28	82	82.7%
No. 4	ER < 10%	25	17	8	68.0%
	ER ≥ 10%	85	10	75	88.2%
		110	27	83	83.6%
No. 5	ER < 10%	25	21	4	84.0%
	ER ≥ 10%	85	15	70	82.4%
		110	36	74	82.7%

1/ i = opportunity cost of capital.

Table 17: Discriminant Functions for Investments (i = 14%) 1/

Discriminant Variables (X_i) for Each Function	Unstandardized Discriminant Functions Coefficients (D_i)	Classification Function Coefficients		Evaluation Statistics		
		FOR ER < 14%	FOR ER ≥ 14%	Canonical Correlation Coefficient	Wilk's Lambda	X^2
Discriminant Function No. 1						
Value Added ÷ Cost	2.1000	1.2961	4.7669			
VOCS ÷ Cost	3.1127	2.7691	7.9137	0.6163	0.6201	50.88
Net Value Per ha	0.002732	0.003528	0.008043			
Intercept/Constant	-1.9149	-1.0583	-3.7513			
Discriminant Function No. 2						
Value Added ÷ Cost	2.3657	1.2299	4.7009			
VOCS ÷ Cost	3.7785	2.9603	8.5040	0.5706	0.6744	41.95
Tons per ha	0.0591	0.2052	0.2920			
Intercept/Constant	-1.6318	-0.9937	-3.0159			
Discriminant Function No. 3						
Value Added ÷ Cost	2.2758	1.7533	5.1666			
VOCS ÷ Cost	3.3817	5.4789	10.5508	0.5790	0.6647	43.49
Traditional Agriculture	-0.5257	3.3641	2.5757			
Intercept/Constant	-1.1651	-2.1594	-3.5183			

1/ i = opportunity cost of capital.

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Table 17: Discriminant Functions for Investments (i = 14%) 1/

Discriminant Variables (X_i) for Each Function	Unstandardized Discriminant Functions Coefficients (D_i)	Classification Function Coefficients		Evaluation Statistics		
		FOR ER < 14%	FOR ER ≥ 14%	Canonical Correlation Coefficient	Wilk's Lambda	X^2
Discriminant Function No. 4						
VOCS ÷ Cost	0.9731	2.1921	3.9833			
Cost ÷ Δ ha	-0.002584	0.004906	0.000148	0.6570	0.5682	60.19
Net Value per ha	0.006632	-0.004166	0.008042			
Intercept/Constant	-0.1069	-2.3061	-1.9177			
Discriminant Function No. 5						
Cost ÷ Δ ha	-0.002502	0.005082	0.000412			
Net Value per ha	0.006700	-0.003696	0.008809			
Market	0.4472	1.5378	2.3725	0.6622	0.5614	61.47
Intercept/Constant	-0.2492	-2.5131	-2.3767			

1/ i = opportunity cost of capital.

Table 18: Reliability and Prediction Errors of Discriminant Functions for Investments (i = 14%) 1/

Discriminant Function No.	Actual Groups	No. of Cases	Predicted Group Membership		Percent Classified Correctly
			ER < 14%	ER ≥ 14%	
No. 1	ER < 14%	36	33	3	91.7%
	ER > 14%	74	15	59	79.7%
		110	48	62	83.6%
No. 2	ER < 14%	36	36	0	100.0%
	ER > 14%	74	18	56	75.7%
		110	54	56	83.6%
No. 3	ER < 14%	36	32	4	88.9%
	ER > 14%	74	14	60	81.1%
		110	46	64	83.6%
No. 4	ER < 14%	36	25	11	69.4%
	ER > 14%	74	6	68	91.9%
		110	31	79	84.6%
No. 5	ER < 14%	36	27	9	75.0%
	ER > 14%	74	6	68	91.9%
		110	33	77	86.4%

1/ i = opportunity cost of capital.

Table 19: **Discriminant Functions for Investments (i = 16%) 1/**

Discriminating Variables (X_i) for Each Function	Unstandardized Discriminant Functions Coefficients (D_i)	Classification Function Coefficients FOR ER < 16%	Classification Function Coefficients FOR ER > 16%	Evaluation Statistics: Canonical Correlation Coefficient	Evaluation Statistics: Wilks' Lambda	Evaluation Statistics: X^2
Discriminant Function No.1						
VOCS ÷ Cost	1.0587	2.3614	4.2767			
Cost ÷ (Δ ha)	-0.002307	0.00398	-0.000190	0.6652	0.5575	62.23
Net Value per ha	0.007186	-0.002985	0.01001			
Intercept (constant)	-0.3753	-1.8941	-2.2161			
Discriminant Function No. 2						
Cost ÷ (Δ ha.)	-0.002333	0.004133	-0.000101			
Pass-km ÷ Cost	-0.007303	0.1139	0.1006			
Ton-km ÷ Cost	0.05470	-0.0588	0.0405	0.6665	0.5558	62.25
Net Value per ha	0.00730	-0.00290	0.0104			
Intercept (Constant)	-0.3413	-1.9760	-2.2360			
Discriminant Function No.3						
Value Added ÷ Cost	2.4724	1.5463	5.6395			
VOCS ÷ Cost	3.8419	3.4985	9.8590	0.6318	0.6008	54.28
Tons per ha	0.09075	0.2042	0.3545			
Intercept (Constant)	-1.7537	-1.0377	-3.6421			

1/ i = opportunity cost of capital.

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Table 19: **Discriminant Functions for Investments (i = 16%)** 1/

Discriminating Variables (X_j) for Each Function	Unstandardized Discriminant Functions Coefficients (D_i)	Classification Function Coefficients		Evaluation Statistics		
		FOR ER < 16%	FOR ER ≥ 16%	Canonical Correlation Coefficient	Wilks' Lambda	X^2
Discriminant Function No. 4						
Value Added ÷ Cost	2.2053	1.7231	6.0738			
VOCS ÷ Cost	3.1168	3.4284	9.5772	0.6968	0.5144	70.78
Net Value per ha	0.003424	0.003988	0.01074			
Intercept (constant)	-2.1195	-1.1385	-4.8954			
Discriminant Function No. 5						
Value Added ÷ Cost	2.3035	1.6086	5.7259			
VOCS ÷ Cost	3.1265	5.4636	11.0519	0.6607	0.5634	61.10
Traditional Agriculture	-0.9255	3.6626	2.0083			
Intercept (constant)	-0.9507	-2.3533	-3.7040			

1/ i = opportunity cost of capital.

Table 20: **Reliability and Prediction Errors of Discriminant Functions for Investments (i = 16%) 1/**

Discriminant Function No.	Actual Groups	No. of Cases	Predicted Group Membership ER < 16%	Predicted Group Membership ER ≥ 16%	Percent Classified Correctly
No. 1	ER < 16%	43	38	5	88%
	ER ≥ 16%	67	3	64	96%
		110	41	69	93%
No. 2	ER < 16%	43	35	8	81%
	ER ≥ 16%	67	3	64	96%
		110	38	72	90%
No. 3	ER < 16%	43	42	1	98%
	ER ≥ 16%	67	15	52	78%
		110	57	53	85%
No. 4	ER < 16%	43	39	4	91%
	ER ≥ 16%	67	14	53	79%
		110	53	57	84%
No. 5	ER < 16%	43	35	8	81%
	ER ≥ 16%	67	11	56	84%
		110	46	64	83%

1/ i = opportunity cost of capital.

SCREENING VIA REGRESSION ANALYSIS

1. The regression method provides an estimate of the economic rate of return (ER) of a rural road or group of interdependent RRs with associated agricultural investments, if any, in the RR's zone of influence, while the discriminant analysis method (Annex G) simply determines whether or not a road or group of roads will pass a feasibility test (fixed ER criterion). The regression analysis predicts the ER of the investment as a function of the characteristics which affect its economic performances. These independent variables include producer surplus measures (agricultural value added, increase in tonnage, increase in cultivated area, etc.), consumer surplus measures (vehicle operating cost savings of normal traffic, passenger-kilometers, ton-kilometers, etc.) and investment and maintenance cost variables. The regression equations presented in Table 21 are derived from data on the worldwide sample of 110 RRs.

2. Two important problems with this method of estimating the ER of an investment should be noted: (1) non-linearity; and (2) heteroskedasticity. Regression analysis assumes that the relationships among the appropriately defined variables are linear, in the sense that the regression coefficients are linear. However, it can be observed from the data set that the relationships between ER and the independent variables are not linear. It was not possible to use logarithmic transformations to better fit the data because of the large number of zeros in the data base. Use of polynomial terms was rejected as such expressions would unduly complicate a supposedly simple screening procedure. As a consequence, the regression equations overestimate the ERs of unfeasible investments and underestimate those ERs above the 35-40% level. An intercept adjustment was later used to correct for the overestimation of ERs for unfeasible investments.

3. A second problem concerns heteroskedasticity or unequal variance of regression residuals. The heteroskedasticity problem common to cross-sectional analysis is present in these regressions. No corrections through proper weighting procedures were attempted in this limited study, because the unbiased property of the regression coefficients remains unaffected. However, the regression estimates are inefficient in the sense that they are not minimum-variance estimates.

4. Results of the Analysis. The regression analyses results are presented in Table 21. (Variable definitions are the same as those given in Table 12 of Annex G). Regression equation No. 1 exhibits the best degree of statistical fit (R^2 = .64), followed by equations Nos. 3 and 4. Regression equations Nos. 2 and 5 are certainly inferior to the others in terms of both degree of closeness of fit (i.e., R^2s) and significance of the regression

coefficients (F-statistic). Measures of producer surplus benefits prove to be the most important predictors, as shown by their generally higher statistical significance.

5. In view of the non-linearity problem it was decided to reduce the intercept (constant) of the regression equations in order to adjust for the overprediction of the ERs of unfeasible investments. The approach taken was to find the average error E using the following formula:

$$E = \frac{1}{n} (R_a - R_p)$$

where n = total number of unfeasible investments,

R_a = actual ER as estimated in the feasibility studies of projects, and

R_p = predicted ER as established by regression equations Nos. 1, 3 and 4.

The adjusted intercept constant C' is then estimated as follows:

$$C' = C - E$$

where C = the intercept value estimated through regression equations Nos. 1, 3 or 4.

The resulting equations after intercept adjustments are presented in Tables 22, 23 and 24 along with measures of their reliability. As shown in these tables, the reliability of the regression equations improves after the intercept (constant) adjustment.

6. The reliability of regression equations Nos. 1, 3 and 4 ranges from 81% to 85% without the intercept adjustment and from 84% to 93% with the intercept adjustment, as shown in Tables 22 through 24. However, the large standard errors associated with these equations make them of limited usefulness in estimating the actual ER of a particular RR or group of RRs with associated agricultural investments, if any, in the RR's zone of influence. Although the results of the reliability testing (about 84% to 93% correct decisions) are satisfying, the use of regression analysis is, therefore, not recommended due to the high standard errors of the estimate which result from the regressions estimated. Consequently, there is no guarantee that the satisfactory reliability will be maintained in the population represented by the sample.

Table 21: **Summary Statistics of the Regression Analysis Methods for Screening Rural Roads**

Evaluation Statistics

	Regression Coefficient	Standard Error of Coefficient	F-Test	R^2	Standard Error of the Estimate
Regression No. 1					
Intercept (constant)	5.023			0.637	11.297
Value Added ÷ Cost	24.1951	2.31	109.6		
VOCS ÷ Cost	77.964	8.85	77.7		
Net Value per ha	0.00949	0.005	2.5		
Regression No. 2					
Intercept (constant)	21.373			0.313	15.545
Cost ÷ (Δ tons)	-0.00736	0.0018	15.54		
Pass-km ÷ Cost	1.2878	0.302	18.17		
Net Value per ha	0.025	0.008	9.69		
Regression No. 3					
Intercept (constant)	22.762			0.412	14.392
Cost ÷ (Δ ha)	-0.0201	0.0033	35.76		
Pass-km ÷ Cost	1.1182	0.287	15.70		
Net Value per ha	0.0509	0.008	39.03		
Regression No. 4					
Intercept (constant)	22.667			0.468	13.686
VOCS ÷ Cost	56.9466	10.6446	28.62		
Cost ÷ (Δ ha)	-0.0203	0.0031	40.94		
Net Value per ha	0.0450	0.0078	32.95		
Regression No. 5					
Intercept (constant)	21.288			0.358	15.029
VOCS ÷ Cost	60.424	11.660	26.85		
Cost ÷ (Δ Tons)	-0.0072	0.002	15.86		
Net Value per ha	0.0184	0.0077	5.59		

Table 22: Reliability of Regression Equation No. 1

With Intercept Adjustment

Actual Groups	No. of Cases	Predicted Group Membership ER < 12%	ER ≥ 12%	Percent Classified Correctly
ER < 12%	32	29	3	91%
ER ≥ 12%	78	5	73	94%
	110	34	76	93%

Note: The intercept adjustment results in a negligible intercept value. The resulting regression equation after the intercept adjustment is:

ER = 24.1951 [value added ÷ cost] + x 77.964 [VOCS ÷ cost]
+ 0.0095 [net value per ha]

Without Intercept Adjustment

Actual Groups	No. of Cases	Predicted Group Membership ER < 12%	ER ≥ 12%	Percent Classified Correctly
ER < 12%	32	17	15	53%
ER ≥ 12%	78	2	76	97%
	110	19	91	85%

Note: The resulting equation is identical to the one presented in Table 21.

Table 23: Reliability of Regression Equation No. 3

With Intercept Adjustment

Actual Groups	No. of Cases	Predicted Group Membership ER < 12%	Predicted Group Membership ER ≥ 12%	Percent Predicted Correctly
ER < 12%	32	26	6	81%
ER ≥ 12%	78	11	67	86%
	110	37	73	84%

Note: The resulting regression equation after the intercept adjustment is:

$$ER = 12.262 - 0.0201\ [\text{cost} \div (\Delta\ \text{tons})] + +1.1182\ (\text{pass-km} \div \text{cost}) + 0.0509\ [\text{net value per ha}]$$

Without Intercept Adjustment

Actual Groups	No. of Cases	Predicted Group Membership ER < 12%	Predicted Group Membership ER ≥ 12%	Percent Predicted Correctly
ER < 12%	32	11	21	34%
ER ≥ 12%	78	0	78	100%
	110	11	99	81%

Note: The resulting equation is identical to the one presented in Table 21.

Table 24: Reliability of Regression Equation No. 4

With Intercept Adjustment

Actual Groups	No. of Cases	Predicted Group Membership ER < 12%	ER ≥ 12%	Percent Classified Correctly
ER < 12%	32	31	1	97%
ER ≥ 12%	78	11	67	85
	110	42	68	89%

Note: The resulting equation after the intercept adjustment is:

$$\hat{ER} = 13.327 + 56.9466\ [\text{VOCS} \div \text{cost}] + - 0.0203\ [\text{cost} \div (\Delta\ \text{ha})] + 0.0450\ [\text{net value per ha}]$$

Without Intercept Adjustment

Actual Groups	No. of Cases	Predicted Group Membership ER ≤ 12%	ER > 12%	Percent Classified Correctly
ER < 12%	32	12	20	38%
ER ≥ 12%	78	0	78	100%
	110	12	98	82%

Note: The resulting equation is identical to the one presented in Table 21.

SAMPLE DESIGN AND CHARACTERISTICS

1. Introduction. The sample of rural roads (RRs) used for this analysis was selected from Bank project files. In the initial review of rural roads and rural development projects, eight projects were identified which had project file data on specific links. These projects provided reasonable geographical coverage of the developing world with, however, a rather strong emphasis on Latin America (three of eight projects). The other projects were in North and West Africa, South and East Asia. Only East Africa fails to be represented in the sample. A key assumption for the analysis is that this sample frame adequately represents the universe of potential road projects in the developing world.

2. Sample Size. The number of RRs to be selected from those for which project files are available was determined according to standard statistical procedures. The characteristic of the RR population which we wish to estimate on the basis of the sample is the proportion of roads passing (or failing) screening tests which will also pass (or fail) the economic feasibility test. This is defined to be the measure of reliability for a specific screening method. Equation (1) presents the formula for determining the coefficient of variation (CV) of a proportion estimated via random sampling without replacement.

$$CV = \frac{\sigma_p}{p} = \sqrt{\frac{(1-p)}{p(n-1)}} \qquad \dots\dots\dots(1)$$

where p = the proportion sought,

σ_p = standard deviation of the proportion,

n = sample size, and

CV = a measure of the level of relative error associated with estimates based on sample data (i.e., the coefficient of variation).

Acceptable ranges of relative errors are given by coefficients of variation which range from 0.01 to 0.10. In other words, the size of the relative error ranges from 1/100 to 1/10 the value of the estimate (in this case, the proportion of correct decisions).

3. Table 25 shows the sample sizes required to achieve coefficients of variation ranging from 0.5 to 0.10. A sample size of 110 RRs was selected on the basis of available data and distribution considerations (para. 4). This sample size assures that the relative error of the estimate will not exceed 5% for values of the estimate in the vicinity of 80%. In other words, if the application of a given screening method to the sample roads results in 80% correct predictions, we can be confident that the true value for the roads represented by the sample lies between (.80) (1 - .05) = 76% and (.80) (1 + .05) = 84%. For success rates of greater than 80%, we can be even more confident that the sample accurately represents what would happen if the same test were applied to all roads in the project files.

Table 25: Sample Sizes Required for Different Relative Error Levels

Proportion of Correct Decisions	Required Sample Size (n) for Different Levels of Coefficients of Variation (CV)	
	CV = 0.10	CV = 0.05
0.8	26	101
0.7	44	172
0.6	68	267

4. Sample Distribution. Some of the projects had data for hundreds of road links recorded in the project files, while others had data for only three or four roads. In order not to allow one or two countries to overwhelm the sample, the number of roads to be selected from each project was predetermined in order to provide approximately equal geographic distribution among the regions. The projects and specific roads selected are shown in Table 26.

5. Sample Characteristics. With the exception of the four Indonesia roads, which will be paved, all of the sample roads were all-weather gravel roads. Very few earth roads were found in the project files. Thus the reliability of the screening methods tested in this study can only be assumed to apply to all-weather, unpaved roads.

Table 26: Identification of Roads in the Sample

Country	No. of Roads	Location	Road Identification
Brazil	12	Class E roads in state of Bahia (serving Cacao)	Routes #1, 10, 11, 17, 23, 28, 37, 38, 39, 40, 43, 47
Honduras	10	Roads in Yoro, Masica and Guayape Valleys	Guayape Valley: Roads #6, 8, 13, 33 Masica Valley: Roads #1, 4, 7 Yoro Valley: Roads #1, 2, 3
Colombia	12	Roads in 7 regions	Reg. Huila: Routes # 02, 03, 23 Reg. Narino: Route #04, 05 Reg. Tolima: Route #10 Reg. Quindio: Route #55 Reg. Risaralda: Route #53 Reg. Sucre: Route #61 Reg. Choco: Routes #63, 64, 65
India	19	Roads in state of Bihar	Bihar Routes: Minapur-Belsaud, Silao-Gorma, Sisai-Basia, N/Beg/6k, S/SAS/8k, S/GAY/13k, S/GAY/20k S/GAY/28k, S/AUR/12k, S/GAY/12k, S/AUR/13k, C/KHU/3k, C/DA/2k, C/RAN/2P N/MOT/3k, N/BEG/1k, S/DIN/1k, N/SAH/3k S/GAY/7k
Indonesia	4	Java Collector roads	Java roads #1, 2, 3, 4
Philippines	6	Roads in 2 provinces	Iloilo Province Roads #41.05, 41.03/ alone and with Agricultural Investments Cebu Province Roads #13.05, 43.03
Benin	22	Roads in 3 provinces	Atacora Province Roads: a, b, c, d, e, f, g, h, i, j, k, l, m, n, o, p, q, Zou Province Roads: #r, s, t Mono Province Roads: u, v
Tunisia	25	Roads in 6 provinces	Province of Gabes: Routes #807, 808 809, 851, 852 Province of Gafsa: Routes #708, 711 Province of Kasserine: Routes #508, 551, 552 Province of Medenine: Routes #1801, 1802, 1803, 1804, 1805, 1854, 1855 Province of Sidi Bouzid: Routes #609 662, 663, 665 Province of Monastir: Routes #1502, 1503, 1505, 1506
Total	110		

INDONESIA: SCREENING ON COST PER POPULATION AND COST PER CULTIVATED AREA

1. The simplicity of this screening method makes it an attractive alternative to more complicated methods. It is believed to work well in Indonesia because of the relatively high volumes of both freight and passenger traffic on the roads to be improved. Both types of traffic are closely linked to the key parameters selected for screening purposes.

2. A prescreening procedure eliminates from analysis those roads that (1) lie within a 3 km distance of an alternative road, (2) are less than 2 km in length, or (3) do not fit the definition of rural roads. Three types of rural roads are distinguished: (a) collector and through roads; (b) development access roads; and (c) service roads, which comprise all the remaining rural road improvements not otherwise classified.

3. Collector and through roads are evaluated on a 20% sample basis on the basis of vehicle operating cost savings, and while there has been an attempt to relate their ERs to parameter values of cost per person served, the results are still tenuous.

4. Development access roads and service roads are screened on the basis of two key ratios, namely:

(i) the cost of road construction per person residing in the zone of influence 5 years after construction; and

(ii) the cost of road construction per hectare of cultivated land in the zone of influence 5 years after construction.

5. Economic analysis conducted by a consultant team has determined that for access/service roads an economic rate of return (ER) of 12% corresponds to ratios of US$200 equivalent road construction costs per hectare of cultivated land or alternatively US$50 of road construction costs per person. In highly dense areas of Java, project justification requires road construction costs of US$10 per person or US$400 of road construction costs per hectare of cultivated area served. In less densely populated areas outside of Java, the cultivated area becomes more important than population. In addition, these roads are the subject of an economic evaluation on a 10% sample basis.

6. The population variable plays an important role in the screening of rural roads in Indonesia. The Indonesian project is one of the few cases

where project planners have attempted to measure passenger and non-agricultural freight traffic on a development access road. The consultants estimate that 48 trips per person will be made every year with the development access road (16% in motor vehicles, and another 5% on motor-cycles, and the rest by foot and non-motorized vehicles), compared to 38.4 annual trips per person without the access roads (none of which are by motor vehicles). As a consequence the consumer surplus benefits (savings in vehicle operating costs) account for 70% of the total benefits from the rural roads.

7. This methodology was tested by developing a regression function relating the ER to the two key variables, cost per person served and cost per cultivated area served, for the worldwide sample of 110 rural roads. The resulting regression yields an R^2 of 0.062. In other words, these two parameters explain only 6% of the observed variance of the ER. Furthermore, on this sample the regression coefficient of the population variable is not statistically significantly different from zero at the 95% significance level.

8. The US$50 cost per person criterion was also used to screen the worldwide sample of rural roads into two groups, i.e., economically feasible ones and unfeasible ones. This criterion led to 44% incorrect decisions, compared to the results of full feasibility studies, with particularly high error rates in the relatively densely populated zones of influence of roads in India and the Philippines. This appears to be due to the fact that the calculation of consumer benefits in the sample of roads in these two countries (and indeed in most of the countries in the sample) considered that the passenger and non-agricultural freight traffic would be insignificant.

9. The reliability of the screening criteria in predicting ERs in Indonesia is currently being tested by regional staff, using data from the subprojects included in the first year program for the five sample kabupatens, for which individual ERs have been calculated. Preliminary results indicate that these criteria in fact are not very reliable even in the Indonesian situation, due to the wide variation in improvement types as well as to the variability of ERs within improvement types covered by the sample. Further work is planned by regional staff to define and test new measures which may prove to be more accurate predictors of ERs in Indonesia.

RURAL ROAD CONSTRUCTION COSTS AND VEHICLE OPERATING COSTS

1. Introduction. For the purpose of developing the tables presented in Annex L on the level of ADT traffic required to justify rural road (RR) investments, an attempt was made to collect data on typical costs of construction of RRs and vehicle operating costs on these roads. This annex describes the results of this investigation.

Construction Costs of RRs

2. RR Construction Costs. The analysis that follows is conducted in reference to five major types of rural road investments:

(1) construction of earth roads without drainage;

(2) construction of earth roads with drainage facilities;

(3) construction of all-weather gravel roads;

(4) re-gravelling of previously gravelled roads; and

(5) construction of roads with bituminous surface treatment.

Typical construction costs for these improvements are given in Table 27. These costs have been obtained by actualizing to December 1981 prices the costs of a list of IBRD-financed rural road projects compiled by C.R. Willoughby.3/ The procedure used in projecting costs to 1981 levels was as follows: first, the costs in domestic currency were projected to 1981 using consumer price indexes in the respective countries; second, the projected costs in domestic currencies were converted into dollars at the market exchange rates. The source of the price indexes and the exchange rates is the data compiled by the International Monetary Fund.4/

3/ C.R. Willoughby, Labor-Intensive Construction Techniques: Report of a Bank Seminar, March 9-11, 1977. IBRD Transportation Department, September 15, 1977.

4/ The consumer price index is the only price series reported on a regular basis for most of the countries in the original list compiled by Willoughby. See International Monetary Fund, International Financial Statistics, Volume XXXV, No. 6, June 1982.

Table 27: Typical Construction Costs for Selected Rural Road Projects

(1) With-Project Situation	(2) Without-Project Situation	(3) Construction Costs per km[1/] (US Dollars, 1981 prices)
Earth Road without Drainage	Impassable Tracks	6,000-10,000
Earth Road with Drainage	Impassable Tracks	14,000-20,000
Gravel Road	Earth Road without Drainage	15,000-35,000
Regravelled Road	Gravel Road in Poor Condition	8,000-25,000
Road with Bituminous Surface	Gravel Road	100,000-200,000

1/ Costs to improve the conditions of tracks/roads of Column (2) to the conditions of roads of Column (1).

3. The cost estimates presented in Table 27 are nothing more than benchmark factors to aid in this study. They should not be used for costing specific projects. In fact the research showed instances where the costs of construction of rural roads were multiples of the figures presented in Table 27. For example, all-weather gravel roads are being constructed in Paraguay at costs of $125,000 per kilometer. The large variations observed may be indicative of a need to improve RR design standards and specifications.

4. Vehicle Operating Cost Savings. A wide discrepancy in vehicle operating cost savings was found in the feasibility reports analyzed. Most of the discrepancies concerned the savings related to improving tracks to earth roads and earth roads to gravel roads. In addition, some projects exhibited very high savings per ton-kilometer. Table 28 presents the range of vehicle operating costs and cost savings observed. These costs were actualized to December 1981 utilizing the procedure described earlier for the rural road construction costs.[5/] Unfortunately, since the VOCs from the feasibility studies do not disaggregate costs into component elements, it was not possible to apply different price indexes to the fuel costs vs. the other cost components. The differences in cost savings observed in Table 28 to some extent reflect discrepancies between the Kenya tables developed by the Transport and Road Research Laboratory[6/] and the previous research of de Weille,[7/] Bonney and Stevens[8/] and others. Differences between the Kenya tables and the research studies which preceded them are acute for earth and gravel roads. To skirt around this problem of lack of consensus on estimates of vehicle operating cost savings, it was decided to develop the tables of Annex L in a manner which enables the analyst to consider a large range of alternative vehicle operating cost savings estimates.

5/ With the data available this is the best possible procedure; however, it is weak since insufficient attention is given to increases in fuel prices.

6/ S.W. Abaynayaka et al., Tables for Estimating Vehicle Operating Costs in Developing Countries. TRRL Laboratory Report 723, Transport and Road Research Laboratory, 1976.

7/ Jan de Weille, Quantification of Road User Savings, World Bank Occasional Paper No. 2, The John Hopkins Press, 1966.

8/ R.S.P. Bonney and N.F. Stevens, Vehicle Operating Costs on Bituminous, Gravel and Earth Roads in East and Central Africa, Road Research Technical Paper No. 76, Road Research Laboratory, Ministry of Transport, London. Her Majesty's Stationery Office, 1967, p. 22.

Table 28: **Vehicle Operating Cost (VOC) by Means and Surface Types in Flat Terrain**
(US dollars, 1981 prices)

Earth Roads - Flat Terrain

Means	Country (year of study)	Earth Roads in Good Condition: Cost per vehicle-km	Costs per ton-km	Costs per pass-km	VOC on Earth Roads in good condition as Proportion of VOC on Earth Roads in Bad Condition
Passenger Car	Honduras (80)	0.168			77.2%
	Upper Volta (75)	0.213			53.3%
	Benin (76)	0.313			77.8%
	Tunisia (78)	0.179			88.3%
	Tunisia (81)	0.193			n.a.
	Indonesia (80)	0.267			52-62%
Bus-unspec.	Honduras (80)	0.302			76.9%
	Tunisia (78)	0.591			84.1%
Bus-light	Indonesia (80)	0.256			45-55%
Bus-Heavy	Indonesia (80)	0.399			40-50%
Light Vehicle/ Minibus	Honduras (80)	0.110		0.013	76.0%
	Tunisia Minibus (81)	0.633			n.a.
Trucks-2 ton	Upper Volta (75)	0.234			48.6%
	Benin (76)	0.214			49.4%
Trucks-7 ton	Upper Volta (75)	0.433			49.9%
	Benin (76)	1.058			84.3%
Truck-Light	Indonesia (80)	0.272			44-54%
Truck-Med.	Indonesia (80)	0.320			40-50%
Trucks-Unspec.	Honduras (80)	0.462			76.8%
	Honduras (80)	0.474	0.04-0.07		91.1%
	Tunisia (78)	0.457			82.9%
	Tunisia (81)	0.511			n.a.
Oxcarts/ Horsecarts	Honduras (80)	0.220	0.46-0.73		95%
	Bihar (80)	0.12-0.36	0.12-0.36		100%
	Tunisia (78)	0.207			100%
	Sri Lanka (78)		0.68-0.80		n.a.
	Indonesia (80)	0.268			100%
Bicycle	Indonesia (80)	0.085			98-99%
Mules	Honduras (80)	0.086	0.87-1.44	0.09-0.17	94%
	Tunisia (78)	0.058			100%
Pedestrian	Honduras (80)	0.058		0.06-0.17	100%
Pedestrian/ Backpack	Philippines (79)	0.036	3.21 (Head-carry)	0.036	100%
	Indonesia (80)	0.177			100%

contd...

Table 28: **Vehicle Operating Cost (VOC) by Means and Surface Types in Flat Terrain**
(US dollars, 1981 prices)

Gravel Roads - Flat Terrain

Means	Country (year of study)	Gravel Roads in Good Condition: Cost per vehicle-km	Cost per ton-km	Cost per pass-km	VOC on Gravel Roads in good condition as proportion of VOC on: Gravel Road in bad condition	Earth Road in Good condition
Passenger Car	Honduras (80)	0.158			71.3%	94.5%
	Benin (76)	0.212			n.a.	67.6%
	Tunisia (78)	0.145			89.5%	80.6%
	Tunisia (81)	0.133			n.a.	68.9%
	Indonesia (80)	0.267			60-69%	99.8%
Bus-unspec.	Honduras (80)	0.276			71.3%	91.6%
	Tunisia (78)	0.389			80.0%	65.8%
Bus-light	Indonesia (80)	0.224			52-62%	87.2%
Bus-heavy	Indonesia (80)	0.375			49-59%	93.9%
Light	Tunisia (81)	0.36			n.a	56.8%
Vehicle/ Minibus	Philippines (79) Jeepney		0.088	0.013	61-66%	n.a.
	Philippines (79) Minibus			0.008	63.6%	n.a.
Trucks-2 ton	Benin (76)	0.292			n.a.	67.2%
Trucks-6 ton	Senegal (74)	0.591	0.197		n.a.	n.a.
Trucks-7 ton	Benin (76)	0.737			n.a.	69.7%
Trucks-10 ton	Senegal (74)	0.757	0.151		n.a.	n.a.
Trucks-25 ton	Senegal (74)	1.12	0.088		n.a	n.a
Trucks-light	Indonesia (80)	0.241			50-60%	88.0%
Trucks-med.	Indonesia (80)	0.299			49-59%	93.9%
Trucks-Unsp.	Honduras (80)	0.403			71.3%	87.9%
	Tunisia (78)	0.281			77.1%	61.6%
	Tunisia (81)	0.258			n.a.	50.2%
	Colombia (81)	0.97-1.09			n.a.	n.a.
	Philippines (79)		0.037		62.0%	n.a
Tricyles	Philippines (79)		0.185	0.023	63-66%	n.a.
Bicycle	Indonesia (80)	0.085			98-99%	100.0%

contd.....

Table 28: Vehicle Operating Cost (VOC) by Means and Surface Types in Flat Terrain
(US dollars, 1981 prices)

Paved Roads - Flat Terrain

Means	Country (year of study)	Paved Roads in Good Condition: Cost per vehicle-km	Cost per ton-km	Costs per pass-km	VOC on Paved Roads as Proportion of VOC on: Paved Road in Bad Condition	Gravel Road in Good Condition
Passenger Car	Honduras (80)	0.112			66.9%	70.8%
	Indonesia (80)	0.264			61.-72%	99.2%
	Tunisia (78)	0.125			95.1%	86.3%
Bus-unspec.	Honduras (80)	0.205			66.7%	74.5%
	Tunisia (78)	0.319			91.7%	81.9%
Bus-Light	Indonesia (80)	0.220			53-63%	98.6%
Bus-Heavy	Indonesia (80)	0.354			49-59%	94.3%
Trucks-6 ton	Senegal (74)	0.503	0.168		n.a.	85.1%
Trucks-10 ton	Senegal (74)	0.647	0.129		n.a.	85.4%
Trucks-25 ton	Senegal (74)	0.962	0.076		n.a.	85.9%
Truck-Light	Indonesia (80)	0.238			51-61%	98.7%
Truck-Med.	Indonesia (80)	0.283			49-59%	94.3%
Trucks-Unsp.	Honduras (80)	0.346			66.7%	85.7%
	Tunisia (78)	0.222			91.6%	79.1%

Critical Values of Average Daily Traffic

N=10 G= 5 I=10 1/

VOC ($/KM)	VOCS %	CI ($/KM) 8000	10000	18000	20000	25000	35000	50000	75000	125000	200000	250000
0.10	0.05	561	701	1263	1403	1754	2455	3507	5261	8768	14029	17536
0.10	0.10	281	351	631	701	877	1228	1754	2630	4384	7014	8768
0.10	0.15	187	234	421	468	585	818	1169	1754	2923	4676	5845
0.10	0.25	112	140	253	281	351	491	701	1052	1754	2806	3507
0.10	0.35	80	100	180	200	251	351	501	752	1253	2004	2505
0.10	0.50	56	70	126	140	175	246	351	526	877	1403	1754
0.10	0.75	37	47	84	94	117	164	234	351	585	935	1169
0.25	0.05	224	281	505	561	701	982	1403	2104	3507	5611	7014
0.25	0.10	112	140	253	281	351	491	701	1052	1754	2806	3507
0.25	0.15	75	94	168	187	234	327	468	701	1169	1870	2338
0.25	0.25	45	56	101	112	140	196	281	421	701	1122	1403
0.25	0.35	32	40	72	80	100	140	200	301	501	802	1002
0.25	0.50	22	28	51	56	70	98	140	210	351	561	701
0.25	0.75	15	19	34	37	47	65	94	140	234	374	468
0.50	0.05	112	140	253	281	351	491	701	1052	1754	2806	3507
0.50	0.10	56	70	126	140	175	246	351	526	877	1403	1754
0.50	0.15	37	47	84	94	117	164	234	351	585	935	1169
0.50	0.25	22	28	51	56	70	98	140	210	351	561	701
0.50	0.35	16	20	36	40	50	70	100	150	251	401	501
0.50	0.50	11	14	25	28	35	49	70	105	175	281	351
0.50	0.75	7	9	17	19	23	33	47	70	117	187	234
1.00	0.05	56	70	126	140	175	246	351	526	877	1403	1754
1.00	0.10	28	35	63	70	88	123	175	263	438	701	877
1.00	0.15	19	23	42	47	58	82	117	175	292	468	585
1.00	0.25	11	14	25	28	35	49	70	105	175	281	351
1.00	0.35	8	10	18	20	25	35	50	75	125	200	251
1.00	0.50	6	7	13	14	18	25	35	53	88	140	175
1.00	0.75	4	5	8	9	12	16	23	35	58	94	117
2.00	0.05	28	35	63	70	88	123	175	263	438	701	877
2.00	0.10	14	18	32	35	44	61	88	132	219	351	438
2.00	0.15	9	12	21	23	29	41	58	88	146	234	292
2.00	0.25	6	7	13	14	18	25	35	53	88	140	175
2.00	0.35	4	5	9	10	13	18	25	38	63	100	125
2.00	0.50	3	4	6	7	9	12	18	26	44	70	88
2.00	0.75	2	2	4	5	6	8	12	18	29	47	58
4.00	0.05	14	18	32	35	44	61	88	132	219	351	438
4.00	0.10	7	9	16	18	22	31	44	66	110	175	219
4.00	0.15	5	6	11	12	15	20	29	44	73	117	146
4.00	0.25	3	4	6	7	9	12	18	26	44	70	88
4.00	0.35	2	3	5	5	6	9	13	19	31	50	63
4.00	0.50	1	2	3	4	4	6	9	13	22	35	44
4.00	0.75	1	1	2	2	3	4	6	9	15	23	29

1/ Note that the text and Annex M use i and g for the opportunity cost of capital and growth rate of traffic, respectively, while this annex, which is a computer printout, uses I and G.

NB: Additional tables for values of N equal to 20 as well as other variations in G are available in TWD (N-932).

N=10 G= 5 I=11

VOC ($/KM)	VOCS %	CI ($/KM) 8000	10000	18000	20000	25000	35000	50000	75000	125000	200000	250000
0.10	0.05	588	734	1322	1469	1836	2571	3672	5508	9180	14689	18361
0.10	0.10	294	367	661	734	918	1285	1836	2754	4590	7344	9180
0.10	0.15	196	245	441	490	612	857	1224	1836	3060	4896	6120
0.10	0.25	118	147	264	294	367	514	734	1102	1836	2938	3672
0.10	0.35	84	105	189	210	262	367	525	787	1311	2098	2623
0.10	0.50	59	73	132	147	184	257	367	551	918	1469	1836
0.10	0.75	39	49	88	98	122	171	245	367	612	979	1224
0.25	0.05	235	294	529	588	734	1028	1469	2203	3672	5875	7344
0.25	0.10	118	147	264	294	367	514	734	1102	1836	2938	3672
0.25	0.15	78	98	176	196	245	343	490	734	1224	1958	2448
0.25	0.25	47	59	106	118	147	206	294	441	734	1175	1469
0.25	0.35	34	42	76	84	105	147	210	315	525	839	1049
0.25	0.50	24	29	53	59	73	103	147	220	367	588	734
0.25	0.75	16	20	35	39	49	69	98	147	245	392	490
0.50	0.05	118	147	264	294	367	514	734	1102	1836	2938	3672
0.50	0.10	59	73	132	147	184	257	367	551	918	1469	1836
0.50	0.15	39	49	88	98	122	171	245	367	612	979	1224
0.50	0.25	24	29	53	59	73	103	147	220	367	588	734
0.50	0.35	17	21	38	42	52	73	105	157	262	420	525
0.50	0.50	12	15	26	29	37	51	73	110	184	294	367
0.50	0.75	8	10	18	20	24	34	49	73	122	196	245
1.00	0.05	59	73	132	147	184	257	367	551	918	1469	1836
1.00	0.10	29	37	66	73	92	129	184	275	459	734	918
1.00	0.15	20	24	44	49	61	86	122	184	306	490	612
1.00	0.25	12	15	26	29	37	51	73	110	184	294	367
1.00	0.35	8	10	19	21	26	37	52	79	131	210	262
1.00	0.50	6	7	13	15	18	26	37	55	92	147	184
1.00	0.75	4	5	9	10	12	17	24	37	61	98	122
2.00	0.05	29	37	66	73	92	129	184	275	459	734	918
2.00	0.10	15	18	33	37	46	64	92	138	230	367	459
2.00	0.15	10	12	22	24	31	43	61	92	153	245	306
2.00	0.25	6	7	13	15	18	26	37	55	92	147	184
2.00	0.35	4	5	9	10	13	18	26	39	66	105	131
2.00	0.50	3	4	7	7	9	13	18	28	46	73	92
2.00	0.75	2	2	4	5	6	9	12	18	31	49	61
4.00	0.05	15	18	33	37	46	64	92	138	230	367	459
4.00	0.10	7	9	17	18	23	32	46	69	115	184	230
4.00	0.15	5	6	11	12	15	21	31	46	77	122	153
4.00	0.25	3	4	7	7	9	13	18	28	46	73	92
4.00	0.35	2	3	5	5	7	9	13	20	33	52	66
4.00	0.50	1	2	3	4	5	6	9	14	23	37	46
4.00	0.75	1	1	2	2	3	4	6	9	15	24	31

N=10 G= 5 I=12

VOC ($/KM)	VOCS %	CI ($/KM) 8000	10000	18000	20000	25000	35000	50000	75000	125000	200000	250000
0.10	0.05	615	768	1383	1536	1920	2689	3841	5761	9602	15363	19204
0.10	0.10	307	384	691	768	960	1344	1920	2881	4801	7682	9602
0.10	0.15	205	256	461	512	640	896	1280	1920	3201	5121	6401
0.10	0.25	123	154	277	307	384	538	768	1152	1920	3073	3841
0.10	0.35	88	110	196	219	274	384	549	823	1372	2195	2743
0.10	0.50	61	77	138	154	192	269	384	576	960	1536	1920
0.10	0.75	41	51	92	102	128	179	256	384	640	1024	1280
0.25	0.05	246	307	553	615	768	1075	1536	2305	3841	6145	7682
0.25	0.10	123	154	277	307	384	538	768	1152	1920	3073	3841
0.25	0.15	82	102	184	205	256	358	512	768	1280	2048	2561
0.25	0.25	49	61	111	123	154	215	307	461	768	1229	1536
0.25	0.35	35	44	79	88	110	154	219	329	549	878	1097
0.25	0.50	25	31	55	61	77	108	154	230	384	615	768
0.25	0.75	16	20	37	41	51	72	102	154	256	410	512
0.50	0.05	123	154	277	307	384	538	768	1152	1920	3073	3841
0.50	0.10	61	77	138	154	192	269	384	576	960	1536	1920
0.50	0.15	41	51	92	102	128	179	256	384	640	1024	1280
0.50	0.25	25	31	55	61	77	108	154	230	384	615	768
0.50	0.35	18	22	40	44	55	77	110	165	274	439	549
0.50	0.50	12	15	28	31	38	54	77	115	192	307	384
0.50	0.75	8	10	18	20	26	36	51	77	128	205	256
1.00	0.05	61	77	138	154	192	269	384	576	960	1536	1920
1.00	0.10	31	38	69	77	96	134	192	288	480	768	960
1.00	0.15	20	26	46	51	64	90	128	192	320	512	640
1.00	0.25	12	15	28	31	38	54	77	115	192	307	384
1.00	0.35	9	11	20	22	27	38	55	82	137	219	274
1.00	0.50	6	8	14	15	19	27	38	58	96	154	192
1.00	0.75	4	5	9	10	13	18	26	38	64	102	128
2.00	0.05	31	38	69	77	96	134	192	288	480	768	960
2.00	0.10	15	19	35	38	48	67	96	144	240	384	480
2.00	0.15	10	13	23	26	32	45	64	96	160	256	320
2.00	0.25	6	8	14	15	19	27	38	58	96	154	192
2.00	0.35	4	5	10	11	14	19	27	41	69	110	137
2.00	0.50	3	4	7	8	10	13	19	29	48	77	96
2.00	0.75	2	3	5	5	6	9	13	19	32	51	64
4.00	0.05	15	19	35	38	48	67	96	144	240	384	480
4.00	0.10	8	10	17	19	24	34	48	72	120	192	240
4.00	0.15	5	6	12	13	16	22	32	48	80	128	160
4.00	0.25	3	4	7	8	10	13	19	29	48	77	96
4.00	0.35	2	3	5	5	7	10	14	21	34	55	69
4.00	0.50	2	2	3	4	5	7	10	14	24	38	48
4.00	0.75	1	1	2	3	3	4	6	10	16	26	32

N=10 G= 5 I=13

VOC (\$/KM)	VOCS %	CI (\$/KM) 8000	10000	18000	20000	25000	35000	50000	75000	125000	200000	250000
0.10	0.05	642	803	1445	1605	2007	2809	4013	6020	10033	16053	20066
0.10	0.10	321	401	722	803	1003	1405	2007	3010	5016	8026	10033
0.10	0.15	214	268	482	535	669	936	1338	2007	3344	5351	6689
0.10	0.25	128	161	289	321	401	562	803	1204	2007	3211	4013
0.10	0.35	92	115	206	229	287	401	573	860	1433	2293	2867
0.10	0.50	64	80	144	161	201	281	401	602	1003	1605	2007
0.10	0.75	43	54	96	107	134	187	268	401	669	1070	1338
0.25	0.05	257	321	578	642	803	1124	1605	2408	4013	6421	8026
0.25	0.10	128	161	289	321	401	562	803	1204	2007	3211	4013
0.25	0.15	86	107	193	214	268	375	535	803	1338	2140	2675
0.25	0.25	51	64	116	128	161	225	321	482	803	1284	1605
0.25	0.35	37	46	83	92	115	161	229	344	573	917	1147
0.25	0.50	26	32	58	64	80	112	161	241	401	642	803
0.25	0.75	17	21	39	43	54	75	107	161	268	428	535
0.50	0.05	128	161	289	321	401	562	803	1204	2007	3211	4013
0.50	0.10	64	80	144	161	201	281	401	602	1003	1605	2007
0.50	0.15	43	54	96	107	134	187	268	401	669	1070	1338
0.50	0.25	26	32	58	64	80	112	161	241	401	642	803
0.50	0.35	18	23	41	46	57	80	115	172	287	459	573
0.50	0.50	13	16	29	32	40	56	80	120	201	321	401
0.50	0.75	9	11	19	21	27	37	54	80	134	214	268
1.00	0.05	64	80	144	161	201	281	401	602	1003	1605	2007
1.00	0.10	32	40	72	80	100	140	201	301	502	803	1003
1.00	0.15	21	27	48	54	67	94	134	201	334	535	669
1.00	0.25	13	16	29	32	40	56	80	120	201	321	401
1.00	0.35	9	11	21	23	29	40	57	86	143	229	287
1.00	0.50	6	8	14	16	20	28	40	60	100	161	201
1.00	0.75	4	5	10	11	13	19	27	40	67	107	134
2.00	0.05	32	40	72	80	100	140	201	301	502	803	1003
2.00	0.10	16	20	36	40	50	70	100	150	251	401	502
2.00	0.15	11	13	24	27	33	47	67	100	167	268	334
2.00	0.25	6	8	14	16	20	28	40	60	100	161	201
2.00	0.35	5	6	10	11	14	20	29	43	72	115	143
2.00	0.50	3	4	7	8	10	14	20	30	50	80	100
2.00	0.75	2	3	5	5	7	9	13	20	33	54	67
4.00	0.05	16	20	36	40	50	70	100	150	251	401	502
4.00	0.10	8	10	18	20	25	35	50	75	125	201	251
4.00	0.15	5	7	12	13	17	23	33	50	84	134	167
4.00	0.25	3	4	7	8	10	14	20	30	50	80	100
4.00	0.35	2	3	5	6	7	10	14	21	36	57	72
4.00	0.50	2	2	4	4	5	7	10	15	25	40	50
4.00	0.75	1	1	2	3	3	5	7	10	17	27	33

N=10 G= 5 I=14

VOC ($/KM)	VOCS %	CI ($/KM) 8000	10000	18000	20000	25000	35000	50000	75000	125000	200000	250000
0.10	0.05	670	838	1508	1676	2094	2932	4189	6283	10472	16755	20944
0.10	0.10	335	419	754	838	1047	1466	2094	3142	5236	8378	10472
0.10	0.15	223	279	503	559	698	977	1396	2094	3491	5585	6981
0.10	0.25	134	168	302	335	419	586	838	1257	2094	3351	4189
0.10	0.35	96	120	215	239	299	419	598	898	1496	2394	2992
0.10	0.50	67	84	151	168	209	293	419	628	1047	1676	2094
0.10	0.75	45	56	101	112	140	195	279	419	698	1117	1396
0.25	0.05	268	335	603	670	838	1173	1676	2513	4189	6702	8378
0.25	0.10	134	168	302	335	419	586	838	1257	2094	3351	4189
0.25	0.15	89	112	201	223	279	391	559	838	1396	2234	2793
0.25	0.25	54	67	121	134	168	235	335	503	838	1340	1676
0.25	0.35	38	48	86	96	120	168	239	359	598	957	1197
0.25	0.50	27	34	60	67	84	117	168	251	419	670	838
0.25	0.75	18	22	40	45	56	78	112	168	279	447	559
0.50	0.05	134	168	302	335	419	586	838	1257	2094	3351	4189
0.50	0.10	67	84	151	168	209	293	419	628	1047	1676	2094
0.50	0.15	45	56	101	112	140	195	279	419	698	1117	1396
0.50	0.25	27	34	60	67	84	117	168	251	419	670	838
0.50	0.35	19	24	43	48	60	84	120	180	299	479	598
0.50	0.50	13	17	30	34	42	59	84	126	209	335	419
0.50	0.75	9	11	20	22	28	39	56	84	140	223	279
1.00	0.05	67	84	151	168	209	293	419	628	1047	1676	2094
1.00	0.10	34	42	75	84	105	147	209	314	524	838	1047
1.00	0.15	22	28	50	56	70	98	140	209	349	559	698
1.00	0.25	13	17	30	34	42	59	84	126	209	335	419
1.00	0.35	10	12	22	24	30	42	60	90	150	239	299
1.00	0.50	7	8	15	17	21	29	42	63	105	168	209
1.00	0.75	4	6	10	11	14	20	28	42	70	112	140
2.00	0.05	34	42	75	84	105	147	209	314	524	838	1047
2.00	0.10	17	21	38	42	52	73	105	157	262	419	524
2.00	0.15	11	14	25	28	35	49	70	105	175	279	349
2.00	0.25	7	8	15	17	21	29	42	63	105	168	209
2.00	0.35	5	6	11	12	15	21	30	45	75	120	150
2.00	0.50	3	4	8	8	10	15	21	31	52	84	105
2.00	0.75	2	3	5	6	7	10	14	21	35	56	70
4.00	0.05	17	21	38	42	52	73	105	157	262	419	524
4.00	0.10	8	10	19	21	26	37	52	79	131	209	262
4.00	0.15	6	7	13	14	17	24	35	52	87	140	175
4.00	0.25	3	4	8	8	10	15	21	31	52	84	105
4.00	0.35	2	3	5	6	7	10	15	22	37	60	75
4.00	0.50	2	2	4	4	5	7	10	16	26	42	52
4.00	0.75	1	1	3	3	3	5	7	10	17	28	35

N=10 G= 5 I=15

VOC ($/KM)	VOCS %	CI ($/KM) 8000	10000	18000	20000	25000	35000	50000	75000	125000	200000	250000
0.10	0.05	699	874	1572	1747	2184	3058	4368	6552	10920	17472	21840
0.10	0.10	349	437	786	874	1092	1529	2184	3276	5460	8736	10920
0.10	0.15	233	291	524	582	728	1019	1456	2184	3640	5824	7280
0.10	0.25	140	175	314	349	437	612	874	1310	2184	3494	4368
0.10	0.35	100	125	225	250	312	437	624	936	1560	2496	3120
0.10	0.50	70	87	157	175	218	306	437	655	1092	1747	2184
0.10	0.75	47	58	105	116	146	204	291	437	728	1165	1456
0.25	0.05	280	349	629	699	874	1223	1747	2621	4368	6989	8736
0.25	0.10	140	175	314	349	437	612	874	1310	2184	3494	4368
0.25	0.15	93	116	210	233	291	408	582	874	1456	2330	2912
0.25	0.25	56	70	126	140	175	245	349	524	874	1398	1747
0.25	0.35	40	50	90	100	125	175	250	374	624	998	1248
0.25	0.50	28	35	63	70	87	122	175	262	437	699	874
0.25	0.75	19	23	42	47	58	82	116	175	291	466	582
0.50	0.05	140	175	314	349	437	612	874	1310	2184	3494	4368
0.50	0.10	70	87	157	175	218	306	437	655	1092	1747	2184
0.50	0.15	47	58	105	116	146	204	291	437	728	1165	1456
0.50	0.25	28	35	63	70	87	122	175	262	437	699	874
0.50	0.35	20	25	45	50	62	87	125	187	312	499	624
0.50	0.50	14	17	31	35	44	61	87	131	218	349	437
0.50	0.75	9	12	21	23	29	41	58	87	146	233	291
1.00	0.05	70	87	157	175	218	306	437	655	1092	1747	2184
1.00	0.10	35	44	79	87	109	153	218	328	546	874	1092
1.00	0.15	23	29	52	58	73	102	146	218	364	582	728
1.00	0.25	14	17	31	35	44	61	87	131	218	349	437
1.00	0.35	10	12	22	25	31	44	62	94	156	250	312
1.00	0.50	7	9	16	17	22	31	44	66	109	175	218
1.00	0.75	5	6	10	12	15	20	29	44	73	116	146
2.00	0.05	35	44	79	87	109	153	218	328	546	874	1092
2.00	0.10	17	22	39	44	55	76	109	164	273	437	546
2.00	0.15	12	15	26	29	36	51	73	109	182	291	364
2.00	0.25	7	9	16	17	22	31	44	66	109	175	218
2.00	0.35	5	6	11	12	16	22	31	47	78	125	156
2.00	0.50	3	4	8	9	11	15	22	33	55	87	109
2.00	0.75	2	3	5	6	7	10	15	22	36	58	73
4.00	0.05	17	22	39	44	55	76	109	164	273	437	546
4.00	0.10	9	11	20	22	27	38	55	82	136	218	273
4.00	0.15	6	7	13	15	18	25	36	55	91	146	182
4.00	0.25	3	4	8	9	11	15	22	33	55	87	109
4.00	0.35	2	3	6	6	8	11	16	23	39	62	78
4.00	0.50	2	2	4	4	5	8	11	16	27	44	55
4.00	0.75	1	1	3	3	4	5	7	11	18	29	36

N=10 G=5 I=16

VOC ($/KM)	VOCS %	CI ($/KM) 8000	10000	18000	20000	25000	35000	50000	75000	125000	200000	250000
0.10	0.05	728	910	1638	1820	2275	3185	4550	6826	11376	18201	22752
0.10	0.10	364	455	819	910	1138	1593	2275	3413	5688	9101	11376
0.10	0.15	243	303	546	607	758	1062	1517	2275	3792	6067	7584
0.10	0.25	146	182	328	364	455	637	910	1365	2275	3640	4550
0.10	0.35	104	130	234	260	325	455	650	975	1625	2600	3250
0.10	0.50	73	91	164	182	228	319	455	683	1138	1820	2275
0.10	0.75	49	61	109	121	152	212	303	455	758	1213	1517
0.25	0.05	291	364	655	728	910	1274	1820	2730	4550	7281	9101
0.25	0.10	146	182	328	364	455	637	910	1365	2275	3640	4550
0.25	0.15	97	121	218	243	303	425	607	910	1517	2427	3034
0.25	0.25	58	73	131	146	182	255	364	546	910	1456	1820
0.25	0.35	42	52	94	104	130	182	260	390	650	1040	1300
0.25	0.50	29	36	66	73	91	127	182	273	455	728	910
0.25	0.75	19	24	44	49	61	85	121	182	303	485	607
0.50	0.05	146	182	328	364	455	637	910	1365	2275	3640	4550
0.50	0.10	73	91	164	182	228	319	455	683	1138	1820	2275
0.50	0.15	49	61	109	121	152	212	303	455	758	1213	1517
0.50	0.25	29	36	66	73	91	127	182	273	455	728	910
0.50	0.35	21	26	47	52	65	91	130	195	325	520	650
0.50	0.50	15	18	33	36	46	64	91	137	228	364	455
0.50	0.75	10	12	22	24	30	42	61	91	152	243	303
1.00	0.05	73	91	164	182	228	319	455	683	1138	1820	2275
1.00	0.10	36	46	82	91	114	159	228	341	569	910	1138
1.00	0.15	24	30	55	61	76	106	152	228	379	607	758
1.00	0.25	15	18	33	36	46	64	91	137	228	364	455
1.00	0.35	10	13	23	26	33	46	65	98	163	260	325
1.00	0.50	7	9	16	18	23	32	46	68	114	182	228
1.00	0.75	5	6	11	12	15	21	30	46	76	121	152
2.00	0.05	36	46	82	91	114	159	228	341	569	910	1138
2.00	0.10	18	23	41	46	57	80	114	171	284	455	569
2.00	0.15	12	15	27	30	38	53	76	114	190	303	379
2.00	0.25	7	9	16	18	23	32	46	68	114	182	228
2.00	0.35	5	7	12	13	16	23	33	49	81	130	163
2.00	0.50	4	5	8	9	11	16	23	34	57	91	114
2.00	0.75	2	3	5	6	8	11	15	23	38	61	76
4.00	0.05	18	23	41	46	57	80	114	171	284	455	569
4.00	0.10	9	11	20	23	28	40	57	85	142	228	284
4.00	0.15	6	8	14	15	19	27	38	57	95	152	190
4.00	0.25	4	5	8	9	11	16	23	34	57	91	114
4.00	0.35	3	3	6	7	8	11	16	24	41	65	81
4.00	0.50	2	2	4	5	6	8	11	17	28	46	57
4.00	0.75	1	2	3	3	4	5	8	11	19	30	38

N=10 G= 5 I=17

VOC ($/KM)	VOCS %	CI ($/KM) 8000	10000	18000	20000	25000	35000	50000	75000	125000	200000	250000
0.10	0.05	758	947	1705	1894	2368	3315	4736	7104	11840	18944	23680
0.10	0.10	379	474	852	947	1184	1658	2368	3552	5920	9472	11840
0.10	0.15	253	316	568	631	789	1105	1579	2368	3947	6315	7893
0.10	0.25	152	189	341	379	474	663	947	1421	2368	3789	4736
0.10	0.35	108	135	244	271	338	474	677	1015	1691	2706	3383
0.10	0.50	76	95	170	189	237	332	474	710	1184	1894	2368
0.10	0.75	51	63	114	126	158	221	316	474	789	1263	1579
0.25	0.05	303	379	682	758	947	1326	1894	2842	4736	7578	9472
0.25	0.10	152	189	341	379	474	663	947	1421	2368	3789	4736
0.25	0.15	101	126	227	253	316	442	631	947	1579	2526	3157
0.25	0.25	61	76	136	152	189	265	379	568	947	1516	1894
0.25	0.35	43	54	97	108	135	189	271	406	677	1083	1353
0.25	0.50	30	38	68	76	95	133	189	284	474	758	947
0.25	0.75	20	25	45	51	63	88	126	189	316	505	631
0.50	0.05	152	189	341	379	474	663	947	1421	2368	3789	4736
0.50	0.10	76	95	170	189	237	332	474	710	1184	1894	2368
0.50	0.15	51	63	114	126	158	221	316	474	789	1263	1579
0.50	0.25	30	38	68	76	95	133	189	284	474	758	947
0.50	0.35	22	27	49	54	68	95	135	203	338	541	677
0.50	0.50	15	19	34	38	47	66	95	142	237	379	474
0.50	0.75	10	13	23	25	32	44	63	95	158	253	316
1.00	0.05	76	95	170	189	237	332	474	710	1184	1894	2368
1.00	0.10	38	47	85	95	118	166	237	355	592	947	1184
1.00	0.15	25	32	57	63	79	111	158	237	395	631	789
1.00	0.25	15	19	34	38	47	66	95	142	237	379	474
1.00	0.35	11	14	24	27	34	47	68	101	169	271	338
1.00	0.50	8	9	17	19	24	33	47	71	118	189	237
1.00	0.75	5	6	11	13	16	22	32	47	79	126	158
2.00	0.05	38	47	85	95	118	166	237	355	592	947	1184
2.00	0.10	19	24	43	47	59	83	118	178	296	474	592
2.00	0.15	13	16	28	32	39	55	79	118	197	316	395
2.00	0.25	8	9	17	19	24	33	47	71	118	189	237
2.00	0.35	5	7	12	14	17	24	34	51	85	135	169
2.00	0.50	4	5	9	9	12	17	24	36	59	95	118
2.00	0.75	3	3	6	6	8	11	16	24	39	63	79
4.00	0.05	19	24	43	47	59	83	118	178	296	474	592
4.00	0.10	9	12	21	24	30	41	59	89	148	237	296
4.00	0.15	6	8	14	16	20	28	39	59	99	158	197
4.00	0.25	4	5	9	9	12	17	24	36	59	95	118
4.00	0.35	3	3	6	7	8	12	17	25	42	68	85
4.00	0.50	2	2	4	5	6	8	12	18	30	47	59
4.00	0.75	1	2	3	3	4	6	8	12	20	32	39

N=10 G= 5 I=18

VOC ($/KM)	VOCS %	CI ($/KM) 8000	10000	18000	20000	25000	35000	50000	75000	125000	200000	250000
0.10	0.05	788	985	1773	1970	2462	3447	4925	7387	12312	19699	24624
0.10	0.10	394	492	886	985	1231	1724	2462	3694	6156	9849	12312
0.10	0.15	263	328	591	657	821	1149	1642	2462	4104	6566	8208
0.10	0.25	158	197	355	394	492	689	985	1477	2462	3940	4925
0.10	0.35	113	141	253	281	352	492	704	1055	1759	2814	3518
0.10	0.50	79	98	177	197	246	345	492	739	1231	1970	2462
0.10	0.75	53	66	118	131	164	230	328	492	821	1313	1642
0.25	0.05	315	394	709	788	985	1379	1970	2955	4925	7880	9849
0.25	0.10	158	197	355	394	492	689	985	1477	2462	3940	4925
0.25	0.15	105	131	236	263	328	460	657	985	1642	2627	3283
0.25	0.25	63	79	142	158	197	276	394	591	985	1576	1970
0.25	0.35	45	56	101	113	141	197	281	422	704	1126	1407
0.25	0.50	32	39	71	79	98	138	197	295	492	788	985
0.25	0.75	21	26	47	53	66	92	131	197	328	525	657
0.50	0.05	158	197	355	394	492	689	985	1477	2462	3940	4925
0.50	0.10	79	98	177	197	246	345	492	739	1231	1970	2462
0.50	0.15	53	66	118	131	164	230	328	492	821	1313	1642
0.50	0.25	32	39	71	79	98	138	197	295	492	788	985
0.50	0.35	23	28	51	56	70	98	141	211	352	563	704
0.50	0.50	16	20	35	39	49	69	98	148	246	394	492
0.50	0.75	11	13	24	26	33	46	66	98	164	263	328
1.00	0.05	79	98	177	197	246	345	492	739	1231	1970	2462
1.00	0.10	39	49	89	98	123	172	246	369	616	985	1231
1.00	0.15	26	33	59	66	82	115	164	246	410	657	821
1.00	0.25	16	20	35	39	49	69	98	148	246	394	492
1.00	0.35	11	14	25	28	35	49	70	106	176	281	352
1.00	0.50	8	10	18	20	25	34	49	74	123	197	246
1.00	0.75	5	7	12	13	16	23	33	49	82	131	164
2.00	0.05	39	49	89	98	123	172	246	369	616	985	1231
2.00	0.10	20	25	44	49	62	86	123	185	308	492	616
2.00	0.15	13	16	30	33	41	57	82	123	205	328	410
2.00	0.25	8	10	18	20	25	34	49	74	123	197	246
2.00	0.35	6	7	13	14	18	25	35	53	88	141	176
2.00	0.50	4	5	9	10	12	17	25	37	62	98	123
2.00	0.75	3	3	6	7	8	11	16	25	41	66	82
4.00	0.05	20	25	44	49	62	86	123	185	308	492	616
4.00	0.10	10	12	22	25	31	43	62	92	154	246	308
4.00	0.15	7	8	15	16	21	29	41	62	103	164	205
4.00	0.25	4	5	9	10	12	17	25	37	62	98	123
4.00	0.35	3	4	6	7	9	12	18	26	44	70	88
4.00	0.50	2	2	4	5	6	9	12	18	31	49	62
4.00	0.75	1	2	3	3	4	6	8	12	21	33	41

N=10 G= 8 I=10

VOC ($/KM)	VOCS %	CI ($/KM) 8000	10000	18000	20000	25000	35000	50000	75000	125000	200000	250000
0.10	0.05	484	605	1090	1211	1513	2119	3026	4540	7566	12106	15132
0.10	0.10	242	303	545	605	757	1059	1513	2270	3783	6053	7566
0.10	0.15	161	202	363	404	504	706	1009	1513	2522	4035	5044
0.10	0.25	97	121	218	242	303	424	605	908	1513	2421	3026
0.10	0.35	69	86	156	173	216	303	432	649	1081	1729	2162
0.10	0.50	48	61	109	121	151	212	303	454	757	1211	1513
0.10	0.75	32	40	73	81	101	141	202	303	504	807	1009
0.25	0.05	194	242	436	484	605	847	1211	1816	3026	4842	6053
0.25	0.10	97	121	218	242	303	424	605	908	1513	2421	3026
0.25	0.15	65	81	145	161	202	282	404	605	1009	1614	2018
0.25	0.25	39	48	87	97	121	169	242	363	605	968	1211
0.25	0.35	28	35	62	69	86	121	173	259	432	692	865
0.25	0.50	19	24	44	48	61	85	121	182	303	484	605
0.25	0.75	13	16	29	32	40	56	81	121	202	323	404
0.50	0.05	97	121	218	242	303	424	605	908	1513	2421	3026
0.50	0.10	48	61	109	121	151	212	303	454	757	1211	1513
0.50	0.15	32	40	73	81	101	141	202	303	504	807	1009
0.50	0.25	19	24	44	48	61	85	121	182	303	484	605
0.50	0.35	14	17	31	35	43	61	86	130	216	346	432
0.50	0.50	10	12	22	24	30	42	61	91	151	242	303
0.50	0.75	6	8	15	16	20	28	40	61	101	161	202
1.00	0.05	48	61	109	121	151	212	303	454	757	1211	1513
1.00	0.10	24	30	54	61	76	106	151	227	378	605	757
1.00	0.15	16	20	36	40	50	71	101	151	252	404	504
1.00	0.25	10	12	22	24	30	42	61	91	151	242	303
1.00	0.35	7	9	16	17	22	30	43	65	108	173	216
1.00	0.50	5	6	11	12	15	21	30	45	76	121	151
1.00	0.75	3	4	7	8	10	14	20	30	50	81	101
2.00	0.05	24	30	54	61	76	106	151	227	378	605	757
2.00	0.10	12	15	27	30	38	53	76	113	189	303	378
2.00	0.15	8	10	18	20	25	35	50	76	126	202	252
2.00	0.25	5	6	11	12	15	21	30	45	76	121	151
2.00	0.35	3	4	8	9	11	15	22	32	54	86	108
2.00	0.50	2	3	5	6	8	11	15	23	38	61	76
2.00	0.75	2	2	4	4	5	7	10	15	25	40	50
4.00	0.05	12	15	27	30	38	53	76	113	189	303	378
4.00	0.10	6	8	14	15	19	26	38	57	95	151	189
4.00	0.15	4	5	9	10	13	18	25	38	63	101	126
4.00	0.25	2	3	5	6	8	11	15	23	38	61	76
4.00	0.35	2	2	4	4	5	8	11	16	27	43	54
4.00	0.50	1	2	3	3	4	5	8	11	19	30	38
4.00	0.75	1	1	2	2	3	4	5	8	13	20	25

N=10 G= 8 I=11

VOC ($/KM)	VOCS %	CI ($/KM) 6000	10000	16000	20000	25000	35000	50000	75000	125000	200000	250000
0.10	0.05	508	635	1143	1270	1588	2223	3175	4763	7939	12702	15877
0.10	0.10	254	318	572	635	794	1111	1588	2382	3969	6351	7939
0.10	0.15	169	212	381	423	529	741	1058	1588	2646	4234	5292
0.10	0.25	102	127	229	254	318	445	635	953	1588	2540	3175
0.10	0.35	73	91	163	181	227	318	454	680	1134	1815	2268
0.10	0.50	51	64	114	127	159	222	318	476	794	1270	1588
0.10	0.75	34	42	76	85	106	148	212	318	529	847	1058
0.25	0.05	203	254	457	508	635	889	1270	1905	3175	5081	6351
0.25	0.10	102	127	229	254	318	445	635	953	1588	2540	3175
0.25	0.15	68	85	152	169	212	296	423	635	1058	1694	2117
0.25	0.25	41	51	91	102	127	178	254	381	635	1016	1270
0.25	0.35	29	36	65	73	91	127	181	272	454	726	907
0.25	0.50	20	25	46	51	64	89	127	191	318	508	635
0.25	0.75	14	17	30	34	42	59	85	127	212	339	423
0.50	0.05	102	127	229	254	318	445	635	953	1588	2540	3175
0.50	0.10	51	64	114	127	159	222	318	476	794	1270	1588
0.50	0.15	34	42	76	85	106	148	212	318	529	847	1058
0.50	0.25	20	25	46	51	64	89	127	191	318	508	635
0.50	0.35	15	18	33	36	45	64	91	136	227	363	454
0.50	0.50	10	13	23	25	32	44	64	95	159	254	318
0.50	0.75	7	8	15	17	21	30	42	64	106	169	212
1.00	0.05	51	64	114	127	159	222	318	476	794	1270	1588
1.00	0.10	25	32	57	64	79	111	159	238	397	635	794
1.00	0.15	17	21	38	42	53	74	106	159	265	423	529
1.00	0.25	10	13	23	25	32	44	64	95	159	254	318
1.00	0.35	7	9	16	18	23	32	45	68	113	181	227
1.00	0.50	5	6	11	13	16	22	32	48	79	127	159
1.00	0.75	3	4	8	8	11	15	21	32	53	85	106
2.00	0.05	25	32	57	64	79	111	159	238	397	635	794
2.00	0.10	13	16	29	32	40	56	79	119	198	318	397
2.00	0.15	8	11	19	21	26	37	53	79	132	212	265
2.00	0.25	5	6	11	13	16	22	32	48	79	127	159
2.00	0.35	4	5	8	9	11	16	23	34	57	91	113
2.00	0.50	3	3	6	6	8	11	16	24	40	64	79
2.00	0.75	2	2	4	4	5	7	11	16	26	42	53
4.00	0.05	13	16	29	32	40	56	79	119	198	318	397
4.00	0.10	6	8	14	16	20	28	40	60	99	159	198
4.00	0.15	4	5	10	11	13	19	26	40	66	106	132
4.00	0.25	3	3	6	6	8	11	16	24	40	64	79
4.00	0.35	2	2	4	5	6	8	11	17	28	45	57
4.00	0.50	1	2	3	3	4	6	8	12	20	32	40
4.00	0.75	1	1	2	2	3	4	5	8	13	21	26

N=10 G= 8 I=12

VOC ($/KM)	VOCS %	CI ($/KM) 8000	10000	18000	20000	25000	35000	50000	75000	125000	200000	250000
0.10	0.05	533	666	1196	1331	1664	2330	3328	4992	8320	13313	16641
0.10	0.10	266	333	599	666	832	1165	1664	2496	4160	6656	8320
0.10	0.15	178	222	399	444	555	777	1109	1664	2773	4438	5547
0.10	0.25	107	133	240	266	333	466	666	998	1664	2663	3328
0.10	0.35	76	95	171	190	238	333	475	713	1189	1902	2377
0.10	0.50	53	67	120	133	166	233	333	499	832	1331	1664
0.10	0.75	36	44	80	89	111	155	222	333	555	888	1109
0.25	0.05	213	266	479	533	666	932	1331	1997	3328	5325	6656
0.25	0.10	107	133	240	266	333	466	666	998	1664	2663	3328
0.25	0.15	71	89	160	178	222	311	444	666	1109	1775	2219
0.25	0.25	43	53	96	107	133	186	266	399	666	1065	1331
0.25	0.35	30	38	68	76	95	133	190	285	475	761	951
0.25	0.50	21	27	48	53	67	93	133	200	333	533	666
0.25	0.75	14	18	32	36	44	62	89	133	222	355	444
0.50	0.05	107	133	240	266	333	466	666	998	1664	2663	3328
0.50	0.10	53	67	120	133	166	233	333	499	832	1331	1664
0.50	0.15	36	44	80	89	111	155	222	333	555	888	1109
0.50	0.25	21	27	48	53	67	93	133	200	333	533	666
0.50	0.35	15	19	34	38	48	67	95	143	238	380	475
0.50	0.50	11	13	24	27	33	47	67	100	166	266	333
0.50	0.75	7	9	16	18	22	31	44	67	111	178	222
1.00	0.05	53	67	120	133	166	233	333	499	832	1331	1664
1.00	0.10	27	33	60	67	83	116	166	250	416	666	832
1.00	0.15	18	22	40	44	55	78	111	166	277	444	555
1.00	0.25	11	13	24	27	33	47	67	100	166	266	333
1.00	0.35	8	10	17	19	24	33	48	71	119	190	238
1.00	0.50	5	7	12	13	17	23	33	50	83	133	166
1.00	0.75	4	4	8	9	11	16	22	33	55	89	111
2.00	0.05	27	33	60	67	83	116	166	250	416	666	832
2.00	0.10	13	17	30	33	42	58	83	125	208	333	416
2.00	0.15	9	11	20	22	28	39	55	83	139	222	277
2.00	0.25	5	7	12	13	17	23	33	50	83	133	166
2.00	0.35	4	5	9	10	12	17	24	36	59	95	119
2.00	0.50	3	3	6	7	8	12	17	25	42	67	83
2.00	0.75	2	2	4	4	6	8	11	17	28	44	55
4.00	0.05	13	17	30	33	42	58	83	125	208	333	416
4.00	0.10	7	8	15	17	21	29	42	62	104	166	208
4.00	0.15	4	6	10	11	14	19	28	42	69	111	139
4.00	0.25	3	3	6	7	8	12	17	25	42	67	83
4.00	0.35	2	2	4	5	6	8	12	18	30	48	59
4.00	0.50	1	2	3	3	4	6	8	12	21	33	42
4.00	0.75	1	1	2	2	3	4	6	8	14	22	28

N=10 G= 8 I=13

VOC ($/KM)	VOCS %	C1 ($/KM) 8000	10000	18000	20000	25000	35000	50000	75000	125000	200000	250000
0.10	0.05	558	697	1254	1394	1742	2439	3485	5227	8711	13938	17423
0.10	0.10	279	348	627	697	871	1220	1742	2613	4356	6969	8711
0.10	0.15	186	232	418	465	581	813	1162	1742	2904	4646	5808
0.10	0.25	112	139	251	279	348	488	697	1045	1742	2788	3485
0.10	0.35	80	100	179	199	249	348	498	747	1244	1991	2489
0.10	0.50	56	70	125	139	174	244	348	523	871	1394	1742
0.10	0.75	37	46	84	93	116	163	232	348	581	929	1162
0.25	0.05	223	279	502	558	697	976	1394	2091	3485	5575	6969
0.25	0.10	112	139	251	279	348	488	697	1045	1742	2788	3485
0.25	0.15	74	93	167	186	232	325	465	697	1162	1858	2323
0.25	0.25	45	56	100	112	139	195	279	418	697	1115	1394
0.25	0.35	32	40	72	80	100	139	199	299	498	796	996
0.25	0.50	22	28	50	56	70	98	139	209	348	558	697
0.25	0.75	15	19	33	37	46	65	93	139	232	372	465
0.50	0.05	112	139	251	279	348	488	697	1045	1742	2788	3485
0.50	0.10	56	70	125	139	174	244	348	523	871	1394	1742
0.50	0.15	37	46	84	93	116	163	232	348	581	929	1162
0.50	0.25	22	28	50	56	70	98	139	209	348	558	697
0.50	0.35	16	20	36	40	50	70	100	149	249	398	498
0.50	0.50	11	14	25	28	35	49	70	105	174	279	348
0.50	0.75	7	9	17	19	23	33	46	70	116	186	232
1.00	0.05	56	70	125	139	174	244	348	523	871	1394	1742
1.00	0.10	28	35	63	70	87	122	174	261	436	697	871
1.00	0.15	19	23	42	46	58	81	116	174	290	465	581
1.00	0.25	11	14	25	28	35	49	70	105	174	279	348
1.00	0.35	8	10	18	20	25	35	50	75	124	199	249
1.00	0.50	6	7	13	14	17	24	35	52	87	139	174
1.00	0.75	4	5	8	9	12	16	23	35	58	93	116
2.00	0.05	28	35	63	70	87	122	174	261	436	697	871
2.00	0.10	14	17	31	35	44	61	87	131	218	348	436
2.00	0.15	9	12	21	23	29	41	58	87	145	232	290
2.00	0.25	6	7	13	14	17	24	35	52	87	139	174
2.00	0.35	4	5	9	10	12	17	25	37	62	100	124
2.00	0.50	3	3	6	7	9	12	17	26	44	70	87
2.00	0.75	2	2	4	5	6	8	12	17	29	46	58
4.00	0.05	14	17	31	35	44	61	87	131	218	348	436
4.00	0.10	7	9	16	17	22	30	44	65	109	174	218
4.00	0.15	5	6	10	12	15	20	29	44	73	116	145
4.00	0.25	3	3	6	7	9	12	17	26	44	70	87
4.00	0.35	2	2	4	5	6	9	12	19	31	50	62
4.00	0.50	1	2	3	3	4	6	9	13	22	35	44
4.00	0.75	1	1	2	2	3	4	6	9	15	23	29

N=10 G= 8 I=14

VOC ($/KM)	VOCS %	CI ($/KM) 8000	10000	15000	20000	25000	35000	50000	75000	125000	200000	250000
0.10	0.05	503	729	1312	1458	1822	2551	3644	5467	9111	14578	18222
0.10	0.10	292	364	656	729	911	1276	1822	2733	4556	7289	9111
0.10	0.15	194	243	437	486	607	850	1215	1822	3037	4859	6074
0.10	0.25	117	146	262	292	364	510	729	1093	1822	2916	3644
0.10	0.35	83	104	187	208	260	364	521	781	1302	2083	2603
0.10	0.50	58	73	131	146	182	255	364	547	911	1458	1822
0.10	0.75	39	49	87	97	121	170	243	364	607	972	1215
0.25	0.05	233	292	525	583	729	1020	1458	2187	3644	5831	7289
0.25	0.10	117	146	262	292	364	510	729	1093	1822	2916	3644
0.25	0.15	78	97	175	194	243	340	486	729	1215	1944	2430
0.25	0.25	47	58	105	117	146	204	292	437	729	1166	1458
0.25	0.35	33	42	75	83	104	146	208	312	521	833	1041
0.25	0.50	23	29	52	58	73	102	146	219	364	583	729
0.25	0.75	16	19	35	39	49	68	97	146	243	389	486
0.50	0.05	117	146	262	292	364	510	729	1093	1822	2916	3644
0.50	0.10	58	73	131	146	182	255	364	547	911	1458	1822
0.50	0.15	39	49	87	97	121	170	243	364	607	972	1215
0.50	0.25	23	29	52	58	73	102	146	219	364	583	729
0.50	0.35	17	21	37	42	52	73	104	156	260	417	521
0.50	0.50	12	15	26	29	36	51	73	109	182	292	364
0.50	0.75	8	10	17	19	24	34	49	73	121	194	243
1.00	0.05	58	73	131	146	182	255	364	547	911	1458	1822
1.00	0.10	29	36	66	73	91	128	182	273	456	729	911
1.00	0.15	19	24	44	49	61	85	121	182	304	486	607
1.00	0.25	12	15	26	29	36	51	73	109	182	292	364
1.00	0.35	8	10	19	21	26	36	52	78	130	208	260
1.00	0.50	6	7	13	15	18	26	36	55	91	146	182
1.00	0.75	4	5	9	10	12	17	24	36	61	97	121
2.00	0.05	29	36	66	73	91	128	182	273	456	729	911
2.00	0.10	15	18	33	36	46	64	91	137	228	364	456
2.00	0.15	10	12	22	24	30	43	61	91	152	243	304
2.00	0.25	6	7	13	15	18	26	36	55	91	146	182
2.00	0.35	4	5	9	10	13	18	26	39	65	104	130
2.00	0.50	3	4	7	7	9	13	18	27	46	73	91
2.00	0.75	2	2	4	5	6	9	12	18	30	49	61
4.00	0.05	15	18	33	36	46	64	91	137	228	364	456
4.00	0.10	7	9	16	18	23	32	46	68	114	182	228
4.00	0.15	5	6	11	12	15	21	30	46	76	121	152
4.00	0.25	3	4	7	7	9	13	18	27	46	73	91
4.00	0.35	2	3	5	5	7	9	13	20	33	52	65
4.00	0.50	1	2	3	4	5	6	9	14	23	36	46
4.00	0.75	1	1	2	2	3	4	6	9	15	24	30

N=10 G= 8 I=15

VOC ($/KM)	VOCS %	CI ($/KM) 8000	10000	18000	20000	25000	35000	50000	75000	125000	200000	250000
0.10	0.05	609	762	1371	1523	1904	2665	3808	5712	9519	15231	19039
0.10	0.10	305	381	685	762	952	1333	1904	2856	4760	7616	9519
0.10	0.15	203	254	457	508	635	888	1269	1904	3173	5077	6346
0.10	0.25	122	152	274	305	381	533	762	1142	1904	3046	3808
0.10	0.35	87	109	196	218	272	381	544	816	1360	2176	2720
0.10	0.50	61	76	137	152	190	267	381	571	952	1523	1904
0.10	0.75	41	51	91	102	127	178	254	381	635	1015	1269
0.25	0.05	244	305	548	609	762	1066	1523	2285	3808	6092	7616
0.25	0.10	122	152	274	305	381	533	762	1142	1904	3046	3808
0.25	0.15	81	102	183	203	254	355	508	762	1269	2031	2539
0.25	0.25	49	61	110	122	152	213	305	457	762	1218	1523
0.25	0.35	35	44	78	87	109	152	218	326	544	870	1088
0.25	0.50	24	30	55	61	76	107	152	228	381	609	762
0.25	0.75	16	20	37	41	51	71	102	152	254	406	508
0.50	0.05	122	152	274	305	381	533	762	1142	1904	3046	3808
0.50	0.10	61	76	137	152	190	267	381	571	952	1523	1904
0.50	0.15	41	51	91	102	127	178	254	381	635	1015	1269
0.50	0.25	24	30	55	61	76	107	152	228	381	609	762
0.50	0.35	17	22	39	44	54	76	109	163	272	435	544
0.50	0.50	12	15	27	30	38	53	76	114	190	305	381
0.50	0.75	8	10	18	20	25	36	51	76	127	203	254
1.00	0.05	61	76	137	152	190	267	381	571	952	1523	1904
1.00	0.10	30	38	69	76	95	133	190	286	476	762	952
1.00	0.15	20	25	46	51	63	89	127	190	317	508	635
1.00	0.25	12	15	27	30	38	53	76	114	190	305	381
1.00	0.35	9	11	20	22	27	38	54	82	136	218	272
1.00	0.50	6	8	14	15	19	27	38	57	95	152	190
1.00	0.75	4	5	9	10	13	18	25	38	63	102	127
2.00	0.05	30	38	69	76	95	133	190	286	476	762	952
2.00	0.10	15	19	34	38	48	67	95	143	238	381	476
2.00	0.15	10	13	23	25	32	44	63	95	159	254	317
2.00	0.25	6	8	14	15	19	27	38	57	95	152	190
2.00	0.35	4	5	10	11	14	19	27	41	68	109	136
2.00	0.50	3	4	7	8	10	13	19	29	48	76	95
2.00	0.75	2	3	5	5	6	9	13	19	32	51	63
4.00	0.05	15	19	34	38	48	67	95	143	238	381	476
4.00	0.10	8	10	17	19	24	33	48	71	119	190	238
4.00	0.15	5	6	11	13	16	22	32	48	79	127	159
4.00	0.25	3	4	7	8	10	13	19	29	48	76	95
4.00	0.35	2	3	5	5	7	10	14	20	34	54	68
4.00	0.50	2	2	3	4	5	7	10	14	24	38	48
4.00	0.75	1	1	2	3	3	4	6	10	16	25	32

N=10 G= 8 I=16

VOC ($/KM)	VOCS %	CI ($/KM) 6000	10000	18000	20000	25000	35000	50000	75000	125000	200000	250000
0.10	0.05	636	795	1431	1590	1987	2782	3975	5962	9936	15898	19873
0.10	0.10	318	397	715	795	994	1391	1987	2981	4968	7949	9936
0.10	0.15	212	265	477	530	662	927	1325	1987	3312	5299	6624
0.10	0.25	127	159	286	318	397	556	795	1192	1987	3180	3975
0.10	0.35	91	114	204	227	284	397	568	852	1419	2271	2839
0.10	0.50	64	79	143	159	199	278	397	596	994	1590	1987
0.10	0.75	42	53	95	106	132	185	265	397	662	1060	1325
0.25	0.05	254	318	572	636	795	1113	1590	2385	3975	6359	7949
0.25	0.10	127	159	286	318	397	556	795	1192	1987	3180	3975
0.25	0.15	85	106	191	212	265	371	530	795	1325	2120	2650
0.25	0.25	51	64	114	127	159	223	318	477	795	1272	1590
0.25	0.35	36	45	82	91	114	159	227	341	568	908	1136
0.25	0.50	25	32	57	64	79	111	159	238	397	636	795
0.25	0.75	17	21	38	42	53	74	106	159	265	424	530
0.50	0.05	127	159	286	318	397	556	795	1192	1987	3180	3975
0.50	0.10	64	79	143	159	199	278	397	596	994	1590	1987
0.50	0.15	42	53	95	106	132	185	265	397	662	1060	1325
0.50	0.25	25	32	57	64	79	111	159	238	397	636	795
0.50	0.35	18	23	41	45	57	79	114	170	284	454	568
0.50	0.50	13	16	29	32	40	56	79	119	199	318	397
0.50	0.75	8	11	19	21	26	37	53	79	132	212	265
1.00	0.05	64	79	143	159	199	278	397	596	994	1590	1987
1.00	0.10	32	40	72	79	99	139	199	298	497	795	994
1.00	0.15	21	26	48	53	66	93	132	199	331	530	662
1.00	0.25	13	16	29	32	40	56	79	119	199	318	397
1.00	0.35	9	11	20	23	28	40	57	85	142	227	284
1.00	0.50	6	8	14	16	20	28	40	60	99	159	199
1.00	0.75	4	5	10	11	13	19	26	40	66	106	132
2.00	0.05	32	40	72	79	99	139	199	298	497	795	994
2.00	0.10	16	20	36	40	50	70	99	149	248	397	497
2.00	0.15	11	13	24	26	33	46	66	99	166	265	331
2.00	0.25	6	8	14	16	20	28	40	60	99	159	199
2.00	0.35	5	6	10	11	14	20	28	43	71	114	142
2.00	0.50	3	4	7	8	10	14	20	30	50	79	99
2.00	0.75	2	3	5	5	7	9	13	20	33	53	66
4.00	0.05	16	20	36	40	50	70	99	149	248	397	497
4.00	0.10	8	10	18	20	25	35	50	75	124	199	248
4.00	0.15	5	7	12	13	17	23	33	50	83	132	166
4.00	0.25	3	4	7	8	10	14	20	30	50	79	99
4.00	0.35	2	3	5	6	7	10	14	21	35	57	71
4.00	0.50	2	2	4	4	5	7	10	15	25	40	50
4.00	0.75	1	1	2	3	3	5	7	10	17	26	33

N=10 G= 8 I=17

VOC ($/KM)	VOCS %	CI ($/KM) 8000	10000	18000	20000	25000	35000	50000	75000	125000	200000	250000
0.10	0.05	663	829	1492	1658	2072	2901	4145	6217	10361	16578	20723
0.10	0.10	332	414	746	829	1036	1451	2072	3108	5181	8289	10361
0.10	0.15	221	276	497	553	691	967	1382	2072	3454	5526	6908
0.10	0.25	133	166	298	332	414	580	829	1243	2072	3316	4145
0.10	0.35	95	118	213	237	296	414	592	888	1480	2368	2960
0.10	0.50	66	83	149	166	207	290	414	622	1036	1658	2072
0.10	0.75	44	55	99	111	138	193	276	414	691	1105	1382
0.25	0.05	265	332	597	663	829	1160	1658	2487	4145	6631	8289
0.25	0.10	133	166	298	332	414	580	829	1243	2072	3316	4145
0.25	0.15	88	111	199	221	276	387	553	829	1382	2210	2763
0.25	0.25	53	66	119	133	166	232	332	497	829	1326	1658
0.25	0.35	38	47	85	95	118	166	237	355	592	947	1184
0.25	0.50	27	33	60	66	83	116	166	249	414	663	829
0.25	0.75	18	22	40	44	55	77	111	166	276	442	553
0.50	0.05	133	166	298	332	414	580	829	1243	2072	3316	4145
0.50	0.10	66	83	149	166	207	290	414	622	1036	1658	2072
0.50	0.15	44	55	99	111	138	193	276	414	691	1105	1382
0.50	0.25	27	33	60	66	83	116	166	249	414	663	829
0.50	0.35	19	24	43	47	59	83	118	178	296	474	592
0.50	0.50	13	17	30	33	41	58	83	124	207	332	414
0.50	0.75	9	11	20	22	28	39	55	83	138	221	276
1.00	0.05	66	83	149	166	207	290	414	622	1036	1658	2072
1.00	0.10	33	41	75	83	104	145	207	311	518	829	1036
1.00	0.15	22	28	50	55	69	97	138	207	345	553	691
1.00	0.25	13	17	30	33	41	58	83	124	207	332	414
1.00	0.35	9	12	21	24	30	41	59	89	148	237	296
1.00	0.50	7	8	15	17	21	29	41	62	104	166	207
1.00	0.75	4	6	10	11	14	19	28	41	69	111	138
2.00	0.05	33	41	75	83	104	145	207	311	518	829	1036
2.00	0.10	17	21	37	41	52	73	104	155	259	414	518
2.00	0.15	11	14	25	28	35	48	69	104	173	276	345
2.00	0.25	7	8	15	17	21	29	41	62	104	166	207
2.00	0.35	5	6	11	12	15	21	30	44	74	118	148
2.00	0.50	3	4	7	8	10	15	21	31	52	83	104
2.00	0.75	2	3	5	6	7	10	14	21	35	55	69
4.00	0.05	17	21	37	41	52	73	104	155	259	414	518
4.00	0.10	8	10	19	21	26	36	52	78	130	207	259
4.00	0.15	6	7	12	14	17	24	35	52	86	138	173
4.00	0.25	3	4	7	8	10	15	21	31	52	83	104
4.00	0.35	2	3	5	6	7	10	15	22	37	59	74
4.00	0.50	2	2	4	4	5	7	10	16	26	41	52
4.00	0.75	1	1	2	3	3	5	7	10	17	28	35

N=10 G= 8 I=18

VOC ($/KM)	VOCS %	CI ($/KM) 8000	10000	18000	20000	25000	35000	50000	75000	125000	200000	250000
0.10	0.05	691	864	1554	1727	2159	3023	4318	6477	10795	17271	21589
0.10	0.10	345	432	777	864	1079	1511	2159	3238	5397	8636	10795
0.10	0.15	230	288	518	576	720	1008	1439	2159	3598	5757	7196
0.10	0.25	138	173	311	345	432	605	864	1295	2159	3454	4318
0.10	0.35	99	123	222	247	308	432	617	925	1542	2467	3084
0.10	0.50	69	86	155	173	216	302	432	648	1079	1727	2159
0.10	0.75	46	58	104	115	144	202	288	432	720	1151	1439
0.25	0.05	276	345	622	691	864	1209	1727	2591	4318	6909	8636
0.25	0.10	138	173	311	345	432	605	864	1295	2159	3454	4318
0.25	0.15	92	115	207	230	288	403	576	864	1439	2303	2879
0.25	0.25	55	69	124	138	173	242	345	518	864	1382	1727
0.25	0.35	39	49	89	99	123	173	247	370	617	987	1234
0.25	0.50	28	35	62	69	86	121	173	259	432	691	864
0.25	0.75	18	23	41	46	58	81	115	173	288	461	576
0.50	0.05	138	173	311	345	432	605	864	1295	2159	3454	4318
0.50	0.10	69	86	155	173	216	302	432	648	1079	1727	2159
0.50	0.15	46	58	104	115	144	202	288	432	720	1151	1439
0.50	0.25	28	35	62	69	86	121	173	259	432	691	864
0.50	0.35	20	25	44	49	62	86	123	185	308	493	617
0.50	0.50	14	17	31	35	43	60	86	130	216	345	432
0.50	0.75	9	12	21	23	29	40	58	86	144	230	288
1.00	0.05	69	86	155	173	216	302	432	648	1079	1727	2159
1.00	0.10	35	43	78	86	108	151	216	324	540	864	1079
1.00	0.15	23	29	52	58	72	101	144	216	360	576	720
1.00	0.25	14	17	31	35	43	60	86	130	216	345	432
1.00	0.35	10	12	22	25	31	43	62	93	154	247	308
1.00	0.50	7	9	16	17	22	30	43	65	108	173	216
1.00	0.75	5	6	10	12	14	20	29	43	72	115	144
2.00	0.05	35	43	78	86	108	151	216	324	540	864	1079
2.00	0.10	17	22	39	43	54	76	108	162	270	432	540
2.00	0.15	12	14	26	29	36	50	72	108	180	288	360
2.00	0.25	7	9	16	17	22	30	43	65	108	173	216
2.00	0.35	5	6	11	12	15	22	31	46	77	123	154
2.00	0.50	3	4	8	9	11	15	22	32	54	86	108
2.00	0.75	2	3	5	6	7	10	14	22	36	58	72
4.00	0.05	17	22	39	43	54	76	108	162	270	432	540
4.00	0.10	9	11	19	22	27	38	54	81	135	216	270
4.00	0.15	6	7	13	14	18	25	36	54	90	144	180
4.00	0.25	3	4	8	9	11	15	22	32	54	86	108
4.00	0.35	2	3	6	6	8	11	15	23	39	62	77
4.00	0.50	2	2	4	4	5	8	11	16	27	43	54
4.00	0.75	1	1	3	3	4	5	7	11	18	29	36

N=10 G=10 I=10

VOC (\$/KM)	VOCS %	CI (\$/KM) 8000	10000	18000	20000	25000	35000	50000	75000	125000	200000	250000
0.10	0.05	438	548	986	1096	1370	1918	2740	4110	6849	10959	13699
0.10	0.10	219	274	493	548	685	959	1370	2055	3425	5479	6849
0.10	0.15	146	183	329	365	457	639	913	1370	2283	3653	4566
0.10	0.25	88	110	197	219	274	384	548	822	1370	2192	2740
0.10	0.35	63	78	141	157	196	274	391	587	978	1566	1957
0.10	0.50	44	55	99	110	137	192	274	411	685	1096	1370
0.10	0.75	29	37	66	73	91	128	183	274	457	731	913
0.25	0.05	175	219	395	438	548	767	1096	1644	2740	4384	5479
0.25	0.10	88	110	197	219	274	384	548	822	1370	2192	2740
0.25	0.15	58	73	132	146	183	256	365	548	913	1461	1826
0.25	0.25	35	44	79	88	110	153	219	329	548	877	1096
0.25	0.35	25	31	56	63	78	110	157	235	391	626	783
0.25	0.50	18	22	39	44	55	77	110	164	274	438	548
0.25	0.75	12	15	26	29	37	51	73	110	183	292	365
0.50	0.05	88	110	197	219	274	384	548	822	1370	2192	2740
0.50	0.10	44	55	99	110	137	192	274	411	685	1096	1370
0.50	0.15	29	37	66	73	91	128	183	274	457	731	913
0.50	0.25	18	22	39	44	55	77	110	164	274	438	548
0.50	0.35	13	16	28	31	39	55	78	117	196	313	391
0.50	0.50	9	11	20	22	27	38	55	82	137	219	274
0.50	0.75	6	7	13	15	18	26	37	55	91	146	183
1.00	0.05	44	55	99	110	137	192	274	411	685	1096	1370
1.00	0.10	22	27	49	55	68	96	137	205	342	548	685
1.00	0.15	15	18	33	37	46	64	91	137	228	365	457
1.00	0.25	9	11	20	22	27	38	55	82	137	219	274
1.00	0.35	6	8	14	16	20	27	39	59	98	157	196
1.00	0.50	4	5	10	11	14	19	27	41	68	110	137
1.00	0.75	3	4	7	7	9	13	18	27	46	73	91
2.00	0.05	22	27	49	55	68	96	137	205	342	548	685
2.00	0.10	11	14	25	27	34	48	68	103	171	274	342
2.00	0.15	7	9	16	18	23	32	46	68	114	183	228
2.00	0.25	4	5	10	11	14	19	27	41	68	110	137
2.00	0.35	3	4	7	8	10	14	20	29	49	78	98
2.00	0.50	2	3	5	5	7	10	14	21	34	55	68
2.00	0.75	1	2	3	4	5	6	9	14	23	37	46
4.00	0.05	11	14	25	27	34	48	68	103	171	274	342
4.00	0.10	5	7	12	14	17	24	34	51	86	137	171
4.00	0.15	4	5	8	9	11	16	23	34	57	91	114
4.00	0.25	2	3	5	5	7	10	14	21	34	55	68
4.00	0.35	2	2	4	4	5	7	10	15	24	39	49
4.00	0.50	1	1	2	3	3	5	7	10	17	27	34
4.00	0.75	1	1	2	2	2	3	5	7	11	18	23

N=10 G=10 I=11

VOC ($/KM)	VOCS %	CI ($/KM) 8000	10000	18000	20000	25000	35000	50000	75000	125000	200000	250000
0.10	0.05	461	576	1036	1151	1439	2015	2879	4318	7196	11514	14393
0.10	0.10	230	288	518	576	720	1007	1439	2159	3598	5757	7196
0.10	0.15	154	192	345	384	480	672	960	1439	2399	3838	4798
0.10	0.25	92	115	207	230	288	403	576	864	1439	2303	2879
0.10	0.35	66	82	148	164	206	288	411	617	1028	1645	2056
0.10	0.50	46	58	104	115	144	201	288	432	720	1151	1439
0.10	0.75	31	38	69	77	96	134	192	288	480	768	960
0.25	0.05	184	230	415	461	576	806	1151	1727	2879	4606	5757
0.25	0.10	92	115	207	230	288	403	576	864	1439	2303	2879
0.25	0.15	61	77	138	154	192	269	384	576	960	1535	1919
0.25	0.25	37	46	83	92	115	161	230	345	576	921	1151
0.25	0.35	26	33	59	66	82	115	164	247	411	658	822
0.25	0.50	18	23	41	46	58	81	115	173	288	461	576
0.25	0.75	12	15	28	31	38	54	77	115	192	307	384
0.50	0.05	92	115	207	230	288	403	576	864	1439	2303	2879
0.50	0.10	46	58	104	115	144	201	288	432	720	1151	1439
0.50	0.15	31	38	69	77	96	134	192	288	480	768	960
0.50	0.25	18	23	41	46	58	81	115	173	288	461	576
0.50	0.35	13	16	30	33	41	58	82	123	206	329	411
0.50	0.50	9	12	21	23	29	40	58	86	144	230	288
0.50	0.75	6	8	14	15	19	27	38	58	96	154	192
1.00	0.05	46	58	104	115	144	201	288	432	720	1151	1439
1.00	0.10	23	29	52	58	72	101	144	216	360	576	720
1.00	0.15	15	19	35	38	48	67	96	144	240	384	480
1.00	0.25	9	12	21	23	29	40	58	86	144	230	288
1.00	0.35	7	8	15	16	21	29	41	62	103	164	206
1.00	0.50	5	6	10	12	14	20	29	43	72	115	144
1.00	0.75	3	4	7	8	10	13	19	29	48	77	96
2.00	0.05	23	29	52	58	72	101	144	216	360	576	720
2.00	0.10	12	14	26	29	36	50	72	108	180	288	360
2.00	0.15	8	10	17	19	24	34	48	72	120	192	240
2.00	0.25	5	6	10	12	14	20	29	43	72	115	144
2.00	0.35	3	4	7	8	10	14	21	31	51	82	103
2.00	0.50	2	3	5	6	7	10	14	22	36	58	72
2.00	0.75	2	2	3	4	5	7	10	14	24	38	48
4.00	0.05	12	14	26	29	36	50	72	108	180	288	360
4.00	0.10	6	7	13	14	18	25	36	54	90	144	180
4.00	0.15	4	5	9	10	12	17	24	36	60	96	120
4.00	0.25	2	3	5	6	7	10	14	22	36	58	72
4.00	0.35	2	2	4	4	5	7	10	15	26	41	51
4.00	0.50	1	1	3	3	4	5	7	11	18	29	36
4.00	0.75	1	1	2	2	2	3	5	7	12	19	24

N=10 G=10 I=12

VOC (\$/KM)	VOCS %	CI (\$/KM) 8000	10000	16000	20000	25000	35000	50000	75000	125000	200000	250000
0.10	0.05	483	604	1088	1206	1511	2115	3021	4532	7553	12084	15106
0.10	0.10	242	302	544	604	755	1057	1511	2266	3776	6042	7553
0.10	0.15	161	201	363	403	504	705	1007	1511	2518	4028	5035
0.10	0.25	97	121	218	242	302	423	604	906	1511	2417	3021
0.10	0.35	69	86	155	173	216	302	432	647	1079	1726	2158
0.10	0.50	48	60	109	121	151	211	302	453	755	1208	1511
0.10	0.75	32	40	73	81	101	141	201	302	504	806	1007
0.25	0.05	193	242	435	483	604	846	1208	1813	3021	4834	6042
0.25	0.10	97	121	218	242	302	423	604	906	1511	2417	3021
0.25	0.15	64	81	145	161	201	282	403	604	1007	1611	2014
0.25	0.25	39	48	87	97	121	169	242	363	604	967	1208
0.25	0.35	28	35	62	69	86	121	173	259	432	691	863
0.25	0.50	19	24	44	48	60	85	121	181	302	483	604
0.25	0.75	13	16	29	32	40	56	81	121	201	322	403
0.50	0.05	97	121	218	242	302	423	604	906	1511	2417	3021
0.50	0.10	48	60	109	121	151	211	302	453	755	1208	1511
0.50	0.15	32	40	73	81	101	141	201	302	504	806	1007
0.50	0.25	19	24	44	48	60	85	121	181	302	483	604
0.50	0.35	14	17	31	35	43	60	86	129	216	345	432
0.50	0.50	10	12	22	24	30	42	60	91	151	242	302
0.50	0.75	6	8	15	16	20	28	40	60	101	161	201
1.00	0.05	48	60	109	121	151	211	302	453	755	1208	1511
1.00	0.10	24	30	54	60	76	106	151	227	378	604	755
1.00	0.15	16	20	36	40	50	70	101	151	252	403	504
1.00	0.25	10	12	22	24	30	42	60	91	151	242	302
1.00	0.35	7	9	16	17	22	30	43	65	108	173	216
1.00	0.50	5	6	11	12	15	21	30	45	76	121	151
1.00	0.75	3	4	7	8	10	14	20	30	50	81	101
2.00	0.05	24	30	54	60	76	106	151	227	378	604	755
2.00	0.10	12	15	27	30	38	53	76	113	189	302	378
2.00	0.15	8	10	18	20	25	35	50	76	126	201	252
2.00	0.25	5	6	11	12	15	21	30	45	76	121	151
2.00	0.35	3	4	8	9	11	15	22	32	54	86	108
2.00	0.50	2	3	5	6	8	11	15	23	38	60	76
2.00	0.75	2	2	4	4	5	7	10	15	25	40	50
4.00	0.05	12	15	27	30	38	53	76	113	189	302	378
4.00	0.10	6	8	14	15	19	26	38	57	94	151	189
4.00	0.15	4	5	9	10	13	18	25	38	63	101	126
4.00	0.25	2	3	5	6	8	11	15	23	38	60	76
4.00	0.35	2	2	4	4	5	8	11	16	27	43	54
4.00	0.50	1	2	3	3	4	5	8	11	19	30	38
4.00	0.75	1	1	2	2	3	4	5	8	13	20	25

N=10 G=10 I=13

VOC (\$/KM)	VOCS %	CI (\$/KM) 8000	10000	18000	20000	25000	35000	50000	75000	125000	200000	250000
0.10	0.05	507	633	1140	1267	1584	2217	3167	4751	7918	12669	15836
0.10	0.10	253	317	570	633	792	1109	1584	2375	3959	6334	7918
0.10	0.15	169	211	380	422	528	739	1056	1584	2639	4223	5279
0.10	0.25	101	127	228	253	317	443	633	950	1584	2534	3167
0.10	0.35	72	90	163	181	226	317	452	679	1131	1810	2262
0.10	0.50	51	63	114	127	158	222	317	475	792	1267	1584
0.10	0.75	34	42	76	84	106	148	211	317	528	845	1056
0.25	0.05	203	253	456	507	633	887	1267	1900	3167	5068	6334
0.25	0.10	101	127	228	253	317	443	633	950	1584	2534	3167
0.25	0.15	68	84	152	169	211	296	422	633	1056	1689	2111
0.25	0.25	41	51	91	101	127	177	253	380	633	1014	1267
0.25	0.35	29	36	65	72	90	127	181	271	452	724	905
0.25	0.50	20	25	46	51	63	89	127	190	317	507	633
0.25	0.75	14	17	30	34	42	59	84	127	211	338	422
0.50	0.05	101	127	228	253	317	443	633	950	1584	2534	3167
0.50	0.10	51	63	114	127	158	222	317	475	792	1267	1584
0.50	0.15	34	42	76	84	106	148	211	317	528	845	1056
0.50	0.25	20	25	46	51	63	89	127	190	317	507	633
0.50	0.35	14	18	33	36	45	63	90	136	226	362	452
0.50	0.50	10	13	23	25	32	44	63	95	158	253	317
0.50	0.75	7	8	15	17	21	30	42	63	106	169	211
1.00	0.05	51	63	114	127	158	222	317	475	792	1267	1584
1.00	0.10	25	32	57	63	79	111	158	238	396	633	792
1.00	0.15	17	21	38	42	53	74	106	158	264	422	528
1.00	0.25	10	13	23	25	32	44	63	95	158	253	317
1.00	0.35	7	9	16	18	23	32	45	68	113	181	226
1.00	0.50	5	6	11	13	16	22	32	48	79	127	158
1.00	0.75	3	4	8	8	11	15	21	32	53	84	106
2.00	0.05	25	32	57	63	79	111	158	238	396	633	792
2.00	0.10	13	16	29	32	40	55	79	119	198	317	396
2.00	0.15	8	11	19	21	26	37	53	79	132	211	264
2.00	0.25	5	6	11	13	16	22	32	48	79	127	158
2.00	0.35	4	5	8	9	11	16	23	34	57	90	113
2.00	0.50	3	3	6	6	8	11	16	24	40	63	79
2.00	0.75	2	2	4	4	5	7	11	16	26	42	53
4.00	0.05	13	16	29	32	40	55	79	119	198	317	396
4.00	0.10	6	8	14	16	20	28	40	59	99	158	198
4.00	0.15	4	5	10	11	13	18	26	40	66	106	132
4.00	0.25	3	3	6	6	8	11	16	24	40	63	79
4.00	0.35	2	2	4	5	6	8	11	17	28	45	57
4.00	0.50	1	2	3	3	4	6	8	12	20	32	40
4.00	0.75	1	1	2	2	3	4	5	8	13	21	26

N=10 G=10 I=14

VDC ($/KW)	VDCS X	CI ($/KW) 8000	10000	18000	20000	25000	35000	50000	75000	125000	200000	250000
0.10	0.05	531	663	1194	1327	1658	2322	3317	4975	8292	13268	16585
0.10	0.10	265	332	597	663	829	1161	1658	2488	4146	6634	8292
0.10	0.15	177	221	398	442	553	774	1106	1658	2764	4423	5528
0.10	0.25	106	133	239	265	332	464	663	995	1658	2654	3317
0.10	0.35	76	95	171	190	237	332	474	711	1185	1895	2369
0.10	0.50	53	66	119	133	166	232	332	498	829	1327	1658
0.10	0.75	35	44	80	88	111	155	221	332	553	885	1106
0.25	0.05	212	265	478	531	663	929	1327	1990	3317	5307	6634
0.25	0.10	106	133	239	265	332	464	663	995	1658	2654	3317
0.25	0.15	71	88	159	177	221	310	442	663	1106	1769	2211
0.25	0.25	42	53	96	106	133	186	265	398	663	1061	1327
0.25	0.35	30	38	68	76	95	133	190	284	474	758	948
0.25	0.50	21	27	48	53	66	93	133	199	332	531	663
0.25	0.75	14	18	32	35	44	62	88	133	221	354	442
0.50	0.05	106	133	239	265	332	464	663	995	1658	2654	3317
0.50	0.10	53	66	119	133	166	232	332	498	829	1327	1658
0.50	0.15	35	44	80	88	111	155	221	332	553	885	1106
0.50	0.25	21	27	48	53	66	93	133	199	332	531	663
0.50	0.35	15	19	34	38	47	66	95	142	237	379	474
0.50	0.50	11	13	24	27	33	46	66	100	166	265	332
0.50	0.75	7	9	16	18	22	31	44	66	111	177	221
1.00	0.05	53	66	119	133	166	232	332	498	829	1327	1658
1.00	0.10	27	33	60	66	83	116	166	249	415	663	829
1.00	0.15	18	22	40	44	55	77	111	166	276	442	553
1.00	0.25	11	13	24	27	33	46	66	100	166	265	332
1.00	0.35	8	9	17	19	24	33	47	71	118	190	237
1.00	0.50	5	7	12	13	17	23	33	50	83	133	166
1.00	0.75	4	4	8	9	11	15	22	33	55	88	111
2.00	0.05	27	33	60	66	83	116	166	249	415	663	829
2.00	0.10	13	17	30	33	41	58	83	124	207	332	415
2.00	0.15	9	11	20	22	28	39	55	83	138	221	276
2.00	0.25	5	7	12	13	17	23	33	50	83	133	166
2.00	0.35	4	5	9	9	12	17	24	36	59	95	118
2.00	0.50	3	3	6	7	8	12	17	25	41	66	83
2.00	0.75	2	2	4	4	6	8	11	17	28	44	55
4.00	0.05	13	17	30	33	41	58	83	124	207	332	415
4.00	0.10	7	8	15	17	21	29	41	62	104	166	207
4.00	0.15	4	6	10	11	14	19	28	41	69	111	138
4.00	0.25	3	3	6	7	8	12	17	25	41	66	83
4.00	0.35	2	2	4	5	6	8	12	18	30	47	59
4.00	0.50	1	2	3	3	4	6	8	12	21	33	41
4.00	0.75	1	1	2	2	3	4	6	8	14	22	28

N=10 G=10 I=15

VOC ($/KM)	VOCS %	CI ($/KM) 8000	10000	18000	20000	25000	35000	50000	75000	125000	200000	250000
0.10	0.05	555	694	1249	1388	1735	2429	3470	5205	8675	13881	17351
0.10	0.10	278	347	625	694	868	1215	1735	2603	4338	6940	8675
0.10	0.15	185	231	416	463	578	810	1157	1735	2892	4627	5784
0.10	0.25	111	139	250	278	347	486	694	1041	1735	2776	3470
0.10	0.35	79	99	178	198	248	347	496	744	1239	1983	2479
0.10	0.50	56	69	125	139	174	243	347	521	868	1388	1735
0.10	0.75	37	46	83	93	116	162	231	347	578	925	1157
0.25	0.05	222	278	500	555	694	972	1388	2082	3470	5552	6940
0.25	0.10	111	139	250	278	347	486	694	1041	1735	2776	3470
0.25	0.15	74	93	167	185	231	324	463	694	1157	1851	2313
0.25	0.25	44	56	100	111	139	194	278	416	694	1110	1388
0.25	0.35	32	40	71	79	99	139	198	297	496	793	991
0.25	0.50	22	28	50	56	69	97	139	208	347	555	694
0.25	0.75	15	19	33	37	46	65	93	139	231	370	463
0.50	0.05	111	139	250	278	347	486	694	1041	1735	2776	3470
0.50	0.10	56	69	125	139	174	243	347	521	868	1388	1735
0.50	0.15	37	46	83	93	116	162	231	347	578	925	1157
0.50	0.25	22	28	50	56	69	97	139	208	347	555	694
0.50	0.35	16	20	36	40	50	69	99	149	248	397	496
0.50	0.50	11	14	25	28	35	49	69	104	174	278	347
0.50	0.75	7	9	17	19	23	32	46	69	116	185	231
1.00	0.05	56	69	125	139	174	243	347	521	868	1388	1735
1.00	0.10	28	35	62	69	87	121	174	260	434	694	868
1.00	0.15	19	23	42	46	58	81	116	174	289	463	578
1.00	0.25	11	14	25	28	35	49	69	104	174	278	347
1.00	0.35	8	10	18	20	25	35	50	74	124	198	248
1.00	0.50	6	7	12	14	17	24	35	52	87	139	174
1.00	0.75	4	5	8	9	12	16	23	35	58	93	116
2.00	0.05	28	35	62	69	87	121	174	260	434	694	868
2.00	0.10	14	17	31	35	43	61	87	130	217	347	434
2.00	0.15	9	12	21	23	29	40	58	87	145	231	289
2.00	0.25	6	7	12	14	17	24	35	52	87	139	174
2.00	0.35	4	5	9	10	12	17	25	37	62	99	124
2.00	0.50	3	3	6	7	9	12	17	26	43	69	87
2.00	0.75	2	2	4	5	6	8	12	17	29	46	58
4.00	0.05	14	17	31	35	43	61	87	130	217	347	434
4.00	0.10	7	9	16	17	22	30	43	65	108	174	217
4.00	0.15	5	6	10	12	14	20	29	43	72	116	145
4.00	0.25	3	3	6	7	9	12	17	26	43	69	87
4.00	0.35	2	2	4	5	6	9	12	19	31	50	62
4.00	0.50	1	2	3	3	4	6	9	13	22	35	43
4.00	0.75	1	1	2	2	3	4	6	9	14	23	29

N=10 G=10 I=16

VOC ($/KM)	VOCS %	CI ($/KM) 6000	10000	18000	20000	25000	35000	50000	75000	125000	200000	250000
0.10	0.05	580	725	1306	1451	1813	2539	3627	5440	9067	14507	18134
0.10	0.10	290	363	653	725	907	1269	1813	2720	4534	7254	9067
0.10	0.15	193	242	435	484	604	846	1209	1813	3022	4836	6045
0.10	0.25	116	145	261	290	363	508	725	1088	1813	2901	3627
0.10	0.35	83	104	187	207	259	363	518	777	1295	2072	2591
0.10	0.50	58	73	131	145	181	254	363	544	907	1451	1813
0.10	0.75	39	48	87	97	121	169	242	363	604	967	1209
0.25	0.05	232	290	522	580	725	1016	1451	2176	3627	5803	7254
0.25	0.10	116	145	261	290	363	508	725	1088	1813	2901	3627
0.25	0.15	77	97	174	193	242	339	484	725	1209	1934	2418
0.25	0.25	46	58	104	116	145	203	290	435	725	1161	1451
0.25	0.35	33	41	75	83	104	145	207	311	518	829	1036
0.25	0.50	23	29	52	58	73	102	145	218	363	580	725
0.25	0.75	15	19	35	39	48	68	97	145	242	387	484
0.50	0.05	116	145	261	290	363	508	725	1088	1813	2901	3627
0.50	0.10	58	73	131	145	181	254	363	544	907	1451	1813
0.50	0.15	39	48	87	97	121	169	242	363	604	967	1209
0.50	0.25	23	29	52	58	73	102	145	218	363	580	725
0.50	0.35	17	21	37	41	52	73	104	155	259	414	518
0.50	0.50	12	15	26	29	36	51	73	109	181	290	363
0.50	0.75	8	10	17	19	24	34	48	73	121	193	242
1.00	0.05	58	73	131	145	181	254	363	544	907	1451	1813
1.00	0.10	29	36	65	73	91	127	181	272	453	725	907
1.00	0.15	19	24	44	48	60	85	121	181	302	484	604
1.00	0.25	12	15	26	29	36	51	73	109	181	290	363
1.00	0.35	8	10	19	21	26	36	52	78	130	207	259
1.00	0.50	6	7	13	15	18	25	36	54	91	145	181
1.00	0.75	4	5	9	10	12	17	24	36	60	97	121
2.00	0.05	29	36	65	73	91	127	181	272	453	725	907
2.00	0.10	15	18	33	36	45	63	91	136	227	363	453
2.00	0.15	10	12	22	24	30	42	60	91	151	242	302
2.00	0.25	6	7	13	15	18	25	36	54	91	145	181
2.00	0.35	4	5	9	10	13	18	26	39	65	104	130
2.00	0.50	3	4	7	7	9	13	18	27	45	73	91
2.00	0.75	2	2	4	5	6	8	12	18	30	48	60
4.00	0.05	15	18	33	36	45	63	91	136	227	363	453
4.00	0.10	7	9	16	18	23	32	45	68	113	181	227
4.00	0.15	5	6	11	12	15	21	30	45	76	121	151
4.00	0.25	3	4	7	7	9	13	18	27	45	73	91
4.00	0.35	2	3	5	5	6	9	13	19	32	52	65
4.00	0.50	1	2	3	4	5	6	9	14	23	36	45
4.00	0.75	1	1	2	2	3	4	6	9	15	24	30

N=10 G=10 I=17

VOC ($/KM)	VOCS %	CI ($/KM) 8000	10000	18000	20000	25000	35000	50000	75000	125000	200000	250000
0.10	0.05	606	757	1363	1515	1893	2651	3787	5680	9467	15147	18934
0.10	0.10	303	379	682	757	947	1325	1893	2840	4734	7574	9467
0.10	0.15	202	252	454	505	631	884	1262	1893	3156	5049	6311
0.10	0.25	121	151	273	303	379	530	757	1136	1893	3029	3787
0.10	0.35	87	108	195	216	270	379	541	811	1352	2164	2705
0.10	0.50	61	76	136	151	189	265	379	568	947	1515	1893
0.10	0.75	40	50	91	101	126	177	252	379	631	1010	1262
0.25	0.05	242	303	545	606	757	1060	1515	2272	3787	6059	7574
0.25	0.10	121	151	273	303	379	530	757	1136	1893	3029	3787
0.25	0.15	81	101	182	202	252	353	505	757	1262	2020	2525
0.25	0.25	48	61	109	121	151	212	303	454	757	1212	1515
0.25	0.35	35	43	78	87	108	151	216	325	541	866	1082
0.25	0.50	24	30	55	61	76	106	151	227	379	606	757
0.25	0.75	16	20	36	40	50	71	101	151	252	404	505
0.50	0.05	121	151	273	303	379	530	757	1136	1893	3029	3787
0.50	0.10	61	76	136	151	189	265	379	568	947	1515	1893
0.50	0.15	40	50	91	101	126	177	252	379	631	1010	1262
0.50	0.25	24	30	55	61	76	106	151	227	379	606	757
0.50	0.35	17	22	39	43	54	76	108	162	270	433	541
0.50	0.50	12	15	27	30	38	53	76	114	189	303	379
0.50	0.75	8	10	18	20	25	35	50	76	126	202	252
1.00	0.05	61	76	136	151	189	265	379	568	947	1515	1893
1.00	0.10	30	38	68	76	95	133	189	284	473	757	947
1.00	0.15	20	25	45	50	63	88	126	189	316	505	631
1.00	0.25	12	15	27	30	38	53	76	114	189	303	379
1.00	0.35	9	11	19	22	27	38	54	81	135	216	270
1.00	0.50	6	8	14	15	19	27	38	57	95	151	189
1.00	0.75	4	5	9	10	13	18	25	38	63	101	126
2.00	0.05	30	38	68	76	95	133	189	284	473	757	947
2.00	0.10	15	19	34	38	47	66	95	142	237	379	473
2.00	0.15	10	13	23	25	32	44	63	95	158	252	316
2.00	0.25	6	8	14	15	19	27	38	57	95	151	189
2.00	0.35	4	5	10	11	14	19	27	41	68	108	135
2.00	0.50	3	4	7	8	9	13	19	28	47	76	95
2.00	0.75	2	3	5	5	6	9	13	19	32	50	63
4.00	0.05	15	19	34	38	47	66	95	142	237	379	473
4.00	0.10	8	9	17	19	24	33	47	71	118	189	237
4.00	0.15	5	6	11	13	16	22	32	47	79	126	158
4.00	0.25	3	4	7	8	9	13	19	28	47	76	95
4.00	0.35	2	3	5	5	7	9	14	20	34	54	68
4.00	0.50	2	2	3	4	5	7	9	14	24	38	47
4.00	0.75	1	1	2	3	3	4	6	9	16	25	32

N=10 G=10 I=18

VOC ($/KM)	VOCS %	CI ($/KM) 8000	10000	18000	20000	25000	35000	50000	75000	125000	200000	250000
0.10	0.05	632	790	1422	1580	1975	2765	3950	5925	9875	15800	19750
0.10	0.10	316	395	711	790	988	1383	1975	2963	4938	7900	9875
0.10	0.15	211	263	474	527	658	922	1317	1975	3292	5267	6583
0.10	0.25	126	158	284	316	395	553	790	1185	1975	3160	3950
0.10	0.35	90	113	203	226	282	395	564	846	1411	2257	2821
0.10	0.50	63	79	142	158	198	277	395	593	988	1580	1975
0.10	0.75	42	53	95	105	132	184	263	395	658	1053	1317
0.25	0.05	253	316	569	632	790	1106	1580	2370	3950	6320	7900
0.25	0.10	126	158	284	316	395	553	790	1185	1975	3160	3950
0.25	0.15	84	105	190	211	263	369	527	790	1317	2107	2633
0.25	0.25	51	63	114	126	158	221	316	474	790	1264	1580
0.25	0.35	36	45	81	90	113	158	226	339	564	903	1129
0.25	0.50	25	32	57	63	79	111	158	237	395	632	790
0.25	0.75	17	21	38	42	53	74	105	158	263	421	527
0.50	0.05	126	158	284	316	395	553	790	1185	1975	3160	3950
0.50	0.10	63	79	142	158	198	277	395	593	988	1580	1975
0.50	0.15	42	53	95	105	132	184	263	395	658	1053	1317
0.50	0.25	25	32	57	63	79	111	158	237	395	632	790
0.50	0.35	18	23	41	45	56	79	113	169	282	451	564
0.50	0.50	13	16	28	32	40	55	79	119	198	316	395
0.50	0.75	8	11	19	21	26	37	53	79	132	211	263
1.00	0.05	63	79	142	158	198	277	395	593	988	1580	1975
1.00	0.10	32	40	71	79	99	138	198	296	494	790	988
1.00	0.15	21	26	47	53	66	92	132	198	329	527	658
1.00	0.25	13	16	28	32	40	55	79	119	198	316	395
1.00	0.35	9	11	20	23	28	40	56	85	141	226	282
1.00	0.50	6	8	14	16	20	28	40	59	99	158	198
1.00	0.75	4	5	9	11	13	18	26	40	66	105	132
2.00	0.05	32	40	71	79	99	138	198	296	494	790	988
2.00	0.10	16	20	36	40	49	69	99	148	247	395	494
2.00	0.15	11	13	24	26	33	46	66	99	165	263	329
2.00	0.25	6	8	14	16	20	28	40	59	99	158	198
2.00	0.35	5	6	10	11	14	20	28	42	71	113	141
2.00	0.50	3	4	7	8	10	14	20	30	49	79	99
2.00	0.75	2	3	5	5	7	9	13	20	33	53	66
4.00	0.05	16	20	36	40	49	69	99	148	247	395	494
4.00	0.10	8	10	18	20	25	35	49	74	123	198	247
4.00	0.15	5	7	12	13	16	23	33	49	82	132	165
4.00	0.25	3	4	7	8	10	14	20	30	49	79	99
4.00	0.35	2	3	5	6	7	10	14	21	35	56	71
4.00	0.50	2	2	4	4	5	7	10	15	25	40	49
4.00	0.75	1	1	2	3	3	5	7	10	16	26	33

N=10 G=12 I=10

VOC ($/KM)	VOCS %	C1 ($/KM) 8000	10000	18000	20000	25000	35000	50000	75000	125000	200000	250000
0.10	0.05	396	496	892	991	1239	1735	2478	3717	6195	9912	12390
0.10	0.10	198	248	446	496	619	867	1239	1858	3097	4956	6195
0.10	0.15	132	165	297	330	413	578	826	1239	2065	3304	4130
0.10	0.25	79	99	178	198	248	347	496	743	1239	1982	2478
0.10	0.35	57	71	127	142	177	248	354	531	885	1416	1770
0.10	0.50	40	50	89	99	124	173	248	372	619	991	1239
0.10	0.75	26	33	59	66	83	116	165	248	413	661	826
0.25	0.05	159	198	357	396	496	694	991	1487	2478	3965	4956
0.25	0.10	79	99	178	198	248	347	496	743	1239	1982	2478
0.25	0.15	53	66	119	132	165	231	330	496	826	1322	1652
0.25	0.25	32	40	71	79	99	139	198	297	496	793	991
0.25	0.35	23	28	51	57	71	99	142	212	354	566	708
0.25	0.50	16	20	36	40	50	69	99	149	248	396	496
0.25	0.75	11	13	24	26	33	46	66	99	165	264	330
0.50	0.05	79	99	178	198	248	347	496	743	1239	1982	2478
0.50	0.10	40	50	89	99	124	173	248	372	619	991	1239
0.50	0.15	26	33	59	66	83	116	165	248	413	661	826
0.50	0.25	16	20	36	40	50	69	99	149	248	396	496
0.50	0.35	11	14	25	28	35	50	71	106	177	283	354
0.50	0.50	8	10	18	20	25	35	50	74	124	198	248
0.50	0.75	5	7	12	13	17	23	33	50	83	132	165
1.00	0.05	40	50	89	99	124	173	248	372	619	991	1239
1.00	0.10	20	25	45	50	62	87	124	186	310	496	619
1.00	0.15	13	17	30	33	41	58	83	124	206	330	413
1.00	0.25	8	10	18	20	25	35	50	74	124	198	248
1.00	0.35	6	7	13	14	18	25	35	53	88	142	177
1.00	0.50	4	5	9	10	12	17	25	37	62	99	124
1.00	0.75	3	3	6	7	8	12	17	25	41	66	83
2.00	0.05	20	25	45	50	62	87	124	186	310	496	619
2.00	0.10	10	12	22	25	31	43	62	93	155	248	310
2.00	0.15	7	8	15	17	21	29	41	62	103	165	206
2.00	0.25	4	5	9	10	12	17	25	37	62	99	124
2.00	0.35	3	4	6	7	9	12	18	27	44	71	88
2.00	0.50	2	2	4	5	6	9	12	19	31	50	62
2.00	0.75	1	2	3	3	4	6	8	12	21	33	41
4.00	0.05	10	12	22	25	31	43	62	93	155	248	310
4.00	0.10	5	6	11	12	15	22	31	46	77	124	155
4.00	0.15	3	4	7	8	10	14	21	31	52	83	103
4.00	0.25	2	2	4	5	6	9	12	19	31	50	62
4.00	0.35	1	2	3	4	4	6	9	13	22	35	44
4.00	0.50	1	1	2	2	3	4	6	9	15	25	31
4.00	0.75	1	1	1	2	2	3	4	6	10	17	21

N=10 G=12 I=11

VOC ($/KM)	VOCS %	C1 ($/KM) 8000	10000	18000	20000	25000	35000	50000	75000	125000	200000	250000
0.10	0.05	417	521	939	1043	1304	1825	2607	3911	6518	10428	13035
0.10	0.10	209	261	469	521	652	912	1304	1955	3259	5214	6518
0.10	0.15	139	174	313	348	435	608	869	1304	2173	3476	4345
0.10	0.25	83	104	188	209	261	365	521	782	1304	2086	2607
0.10	0.35	60	74	134	149	186	261	372	559	931	1490	1862
0.10	0.50	42	52	94	104	130	182	261	391	652	1043	1304
0.10	0.75	28	35	63	70	87	122	174	261	435	695	869
0.25	0.05	167	209	375	417	521	730	1043	1564	2607	4171	5214
0.25	0.10	83	104	188	209	261	365	521	782	1304	2086	2607
0.25	0.15	56	70	125	139	174	243	348	521	869	1390	1738
0.25	0.25	33	42	75	83	104	146	209	313	521	834	1043
0.25	0.35	24	30	54	60	74	104	149	223	372	596	745
0.25	0.50	17	21	38	42	52	73	104	156	261	417	521
0.25	0.75	11	14	25	28	35	49	70	104	174	278	348
0.50	0.05	83	104	188	209	261	365	521	782	1304	2086	2607
0.50	0.10	42	52	94	104	130	182	261	391	652	1043	1304
0.50	0.15	28	35	63	70	87	122	174	261	435	695	869
0.50	0.25	17	21	38	42	52	73	104	156	261	417	521
0.50	0.35	12	15	27	30	37	52	74	112	186	298	372
0.50	0.50	8	10	19	21	26	36	52	78	130	209	261
0.50	0.75	6	7	13	14	17	24	35	52	87	139	174
1.00	0.05	42	52	94	104	130	182	261	391	652	1043	1304
1.00	0.10	21	26	47	52	65	91	130	196	326	521	652
1.00	0.15	14	17	31	35	43	61	87	130	217	348	435
1.00	0.25	8	10	19	21	26	36	52	78	130	209	261
1.00	0.35	6	7	13	15	19	26	37	56	93	149	186
1.00	0.50	4	5	9	10	13	18	26	39	65	104	130
1.00	0.75	3	3	6	7	9	12	17	26	43	70	87
2.00	0.05	21	26	47	52	65	91	130	196	326	521	652
2.00	0.10	10	13	23	26	33	46	65	98	163	261	326
2.00	0.15	7	9	16	17	22	30	43	65	109	174	217
2.00	0.25	4	5	9	10	13	18	26	39	65	104	130
2.00	0.35	3	4	7	7	9	13	19	28	47	74	93
2.00	0.50	2	3	5	5	7	9	13	20	33	52	65
2.00	0.75	1	2	3	3	4	6	9	13	22	35	43
4.00	0.05	10	13	23	26	33	46	65	98	163	261	326
4.00	0.10	5	7	12	13	16	23	33	49	81	130	163
4.00	0.15	3	4	8	9	11	15	22	33	54	87	109
4.00	0.25	2	3	5	5	7	9	13	20	33	52	65
4.00	0.35	1	2	3	4	5	7	9	14	23	37	47
4.00	0.50	1	1	2	3	3	5	7	10	16	26	33
4.00	0.75	1	1	2	2	2	3	4	7	11	17	22

N=10 G=12 I=12

VOC ($/KM)	VOCS %	CI ($/KM) 8000	10000	18000	20000	25000	35000	50000	75000	125000	200000	250000
0.10	0.05	438	548	986	1096	1370	1918	2740	4110	6849	10959	13699
0.10	0.10	219	274	493	548	685	959	1370	2055	3425	5479	6849
0.10	0.15	146	183	329	365	457	639	913	1370	2283	3653	4566
0.10	0.25	88	110	197	219	274	384	548	822	1370	2192	2740
0.10	0.35	63	78	141	157	196	274	391	587	978	1566	1957
0.10	0.50	44	55	99	110	137	192	274	411	685	1096	1370
0.10	0.75	29	37	66	73	91	128	183	274	457	731	913
0.25	0.05	175	219	395	438	548	767	1096	1644	2740	4384	5479
0.25	0.10	88	110	197	219	274	384	548	822	1370	2192	2740
0.25	0.15	58	73	132	146	183	256	365	548	913	1461	1826
0.25	0.25	35	44	79	88	110	153	219	329	548	877	1096
0.25	0.35	25	31	56	63	78	110	157	235	391	626	783
0.25	0.50	18	22	39	44	55	77	110	164	274	438	548
0.25	0.75	12	15	26	29	37	51	73	110	183	292	365
0.50	0.05	88	110	197	219	274	384	548	822	1370	2192	2740
0.50	0.10	44	55	99	110	137	192	274	411	685	1096	1370
0.50	0.15	29	37	66	73	91	128	183	274	457	731	913
0.50	0.25	18	22	39	44	55	77	110	164	274	438	548
0.50	0.35	13	16	28	31	39	55	78	117	196	313	391
0.50	0.50	9	11	20	22	27	38	55	82	137	219	274
0.50	0.75	6	7	13	15	18	26	37	55	91	146	183
1.00	0.05	44	55	99	110	137	192	274	411	685	1096	1370
1.00	0.10	22	27	49	55	68	96	137	205	342	548	685
1.00	0.15	15	18	33	37	46	64	91	137	228	365	457
1.00	0.25	9	11	20	22	27	38	55	82	137	219	274
1.00	0.35	6	8	14	16	20	27	39	59	98	157	196
1.00	0.50	4	5	10	11	14	19	27	41	68	110	137
1.00	0.75	3	4	7	7	9	13	18	27	46	73	91
2.00	0.05	22	27	49	55	68	96	137	205	342	548	685
2.00	0.10	11	14	25	27	34	48	68	103	171	274	342
2.00	0.15	7	9	16	18	23	32	46	68	114	183	228
2.00	0.25	4	5	10	11	14	19	27	41	68	110	137
2.00	0.35	3	4	7	8	10	14	20	29	49	78	98
2.00	0.50	2	3	5	5	7	10	14	21	34	55	68
2.00	0.75	1	2	3	4	5	6	9	14	23	37	46
4.00	0.05	11	14	25	27	34	48	68	103	171	274	342
4.00	0.10	5	7	12	14	17	24	34	51	86	137	171
4.00	0.15	4	5	8	9	11	16	23	34	57	91	114
4.00	0.25	2	3	5	5	7	10	14	21	34	55	68
4.00	0.35	2	2	4	4	5	7	10	15	24	39	49
4.00	0.50	1	1	2	3	3	5	7	10	17	27	34
4.00	0.75	1	1	2	2	2	3	5	7	11	18	23

N=10 G=12 I=13

VOC ($/KM)	VOCS %	CI ($/KM) 8000	10000	18000	20000	25000	35000	50000	75000	125000	200000	250000
0.10	0.05	460	575	1035	1150	1438	2013	2876	4314	7190	11504	14380
0.10	0.10	230	288	518	575	719	1007	1438	2157	3595	5752	7190
0.10	0.15	153	192	345	383	479	671	959	1438	2397	3835	4793
0.10	0.25	92	115	207	230	288	403	575	863	1438	2301	2876
0.10	0.35	66	82	148	164	205	288	411	616	1027	1643	2054
0.10	0.50	46	58	104	115	144	201	288	431	719	1150	1438
0.10	0.75	31	38	69	77	96	134	192	288	479	767	959
0.25	0.05	184	230	414	460	575	805	1150	1726	2876	4602	5752
0.25	0.10	92	115	207	230	288	403	575	863	1438	2301	2876
0.25	0.15	61	77	138	153	192	268	383	575	959	1534	1917
0.25	0.25	37	46	83	92	115	161	230	345	575	920	1150
0.25	0.35	26	33	59	66	82	115	164	247	411	657	822
0.25	0.50	18	23	41	46	58	81	115	173	288	460	575
0.25	0.75	12	15	28	31	38	54	77	115	192	307	383
0.50	0.05	92	115	207	230	288	403	575	863	1438	2301	2876
0.50	0.10	46	58	104	115	144	201	288	431	719	1150	1438
0.50	0.15	31	38	69	77	96	134	192	288	479	767	959
0.50	0.25	18	23	41	46	58	81	115	173	288	460	575
0.50	0.35	13	16	30	33	41	58	82	123	205	329	411
0.50	0.50	9	12	21	23	29	40	58	86	144	230	288
0.50	0.75	6	8	14	15	19	27	38	58	96	153	192
1.00	0.05	46	58	104	115	144	201	288	431	719	1150	1438
1.00	0.10	23	29	52	58	72	101	144	216	360	575	719
1.00	0.15	15	19	35	38	48	67	96	144	240	383	479
1.00	0.25	9	12	21	23	29	40	58	86	144	230	288
1.00	0.35	7	8	15	16	21	29	41	62	103	164	205
1.00	0.50	5	6	10	12	14	20	29	43	72	115	144
1.00	0.75	3	4	7	8	10	13	19	29	46	77	96
2.00	0.05	23	29	52	58	72	101	144	216	360	575	719
2.00	0.10	12	14	26	29	36	50	72	108	180	288	360
2.00	0.15	8	10	17	19	24	34	48	72	120	192	240
2.00	0.25	5	6	10	12	14	20	29	43	72	115	144
2.00	0.35	3	4	7	8	10	14	21	31	51	82	103
2.00	0.50	2	3	5	6	7	10	14	22	36	58	72
2.00	0.75	2	2	3	4	5	7	10	14	24	38	48
4.00	0.05	12	14	26	29	36	50	72	108	180	288	360
4.00	0.10	6	7	13	14	18	25	36	54	90	144	180
4.00	0.15	4	5	9	10	12	17	24	36	60	96	120
4.00	0.25	2	3	5	6	7	10	14	22	36	58	72
4.00	0.35	2	2	4	4	5	7	10	15	26	41	51
4.00	0.50	1	1	3	3	4	5	7	11	18	29	36
4.00	0.75	1	1	2	2	2	3	5	7	12	19	24

N=10 G=12 I=14

VOC (S/KM)	VOCS %	CI (S/KM) 8000	10000	18000	20000	25000	35000	50000	75000	125000	200000	250000
0.10	0.05	483	603	1086	1206	1508	2111	3016	4524	7540	12064	15080
0.10	0.10	241	302	543	603	754	1056	1508	2262	3770	6032	7540
0.10	0.15	161	201	362	402	503	704	1005	1508	2513	4021	5027
0.10	0.25	97	121	217	241	302	422	603	905	1508	2413	3016
0.10	0.35	69	86	155	172	215	302	431	646	1077	1723	2154
0.10	0.50	48	60	109	121	151	211	302	452	754	1206	1508
0.10	0.75	32	40	72	80	101	141	201	302	503	804	1005
0.25	0.05	193	241	434	483	603	844	1206	1810	3016	4826	6032
0.25	0.10	97	121	217	241	302	422	603	905	1508	2413	3016
0.25	0.15	64	80	145	161	201	281	402	603	1005	1609	2011
0.25	0.25	39	48	87	97	121	169	241	362	603	965	1206
0.25	0.35	28	34	62	69	86	121	172	259	431	689	862
0.25	0.50	19	24	43	48	60	84	121	181	302	483	603
0.25	0.75	13	16	29	32	40	56	80	121	201	322	402
0.50	0.05	97	121	217	241	302	422	603	905	1508	2413	3016
0.50	0.10	48	60	109	121	151	211	302	452	754	1206	1508
0.50	0.15	32	40	72	80	101	141	201	302	503	804	1005
0.50	0.25	19	24	43	48	60	84	121	181	302	483	603
0.50	0.35	14	17	31	34	43	60	86	129	215	345	431
0.50	0.50	10	12	22	24	30	42	60	90	151	241	302
0.50	0.75	6	8	14	16	20	28	40	60	101	161	201
1.00	0.05	48	60	109	121	151	211	302	452	754	1206	1508
1.00	0.10	24	30	54	60	75	106	151	226	377	603	754
1.00	0.15	16	20	36	40	50	70	101	151	251	402	503
1.00	0.25	10	12	22	24	30	42	60	90	151	241	302
1.00	0.35	7	9	16	17	22	30	43	65	108	172	215
1.00	0.50	5	6	11	12	15	21	30	45	75	121	151
1.00	0.75	3	4	7	8	10	14	20	30	50	80	101
2.00	0.05	24	30	54	60	75	106	151	226	377	603	754
2.00	0.10	12	15	27	30	38	53	75	113	188	302	377
2.00	0.15	8	10	18	20	25	35	50	75	126	201	251
2.00	0.25	5	6	11	12	15	21	30	45	75	121	151
2.00	0.35	3	4	8	9	11	15	22	32	54	86	108
2.00	0.50	2	3	5	6	8	11	15	23	38	60	75
2.00	0.75	2	2	4	4	5	7	10	15	25	40	50
4.00	0.05	12	15	27	30	38	53	75	113	188	302	377
4.00	0.10	6	8	14	15	19	26	38	57	94	151	188
4.00	0.15	4	5	9	10	13	18	25	38	63	101	126
4.00	0.25	2	3	5	6	8	11	15	23	38	60	75
4.00	0.35	2	2	4	4	5	8	11	16	27	43	54
4.00	0.50	1	2	3	3	4	5	8	11	19	30	38
4.00	0.75	1	1	2	2	3	4	5	8	13	20	25

N=10 G=12 I=15

VOC ($/KM)	VOCS %	CI ($/KM) 8000	10000	18000	20000	25000	35000	50000	75000	125000	200000	250000
0.10	0.05	505	632	1137	1264	1580	2212	3159	4739	7898	12637	15797
0.10	0.10	253	316	569	632	790	1106	1580	2369	3949	6319	7898
0.10	0.15	168	211	379	421	527	737	1053	1580	2633	4212	5266
0.10	0.25	101	126	227	253	316	442	632	948	1580	2527	3159
0.10	0.35	72	90	162	181	226	316	451	677	1128	1805	2257
0.10	0.50	51	63	114	126	158	221	316	474	790	1264	1580
0.10	0.75	34	42	76	84	105	147	211	316	527	842	1053
0.25	0.05	202	253	455	505	632	885	1264	1896	3159	5055	6319
0.25	0.10	101	126	227	253	316	442	632	948	1580	2527	3159
0.25	0.15	67	84	152	168	211	295	421	632	1053	1685	2106
0.25	0.25	40	51	91	101	126	177	253	379	632	1011	1264
0.25	0.35	29	36	65	72	90	126	181	271	451	722	903
0.25	0.50	20	25	45	51	63	88	126	190	316	505	632
0.25	0.75	13	17	30	34	42	59	84	126	211	337	421
0.50	0.05	101	126	227	253	316	442	632	948	1580	2527	3159
0.50	0.10	51	63	114	126	158	221	316	474	790	1264	1580
0.50	0.15	34	42	76	84	105	147	211	316	527	842	1053
0.50	0.25	20	25	45	51	63	88	126	190	316	505	632
0.50	0.35	14	18	32	36	45	63	90	135	226	361	451
0.50	0.50	10	13	23	25	32	44	63	95	158	253	316
0.50	0.75	7	8	15	17	21	29	42	63	105	168	211
1.00	0.05	51	63	114	126	158	221	316	474	790	1264	1580
1.00	0.10	25	32	57	63	79	111	158	237	395	632	790
1.00	0.15	17	21	38	42	53	74	105	158	263	421	527
1.00	0.25	10	13	23	25	32	44	63	95	158	253	316
1.00	0.35	7	9	16	16	23	32	45	68	113	181	226
1.00	0.50	5	6	11	13	16	22	32	47	79	126	158
1.00	0.75	3	4	8	8	11	15	21	32	53	84	105
2.00	0.05	25	32	57	63	79	111	158	237	395	632	790
2.00	0.10	13	16	28	32	39	55	79	118	197	316	395
2.00	0.15	8	11	19	21	26	37	53	79	132	211	263
2.00	0.25	5	6	11	13	16	22	32	47	79	126	158
2.00	0.35	4	5	8	9	11	16	23	34	56	90	113
2.00	0.50	3	3	6	6	8	11	16	24	39	63	79
2.00	0.75	2	2	4	4	5	7	11	16	26	42	53
4.00	0.05	13	16	28	32	39	55	79	118	197	316	395
4.00	0.10	6	8	14	16	20	28	39	59	99	158	197
4.00	0.15	4	5	9	11	13	18	26	39	66	105	132
4.00	0.25	3	3	6	6	8	11	16	24	39	63	79
4.00	0.35	2	2	4	5	6	8	11	17	28	45	56
4.00	0.50	1	2	3	3	4	6	8	12	20	32	39
4.00	0.75	1	1	2	2	3	4	5	8	13	21	26

N=10 G=12 I=16

VOC ($/KM)	VOCS %	CI ($/KM) 6000	10000	18000	20000	25000	35000	50000	75000	125000	200000	250000
0.10	0.05	529	661	1190	1322	1653	2314	3306	4959	8265	13225	16531
0.10	0.10	264	331	595	661	827	1157	1653	2480	4133	6612	8265
0.10	0.15	176	220	397	441	551	771	1102	1653	2755	4408	5510
0.10	0.25	106	132	238	264	331	463	661	992	1653	2645	3306
0.10	0.35	76	94	170	189	236	331	472	708	1181	1889	2362
0.10	0.50	53	66	119	132	165	231	331	496	827	1322	1653
0.10	0.75	35	44	79	88	110	154	220	331	551	882	1102
0.25	0.05	212	264	476	529	661	926	1322	1984	3306	5290	6612
0.25	0.10	106	132	238	264	331	463	661	992	1653	2645	3306
0.25	0.15	71	88	159	176	220	309	441	661	1102	1763	2204
0.25	0.25	42	53	95	106	132	185	264	397	661	1058	1322
0.25	0.35	30	38	68	76	94	132	189	283	472	756	945
0.25	0.50	21	26	48	53	66	93	132	198	331	529	661
0.25	0.75	14	18	32	35	44	62	88	132	220	353	441
0.50	0.05	106	132	238	264	331	463	661	992	1653	2645	3306
0.50	0.10	53	66	119	132	165	231	331	496	827	1322	1653
0.50	0.15	35	44	79	88	110	154	220	331	551	882	1102
0.50	0.25	21	26	48	53	66	93	132	198	331	529	661
0.50	0.35	15	19	34	38	47	66	94	142	236	378	472
0.50	0.50	11	13	24	26	33	46	66	99	165	264	331
0.50	0.75	7	9	16	18	22	31	44	66	110	176	220
1.00	0.05	53	66	119	132	165	231	331	496	827	1322	1653
1.00	0.10	26	33	60	66	83	116	165	248	413	661	827
1.00	0.15	18	22	40	44	55	77	110	165	276	441	551
1.00	0.25	11	13	24	26	33	46	66	99	165	264	331
1.00	0.35	8	9	17	19	24	33	47	71	118	189	236
1.00	0.50	5	7	12	13	17	23	33	50	83	132	165
1.00	0.75	4	4	8	9	11	15	22	33	55	88	110
2.00	0.05	26	33	60	66	83	116	165	248	413	661	827
2.00	0.10	13	17	30	33	41	58	83	124	207	331	413
2.00	0.15	9	11	20	22	28	39	55	83	138	220	276
2.00	0.25	5	7	12	13	17	23	33	50	83	132	165
2.00	0.35	4	5	9	9	12	17	24	35	59	94	118
2.00	0.50	3	3	6	7	8	12	17	25	41	66	83
2.00	0.75	2	2	4	4	6	8	11	17	28	44	55
4.00	0.05	13	17	30	33	41	58	83	124	207	331	413
4.00	0.10	7	8	15	17	21	29	41	62	103	165	207
4.00	0.15	4	6	10	11	14	19	28	41	69	110	138
4.00	0.25	3	3	6	7	8	12	17	25	41	66	83
4.00	0.35	2	2	4	5	6	8	12	18	30	47	59
4.00	0.50	1	2	3	3	4	6	8	12	21	33	41
4.00	0.75	1	1	2	2	3	4	6	8	14	22	28

N=10 G=12 I=17

VOC ($/KM)	VOCS %	CI ($/KM) 8000	10000	18000	20000	25000	35000	50000	75000	125000	200000	250000
0.10	0.05	553	691	1244	1383	1728	2419	3456	5185	8641	13825	17282
0.10	0.10	277	346	622	691	864	1210	1728	2592	4320	6913	8641
0.10	0.15	184	230	415	461	576	806	1152	1728	2880	4608	5761
0.10	0.25	111	138	249	277	346	484	691	1037	1728	2765	3456
0.10	0.35	79	99	178	198	247	346	494	741	1234	1975	2469
0.10	0.50	55	69	124	138	173	242	346	518	864	1383	1728
0.10	0.75	37	46	83	92	115	161	230	346	576	922	1152
0.25	0.05	221	277	498	553	691	968	1383	2074	3456	5530	6913
0.25	0.10	111	138	249	277	346	484	691	1037	1728	2765	3456
0.25	0.15	74	92	166	184	230	323	461	691	1152	1843	2304
0.25	0.25	44	55	100	111	138	194	277	415	691	1106	1383
0.25	0.35	32	40	71	79	99	138	198	296	494	790	988
0.25	0.50	22	28	50	55	69	97	138	207	346	553	691
0.25	0.75	15	18	33	37	46	65	92	138	230	369	461
0.50	0.05	111	138	249	277	346	484	691	1037	1728	2765	3456
0.50	0.10	55	69	124	138	173	242	346	518	864	1383	1728
0.50	0.15	37	46	83	92	115	161	230	346	576	922	1152
0.50	0.25	22	28	50	55	69	97	138	207	346	553	691
0.50	0.35	16	20	36	40	49	69	99	148	247	395	494
0.50	0.50	11	14	25	28	35	48	69	104	173	277	346
0.50	0.75	7	9	17	18	23	32	46	69	115	184	230
1.00	0.05	55	69	124	138	173	242	346	518	864	1383	1728
1.00	0.10	28	35	62	69	86	121	173	259	432	691	864
1.00	0.15	18	23	41	46	58	81	115	173	288	461	576
1.00	0.25	11	14	25	28	35	48	69	104	173	277	346
1.00	0.35	8	10	18	20	25	35	49	74	123	198	247
1.00	0.50	6	7	12	14	17	24	35	52	86	138	173
1.00	0.75	4	5	8	9	12	16	23	35	58	92	115
2.00	0.05	28	35	62	69	86	121	173	259	432	691	864
2.00	0.10	14	17	31	35	43	60	86	130	216	346	432
2.00	0.15	9	12	21	23	29	40	58	86	144	230	288
2.00	0.25	6	7	12	14	17	24	35	52	86	138	173
2.00	0.35	4	5	9	10	12	17	25	37	62	99	123
2.00	0.50	3	3	6	7	9	12	17	26	43	69	86
2.00	0.75	2	2	4	5	6	8	12	17	29	46	58
4.00	0.05	14	17	31	35	43	60	86	130	216	346	432
4.00	0.10	7	9	16	17	22	30	43	65	108	173	216
4.00	0.15	5	6	10	12	14	20	29	43	72	115	144
4.00	0.25	3	3	6	7	9	12	17	26	43	69	86
4.00	0.35	2	2	4	5	6	9	12	19	31	49	62
4.00	0.50	1	2	3	3	4	6	9	13	22	35	43
4.00	0.75	1	1	2	2	3	4	6	9	14	23	29

N=10 G=12 T=18

VOC ($/KH)	VOCS %	CI ($/KH) 8000	10000	18000	20000	25000	35000	50000	75000	125000	200000	250000
0.10	0.05	578	722	1300	1444	1805	2527	3610	5415	9025	14440	18049
0.10	0.10	289	361	650	722	902	1263	1805	2707	4512	7220	9025
0.10	0.15	193	241	433	481	602	842	1203	1805	3008	4813	6016
0.10	0.25	116	144	260	289	361	505	722	1083	1805	2888	3610
0.10	0.35	83	103	186	206	258	361	516	774	1289	2063	2578
0.10	0.50	58	72	130	144	180	253	361	541	902	1444	1805
0.10	0.75	39	48	87	96	120	168	241	361	602	963	1203
0.25	0.05	231	289	520	578	722	1011	1444	2166	3610	5776	7220
0.25	0.10	116	144	260	289	361	505	722	1083	1805	2888	3610
0.25	0.15	77	96	173	193	241	337	481	722	1203	1925	2407
0.25	0.25	46	58	104	116	144	202	289	433	722	1155	1444
0.25	0.35	33	41	74	83	103	144	206	309	516	825	1031
0.25	0.50	23	29	52	58	72	101	144	217	361	578	722
0.25	0.75	15	19	35	39	48	67	96	144	241	385	481
0.50	0.05	116	144	260	289	361	505	722	1083	1805	2888	3610
0.50	0.10	58	72	130	144	180	253	361	541	902	1444	1805
0.50	0.15	39	48	87	96	120	168	241	361	602	963	1203
0.50	0.25	23	29	52	58	72	101	144	217	361	578	722
0.50	0.35	17	21	37	41	52	72	103	155	258	413	516
0.50	0.50	12	14	26	29	36	51	72	108	180	289	361
0.50	0.75	8	10	17	19	24	34	48	72	120	193	241
1.00	0.05	58	72	130	144	180	253	361	541	902	1444	1805
1.00	0.10	29	36	65	72	90	126	180	271	451	722	902
1.00	0.15	19	24	43	48	60	84	120	180	301	481	602
1.00	0.25	12	14	26	29	36	51	72	108	180	289	361
1.00	0.35	8	10	19	21	26	36	52	77	129	206	258
1.00	0.50	6	7	13	14	18	25	36	54	90	144	180
1.00	0.75	4	5	9	10	12	17	24	36	60	96	120
2.00	0.05	29	36	65	72	90	126	180	271	451	722	902
2.00	0.10	14	18	32	36	45	63	90	135	226	361	451
2.00	0.15	10	12	22	24	30	42	60	90	150	241	301
2.00	0.25	6	7	13	14	18	25	36	54	90	144	180
2.00	0.35	4	5	9	10	13	18	26	39	64	103	129
2.00	0.50	3	4	6	7	9	13	18	27	45	72	90
2.00	0.75	2	2	4	5	6	8	12	18	30	48	60
4.00	0.05	14	18	32	36	45	63	90	135	226	361	451
4.00	0.10	7	9	16	18	23	32	45	68	113	180	226
4.00	0.15	5	6	11	12	15	21	30	45	75	120	150
4.00	0.25	3	4	6	7	9	13	18	27	45	72	90
4.00	0.35	2	3	5	5	6	9	13	19	32	52	64
4.00	0.50	1	2	3	4	5	6	9	14	23	36	45
4.00	0.75	1	1	2	2	3	4	6	9	15	24	30

N=10 G=15 I=10

VOC ($/KM)	VOCS %	CI ($/KM) 8000	10000	18000	20000	25000	35000	50000	75000	125000	200000	250000
0.10	0.05	340	426	766	851	1064	1490	2128	3192	5320	8512	10641
0.10	0.10	170	213	383	426	532	745	1064	1596	2660	4256	5320
0.10	0.15	113	142	255	284	355	497	709	1064	1773	2837	3547
0.10	0.25	68	85	153	170	213	298	426	638	1064	1702	2128
0.10	0.35	49	61	109	122	152	213	304	456	760	1216	1520
0.10	0.50	34	43	77	85	106	149	213	319	532	851	1064
0.10	0.75	23	28	51	57	71	99	142	213	355	567	709
0.25	0.05	136	170	306	340	426	596	851	1277	2128	3405	4256
0.25	0.10	68	85	153	170	213	298	426	638	1064	1702	2128
0.25	0.15	45	57	102	113	142	199	284	426	709	1135	1419
0.25	0.25	27	34	61	68	85	119	170	255	426	681	851
0.25	0.35	19	24	44	49	61	85	122	182	304	486	608
0.25	0.50	14	17	31	34	43	60	85	128	213	340	426
0.25	0.75	9	11	20	23	28	40	57	85	142	227	284
0.50	0.05	68	85	153	170	213	298	426	638	1064	1702	2128
0.50	0.10	34	43	77	85	106	149	213	319	532	851	1064
0.50	0.15	23	28	51	57	71	99	142	213	355	567	709
0.50	0.25	14	17	31	34	43	60	85	128	213	340	426
0.50	0.35	10	12	22	24	30	43	61	91	152	243	304
0.50	0.50	7	9	15	17	21	30	43	64	106	170	213
0.50	0.75	5	6	10	11	14	20	28	43	71	113	142
1.00	0.05	34	43	77	85	106	149	213	319	532	851	1064
1.00	0.10	17	21	38	43	53	74	106	160	266	426	532
1.00	0.15	11	14	26	28	35	50	71	106	177	284	355
1.00	0.25	7	9	15	17	21	30	43	64	106	170	213
1.00	0.35	5	6	11	12	15	21	30	46	76	122	152
1.00	0.50	3	4	8	9	11	15	21	32	53	85	106
1.00	0.75	2	3	5	6	7	10	14	21	35	57	71
2.00	0.05	17	21	38	43	53	74	106	160	266	426	532
2.00	0.10	9	11	19	21	27	37	53	80	133	213	266
2.00	0.15	6	7	13	14	18	25	35	53	89	142	177
2.00	0.25	3	4	8	9	11	15	21	32	53	85	106
2.00	0.35	2	3	5	6	8	11	15	23	38	61	76
2.00	0.50	2	2	4	4	5	7	11	16	27	43	53
2.00	0.75	1	1	3	3	4	5	7	11	18	28	35
4.00	0.05	9	11	19	21	27	37	53	80	133	213	266
4.00	0.10	4	5	10	11	13	19	27	40	67	106	133
4.00	0.15	3	4	6	7	9	12	18	27	44	71	89
4.00	0.25	2	2	4	4	5	7	11	16	27	43	53
4.00	0.35	1	2	3	3	4	5	8	11	19	30	38
4.00	0.50	1	1	2	2	3	4	5	8	13	21	27
4.00	0.75	1	1	1	1	2	2	4	5	9	14	18

N=10 G=15 I=11

VOC ($/KM)	VOCS %	CI ($/KM) 8000	10000	18000	20000	25000	35000	50000	75000	125000	200000	250000
0.10	0.05	359	449	808	897	1122	1570	2243	3365	5608	8974	11217
0.10	0.10	179	224	404	449	561	785	1122	1683	2804	4487	5608
0.10	0.15	120	150	269	299	374	523	748	1122	1869	2991	3739
0.10	0.25	72	90	162	179	224	314	449	673	1122	1795	2243
0.10	0.35	51	64	115	128	160	224	320	481	801	1282	1602
0.10	0.50	36	45	81	90	112	157	224	337	561	897	1122
0.10	0.75	24	30	54	60	75	105	150	224	374	598	748
0.25	0.05	144	179	323	359	449	628	897	1346	2243	3589	4487
0.25	0.10	72	90	162	179	224	314	449	673	1122	1795	2243
0.25	0.15	48	60	108	120	150	209	299	449	748	1196	1496
0.25	0.25	29	36	65	72	90	126	179	269	449	718	897
0.25	0.35	21	26	46	51	64	90	128	192	320	513	641
0.25	0.50	14	18	32	36	45	63	90	135	224	359	449
0.25	0.75	10	12	22	24	30	42	60	90	150	239	299
0.50	0.05	72	90	162	179	224	314	449	673	1122	1795	2243
0.50	0.10	36	45	81	90	112	157	224	337	561	897	1122
0.50	0.15	24	30	54	60	75	105	150	224	374	598	748
0.50	0.25	14	18	32	36	45	63	90	135	224	359	449
0.50	0.35	10	13	23	26	32	45	64	96	160	256	320
0.50	0.50	7	9	16	18	22	31	45	67	112	179	224
0.50	0.75	5	6	11	12	15	21	30	45	75	120	150
1.00	0.05	36	45	81	90	112	157	224	337	561	897	1122
1.00	0.10	18	22	40	45	56	79	112	168	280	449	561
1.00	0.15	12	15	27	30	37	52	75	112	187	299	374
1.00	0.25	7	9	16	18	22	31	45	67	112	179	224
1.00	0.35	5	6	12	13	16	22	32	48	80	128	160
1.00	0.50	4	4	8	9	11	16	22	34	56	90	112
1.00	0.75	2	3	5	6	7	10	15	22	37	60	75
2.00	0.05	18	22	40	45	56	79	112	168	280	449	561
2.00	0.10	9	11	20	22	28	39	56	84	140	224	280
2.00	0.15	6	7	13	15	19	26	37	56	93	150	187
2.00	0.25	4	4	8	9	11	16	22	34	56	90	112
2.00	0.35	3	3	6	6	8	11	16	24	40	64	80
2.00	0.50	2	2	4	4	6	8	11	17	28	45	56
2.00	0.75	1	1	3	3	4	5	7	11	19	30	37
4.00	0.05	9	11	20	22	28	39	56	84	140	224	280
4.00	0.10	4	6	10	11	14	20	28	42	70	112	140
4.00	0.15	3	4	7	7	9	13	19	28	47	75	93
4.00	0.25	2	2	4	4	6	8	11	17	28	45	56
4.00	0.35	1	2	3	3	4	6	8	12	20	32	40
4.00	0.50	1	1	2	2	3	4	6	8	14	22	28
4.00	0.75	1	1	1	1	2	3	4	6	9	15	19

N=10 G=15 I=12

VOC ($/KM)	VOCS %	CI ($/KM) 8000	10000	18000	20000	25000	35000	50000	75000	125000	200000	250000
0.10	0.05	378	472	850	945	1181	1654	2362	3543	5905	9449	11811
0.10	0.10	189	236	425	472	591	827	1181	1772	2953	4724	5905
0.10	0.15	126	157	283	315	394	551	787	1181	1968	3150	3937
0.10	0.25	76	94	170	189	236	331	472	709	1181	1890	2362
0.10	0.35	54	67	121	135	169	236	337	506	844	1350	1687
0.10	0.50	38	47	85	94	118	165	236	354	591	945	1181
0.10	0.75	25	31	57	63	79	110	157	236	394	630	787
0.25	0.05	151	189	340	378	472	661	945	1417	2362	3780	4724
0.25	0.10	76	94	170	189	236	331	472	709	1181	1890	2362
0.25	0.15	50	63	113	126	157	220	315	472	787	1260	1575
0.25	0.25	30	38	68	76	94	132	189	283	472	756	945
0.25	0.35	22	27	49	54	67	94	135	202	337	540	675
0.25	0.50	15	19	34	38	47	66	94	142	236	378	472
0.25	0.75	10	13	23	25	31	44	63	94	157	252	315
0.50	0.05	76	94	170	189	236	331	472	709	1181	1890	2362
0.50	0.10	38	47	85	94	118	165	236	354	591	945	1181
0.50	0.15	25	31	57	63	79	110	157	236	394	630	787
0.50	0.25	15	19	34	38	47	66	94	142	236	378	472
0.50	0.35	11	13	24	27	34	47	67	101	169	270	337
0.50	0.50	8	9	17	19	24	33	47	71	118	189	236
0.50	0.75	5	6	11	13	16	22	31	47	79	126	157
1.00	0.05	38	47	85	94	118	165	236	354	591	945	1181
1.00	0.10	19	24	43	47	59	83	118	177	295	472	591
1.00	0.15	13	16	28	31	39	55	79	118	197	315	394
1.00	0.25	8	9	17	19	24	33	47	71	118	189	236
1.00	0.35	5	7	12	13	17	24	34	51	84	135	169
1.00	0.50	4	5	9	9	12	17	24	35	59	94	118
1.00	0.75	3	3	6	6	8	11	16	24	39	63	79
2.00	0.05	19	24	43	47	59	83	118	177	295	472	591
2.00	0.10	9	12	21	24	30	41	59	89	148	236	295
2.00	0.15	6	8	14	16	20	28	39	59	98	157	197
2.00	0.25	4	5	9	9	12	17	24	35	59	94	118
2.00	0.35	3	3	6	7	8	12	17	25	42	67	84
2.00	0.50	2	2	4	5	6	8	12	18	30	47	59
2.00	0.75	1	2	3	3	4	6	8	12	20	31	39
4.00	0.05	9	12	21	24	30	41	59	89	148	236	295
4.00	0.10	5	6	11	12	15	21	30	44	74	118	148
4.00	0.15	3	4	7	8	10	14	20	30	49	79	98
4.00	0.25	2	2	4	5	6	8	12	18	30	47	59
4.00	0.35	1	2	3	3	4	6	8	13	21	34	42
4.00	0.50	1	1	2	2	3	4	6	9	15	24	30
4.00	0.75	1	1	1	2	2	3	4	6	10	16	20

N=10 G=15 I=13

VOC ($/KM)	VOCS %	CI ($/KM) 8000	10000	18000	20000	25000	35000	50000	75000	125000	200000	250000
0.10	0.05	398	497	894	994	1242	1739	2485	3727	6211	9938	12423
0.10	0.10	199	248	447	497	621	870	1242	1863	3106	4969	6211
0.10	0.15	133	166	298	331	414	580	828	1242	2070	3313	4141
0.10	0.25	80	99	179	199	248	348	497	745	1242	1988	2485
0.10	0.35	57	71	128	142	177	246	355	532	887	1420	1775
0.10	0.50	40	50	89	99	124	174	248	373	621	994	1242
0.10	0.75	27	33	60	66	83	116	166	248	414	663	828
0.25	0.05	159	199	358	398	497	696	994	1491	2485	3975	4969
0.25	0.10	80	99	179	199	248	348	497	745	1242	1988	2485
0.25	0.15	53	66	119	133	166	232	331	497	828	1325	1656
0.25	0.25	32	40	72	80	99	139	199	298	497	795	994
0.25	0.35	23	28	51	57	71	99	142	213	355	568	710
0.25	0.50	16	20	36	40	50	70	99	149	248	398	497
0.25	0.75	11	13	24	27	33	46	66	99	166	265	331
0.50	0.05	80	99	179	199	248	348	497	745	1242	1988	2485
0.50	0.10	40	50	89	99	124	174	248	373	621	994	1242
0.50	0.15	27	33	60	66	83	116	166	248	414	663	828
0.50	0.25	16	20	36	40	50	70	99	149	248	398	497
0.50	0.35	11	14	26	28	35	50	71	106	177	284	355
0.50	0.50	8	10	18	20	25	35	50	75	124	199	248
0.50	0.75	5	7	12	13	17	23	33	50	83	133	166
1.00	0.05	40	50	89	99	124	174	248	373	621	994	1242
1.00	0.10	20	25	45	50	62	87	124	186	311	497	621
1.00	0.15	13	17	30	33	41	58	83	124	207	331	414
1.00	0.25	8	10	18	20	25	35	50	75	124	199	248
1.00	0.35	6	7	13	14	18	25	35	53	89	142	177
1.00	0.50	4	5	9	10	12	17	25	37	62	99	124
1.00	0.75	3	3	6	7	8	12	17	25	41	66	83
2.00	0.05	20	25	45	50	62	87	124	186	311	497	621
2.00	0.10	10	12	22	25	31	43	62	93	155	248	311
2.00	0.15	7	8	15	17	21	29	41	62	104	166	207
2.00	0.25	4	5	9	10	12	17	25	37	62	99	124
2.00	0.35	3	4	6	7	9	12	18	27	44	71	89
2.00	0.50	2	2	4	5	6	9	12	19	31	50	62
2.00	0.75	1	2	3	3	4	6	8	12	21	33	41
4.00	0.05	10	12	22	25	31	43	62	93	155	248	311
4.00	0.10	5	6	11	12	16	22	31	47	78	124	155
4.00	0.15	3	4	7	8	10	14	21	31	52	83	104
4.00	0.25	2	2	4	5	6	9	12	19	31	50	62
4.00	0.35	1	2	3	4	4	6	9	13	22	35	44
4.00	0.50	1	1	2	2	3	4	6	9	16	25	31
4.00	0.75	1	1	1	2	2	3	4	6	10	17	21

N=10 G=15 I=14

VOC ($/KM)	VDCS %	CI ($/KM) 8000	10000	18000	20000	25000	35000	50000	75000	125000	200000	250000
0.10	0.05	418	522	940	1044	1305	1827	2610	3916	6526	10442	13052
0.10	0.10	209	261	470	522	653	914	1305	1958	3263	5221	6526
0.10	0.15	139	174	313	348	435	609	870	1305	2175	3481	4351
0.10	0.25	84	104	188	209	261	365	522	783	1305	2088	2610
0.10	0.35	60	75	134	149	186	261	373	559	932	1492	1865
0.10	0.50	42	52	94	104	131	183	261	392	653	1044	1305
0.10	0.75	28	35	63	70	87	122	174	261	435	696	870
0.25	0.05	167	209	376	418	522	731	1044	1566	2610	4177	5221
0.25	0.10	84	104	188	209	261	365	522	783	1305	2088	2610
0.25	0.15	56	70	125	139	174	244	348	522	870	1392	1740
0.25	0.25	33	42	75	84	104	146	209	313	522	835	1044
0.25	0.35	24	30	54	60	75	104	149	224	373	597	746
0.25	0.50	17	21	38	42	52	73	104	157	261	418	522
0.25	0.75	11	14	25	28	35	49	70	104	174	278	348
0.50	0.05	84	104	188	209	261	365	522	783	1305	2088	2610
0.50	0.10	42	52	94	104	131	183	261	392	653	1044	1305
0.50	0.15	28	35	63	70	87	122	174	261	435	696	870
0.50	0.25	17	21	38	42	52	73	104	157	261	418	522
0.50	0.35	12	15	27	30	37	52	75	112	186	298	373
0.50	0.50	8	10	19	21	26	37	52	78	131	209	261
0.50	0.75	6	7	13	14	17	24	35	52	87	139	174
1.00	0.05	42	52	94	104	131	183	261	392	653	1044	1305
1.00	0.10	21	26	47	52	65	91	131	196	326	522	653
1.00	0.15	14	17	31	35	44	61	87	131	218	348	435
1.00	0.25	8	10	19	21	26	37	52	78	131	209	261
1.00	0.35	6	7	13	15	19	26	37	56	93	149	186
1.00	0.50	4	5	9	10	13	18	26	39	65	104	131
1.00	0.75	3	3	6	7	9	12	17	26	44	70	87
2.00	0.05	21	26	47	52	65	91	131	196	326	522	653
2.00	0.10	10	13	23	26	33	46	65	98	163	261	326
2.00	0.15	7	9	16	17	22	30	44	65	109	174	218
2.00	0.25	4	5	9	10	13	18	26	39	65	104	131
2.00	0.35	3	4	7	7	9	13	19	28	47	75	93
2.00	0.50	2	3	5	5	7	9	13	20	33	52	65
2.00	0.75	1	2	3	3	4	6	9	13	22	35	44
4.00	0.05	10	13	23	26	33	46	65	98	163	261	326
4.00	0.10	5	7	12	13	16	23	33	49	82	131	163
4.00	0.15	3	4	8	9	11	15	22	33	54	87	109
4.00	0.25	2	3	5	5	7	9	13	20	33	52	65
4.00	0.35	1	2	3	4	5	7	9	14	23	37	47
4.00	0.50	1	1	2	3	3	5	7	10	16	26	33
4.00	0.75	1	1	2	2	2	3	4	7	11	17	22

N=10 G=15 I=15

VOC ($/KH)	VOCS %	CI ($/KH) 8000	10000	18000	20000	25000	35000	50000	75000	125000	200000	250000
0.10	0.05	438	548	986	1096	1370	1918	2740	4110	6849	10959	13699
0.10	0.10	219	274	493	548	685	959	1370	2055	3425	5479	6849
0.10	0.15	146	183	329	365	457	639	913	1370	2283	3653	4566
0.10	0.25	88	110	197	219	274	384	548	822	1370	2192	2740
0.10	0.35	63	78	141	157	196	274	391	587	978	1566	1957
0.10	0.50	44	55	99	110	137	192	274	411	685	1096	1370
0.10	0.75	29	37	66	73	91	128	183	274	457	731	913
0.25	0.05	175	219	395	438	548	767	1096	1644	2740	4384	5479
0.25	0.10	88	110	197	219	274	384	548	822	1370	2192	2740
0.25	0.15	58	73	132	146	183	256	365	548	913	1461	1826
0.25	0.25	35	44	79	88	110	153	219	329	548	877	1096
0.25	0.35	25	31	56	63	78	110	157	235	391	626	783
0.25	0.50	18	22	39	44	55	77	110	164	274	438	548
0.25	0.75	12	15	26	29	37	51	73	110	183	292	365
0.50	0.05	88	110	197	219	274	384	548	822	1370	2192	2740
0.50	0.10	44	55	99	110	137	192	274	411	685	1096	1370
0.50	0.15	29	37	66	73	91	128	183	274	457	731	913
0.50	0.25	18	22	39	44	55	77	110	164	274	438	548
0.50	0.35	13	16	28	31	39	55	78	117	196	313	391
0.50	0.50	9	11	20	22	27	38	55	82	137	219	274
0.50	0.75	6	7	13	15	18	26	37	55	91	146	183
1.00	0.05	44	55	99	110	137	192	274	411	685	1096	1370
1.00	0.10	22	27	49	55	68	96	137	205	342	548	685
1.00	0.15	15	18	33	37	46	64	91	137	228	365	457
1.00	0.25	9	11	20	22	27	38	55	82	137	219	274
1.00	0.35	6	8	14	16	20	27	39	59	98	157	196
1.00	0.50	4	5	10	11	14	19	27	41	68	110	137
1.00	0.75	3	4	7	7	9	13	18	27	46	73	91
2.00	0.05	22	27	49	55	68	96	137	205	342	548	685
2.00	0.10	11	14	25	27	34	48	68	103	171	274	342
2.00	0.15	7	9	16	18	23	32	46	68	114	183	228
2.00	0.25	4	5	10	11	14	19	27	41	68	110	137
2.00	0.35	3	4	7	8	10	14	20	29	49	78	98
2.00	0.50	2	3	5	5	7	10	14	21	34	55	68
2.00	0.75	1	2	3	4	5	6	9	14	23	37	46
4.00	0.05	11	14	25	27	34	48	68	103	171	274	342
4.00	0.10	5	7	12	14	17	24	34	51	86	137	171
4.00	0.15	4	5	8	9	11	16	23	34	57	91	114
4.00	0.25	2	3	5	5	7	10	14	21	34	55	68
4.00	0.35	2	2	4	4	5	7	10	15	24	39	49
4.00	0.50	1	1	2	3	3	5	7	10	17	27	34
4.00	0.75	1	1	2	2	2	3	5	7	11	18	23

N=10 G=15 I=16

VOC ($/KM)	VOCS %	CI ($/KM) 6000	10000	18000	20000	25000	35000	50000	75000	125000	200000	250000
0.10	0.05	460	574	1034	1149	1436	2011	2872	4309	7181	11490	14362
0.10	0.10	230	287	517	574	718	1005	1436	2154	3591	5745	7181
0.10	0.15	153	191	345	383	479	670	957	1436	2394	3830	4787
0.10	0.25	92	115	207	230	287	402	574	862	1436	2298	2872
0.10	0.35	66	82	148	164	205	287	410	616	1026	1641	2052
0.10	0.50	46	57	103	115	144	201	287	431	718	1149	1436
0.10	0.75	31	38	69	77	96	134	191	287	479	766	957
0.25	0.05	184	230	414	460	574	804	1149	1723	2872	4596	5745
0.25	0.10	92	115	207	230	287	402	574	862	1436	2298	2872
0.25	0.15	61	77	138	153	191	268	383	574	957	1532	1915
0.25	0.25	37	46	83	92	115	161	230	345	574	919	1149
0.25	0.35	26	33	59	66	82	115	164	246	410	657	821
0.25	0.50	18	23	41	46	57	80	115	172	287	460	574
0.25	0.75	12	15	28	31	38	54	77	115	191	306	383
0.50	0.05	92	115	207	230	287	402	574	862	1436	2298	2872
0.50	0.10	46	57	103	115	144	201	287	431	718	1149	1436
0.50	0.15	31	38	69	77	96	134	191	287	479	766	957
0.50	0.25	18	23	41	46	57	80	115	172	287	460	574
0.50	0.35	13	16	30	33	41	57	82	123	205	328	410
0.50	0.50	9	11	21	23	29	40	57	86	144	230	287
0.50	0.75	6	8	14	15	19	27	38	57	96	153	191
1.00	0.05	46	57	103	115	144	201	287	431	718	1149	1436
1.00	0.10	23	29	52	57	72	101	144	215	359	574	718
1.00	0.15	15	19	34	38	48	67	96	144	239	383	479
1.00	0.25	9	11	21	23	29	40	57	86	144	230	287
1.00	0.35	7	8	15	16	21	29	41	62	103	164	205
1.00	0.50	5	6	10	11	14	20	29	43	72	115	144
1.00	0.75	3	4	7	8	10	13	19	29	48	77	96
2.00	0.05	23	29	52	57	72	101	144	215	359	574	718
2.00	0.10	11	14	26	29	36	50	72	108	180	287	359
2.00	0.15	8	10	17	19	24	34	48	72	120	191	239
2.00	0.25	5	6	10	11	14	20	29	43	72	115	144
2.00	0.35	3	4	7	8	10	14	21	31	51	82	103
2.00	0.50	2	3	5	6	7	10	14	22	36	57	72
2.00	0.75	2	2	3	4	5	7	10	14	24	38	48
4.00	0.05	11	14	26	29	36	50	72	108	180	287	359
4.00	0.10	6	7	13	14	18	25	36	54	90	144	180
4.00	0.15	4	5	9	10	12	17	24	36	60	96	120
4.00	0.25	2	3	5	6	7	10	14	22	36	57	72
4.00	0.35	2	2	4	4	5	7	10	15	26	41	51
4.00	0.50	1	1	3	3	4	5	7	11	18	29	36
4.00	0.75	1	1	2	2	2	3	5	7	12	19	24

N=10 G=15 I=17

VOC ($/KM)	VOCS %	CI ($/KM) 6000	10000	18000	20000	25000	35000	50000	75000	125000	200000	250000
0.10	0.05	481	602	1083	1203	1504	2106	3009	4513	7521	12034	15043
0.10	0.10	241	301	542	602	752	1053	1504	2256	3761	6017	7521
0.10	0.15	160	201	361	401	501	702	1003	1504	2507	4011	5014
0.10	0.25	96	120	217	241	301	421	602	903	1504	2407	3009
0.10	0.35	69	86	155	172	215	301	430	645	1074	1719	2149
0.10	0.50	48	60	108	120	150	211	301	451	752	1203	1504
0.10	0.75	32	40	72	80	100	140	201	301	501	802	1003
0.25	0.05	193	241	433	481	602	842	1203	1805	3009	4814	6017
0.25	0.10	96	120	217	241	301	421	602	903	1504	2407	3009
0.25	0.15	64	80	144	160	201	281	401	602	1003	1605	2006
0.25	0.25	39	48	87	96	120	168	241	361	602	963	1203
0.25	0.35	28	34	62	69	86	120	172	258	430	688	860
0.25	0.50	19	24	43	48	60	84	120	181	301	481	602
0.25	0.75	13	16	29	32	40	56	80	120	201	321	401
0.50	0.05	96	120	217	241	301	421	602	903	1504	2407	3009
0.50	0.10	48	60	108	120	150	211	301	451	752	1203	1504
0.50	0.15	32	40	72	80	100	140	201	301	501	802	1003
0.50	0.25	19	24	43	48	60	84	120	181	301	481	602
0.50	0.35	14	17	31	34	43	60	86	129	215	344	430
0.50	0.50	10	12	22	24	30	42	60	90	150	241	301
0.50	0.75	6	8	14	16	20	28	40	60	100	160	201
1.00	0.05	48	60	108	120	150	211	301	451	752	1203	1504
1.00	0.10	24	30	54	60	75	105	150	226	376	602	752
1.00	0.15	16	20	36	40	50	70	100	150	251	401	501
1.00	0.25	10	12	22	24	30	42	60	90	150	241	301
1.00	0.35	7	9	15	17	21	30	43	64	107	172	215
1.00	0.50	5	6	11	12	15	21	30	45	75	120	150
1.00	0.75	3	4	7	8	10	14	20	30	50	80	100
2.00	0.05	24	30	54	60	75	105	150	226	376	602	752
2.00	0.10	12	15	27	30	38	53	75	113	188	301	376
2.00	0.15	8	10	18	20	25	35	50	75	125	201	251
2.00	0.25	5	6	11	12	15	21	30	45	75	120	150
2.00	0.35	3	4	8	9	11	15	21	32	54	86	107
2.00	0.50	2	3	5	6	8	11	15	23	38	60	75
2.00	0.75	2	2	4	4	5	7	10	15	25	40	50
4.00	0.05	12	15	27	30	38	53	75	113	188	301	376
4.00	0.10	6	8	14	15	19	26	38	56	94	150	188
4.00	0.15	4	5	9	10	13	18	25	38	63	100	125
4.00	0.25	2	3	5	6	8	11	15	23	38	60	75
4.00	0.35	2	2	4	4	5	8	11	16	27	43	54
4.00	0.50	1	2	3	3	4	5	8	11	19	30	38
4.00	0.75	1	1	2	2	3	4	5	8	13	20	25

N=10 G=15 I=18

VOC ($/KM)	VOCS %	CI ($/KM) 8000	10000	18000	20000	25000	35000	50000	75000	125000	200000	250000
0.10	0.05	504	630	1133	1259	1574	2204	3148	4722	7870	12592	15740
0.10	0.10	252	315	567	630	787	1102	1574	2361	3935	6296	7870
0.10	0.15	168	210	378	420	525	735	1049	1574	2623	4197	5247
0.10	0.25	101	126	227	252	315	441	630	944	1574	2518	3148
0.10	0.35	72	90	162	180	225	315	450	675	1124	1799	2249
0.10	0.50	50	63	113	126	157	220	315	472	787	1259	1574
0.10	0.75	34	42	76	84	105	147	210	315	525	839	1049
0.25	0.05	201	252	453	504	630	881	1259	1889	3148	5037	6296
0.25	0.10	101	126	227	252	315	441	630	944	1574	2518	3148
0.25	0.15	67	84	151	168	210	294	420	630	1049	1679	2099
0.25	0.25	40	50	91	101	126	176	252	378	630	1007	1259
0.25	0.35	29	36	65	72	90	126	180	270	450	720	899
0.25	0.50	20	25	45	50	63	88	126	189	315	504	630
0.25	0.75	13	17	30	34	42	59	84	126	210	336	420
0.50	0.05	101	126	227	252	315	441	630	944	1574	2518	3148
0.50	0.10	50	63	113	126	157	220	315	472	787	1259	1574
0.50	0.15	34	42	76	84	105	147	210	315	525	839	1049
0.50	0.25	20	25	45	50	63	88	126	189	315	504	630
0.50	0.35	14	18	32	36	45	63	90	135	225	360	450
0.50	0.50	10	13	23	25	31	44	63	94	157	252	315
0.50	0.75	7	8	15	17	21	29	42	63	105	168	210
1.00	0.05	50	63	113	126	157	220	315	472	787	1259	1574
1.00	0.10	25	31	57	63	79	110	157	236	393	630	787
1.00	0.15	17	21	38	42	52	73	105	157	262	420	525
1.00	0.25	10	13	23	25	31	44	63	94	157	252	315
1.00	0.35	7	9	16	18	22	31	45	67	112	180	225
1.00	0.50	5	6	11	13	16	22	31	47	79	126	157
1.00	0.75	3	4	8	8	10	15	21	31	52	84	105
2.00	0.05	25	31	57	63	79	110	157	236	393	630	787
2.00	0.10	13	16	28	31	39	55	79	118	197	315	393
2.00	0.15	8	10	19	21	26	37	52	79	131	210	262
2.00	0.25	5	6	11	13	16	22	31	47	79	126	157
2.00	0.35	4	4	8	9	11	16	22	34	56	90	112
2.00	0.50	3	3	6	6	8	11	16	24	39	63	79
2.00	0.75	2	2	4	4	5	7	10	16	26	42	52
4.00	0.05	13	16	28	31	39	55	79	118	197	315	393
4.00	0.10	6	8	14	16	20	28	39	59	98	157	197
4.00	0.15	4	5	9	10	13	18	26	39	66	105	131
4.00	0.25	3	3	6	6	8	11	16	24	39	63	79
4.00	0.35	2	2	4	4	6	8	11	17	28	45	56
4.00	0.50	1	2	3	3	4	6	8	12	20	31	39
4.00	0.75	1	1	2	2	3	4	5	8	13	21	26

N=15 G= 5 I=10

VOC (S/KM)	VOCS %	CI (S/KM) 8000	10000	15000	20000	25000	35000	50000	75000	125000	200000	250000
0.10	0.05	416	519	935	1039	1299	1818	2597	3896	6493	10389	12986
0.10	0.10	208	260	467	519	649	909	1299	1948	3247	5194	6493
0.10	0.15	139	173	312	346	433	606	866	1299	2164	3463	4329
0.10	0.25	83	104	187	208	260	364	519	779	1299	2078	2597
0.10	0.35	59	74	134	148	186	260	371	557	928	1484	1855
0.10	0.50	42	52	93	104	130	182	260	390	649	1039	1299
0.10	0.75	28	35	62	69	87	121	173	260	433	693	866
0.25	0.05	166	208	374	416	519	727	1039	1558	2597	4156	5194
0.25	0.10	83	104	187	208	260	364	519	779	1299	2078	2597
0.25	0.15	55	69	125	139	173	242	346	519	866	1385	1731
0.25	0.25	33	42	75	83	104	145	208	312	519	831	1039
0.25	0.35	24	30	53	59	74	104	148	223	371	594	742
0.25	0.50	17	21	37	42	52	73	104	156	260	416	519
0.25	0.75	11	14	25	28	35	48	69	104	173	277	346
0.50	0.05	83	104	187	208	260	364	519	779	1299	2078	2597
0.50	0.10	42	52	93	104	130	182	260	390	649	1039	1299
0.50	0.15	28	35	62	69	87	121	173	260	433	693	866
0.50	0.25	17	21	37	42	52	73	104	156	260	416	519
0.50	0.35	12	15	27	30	37	52	74	111	186	297	371
0.50	0.50	8	10	19	21	26	36	52	78	130	208	260
0.50	0.75	6	7	12	14	17	24	35	52	87	139	173
1.00	0.05	42	52	93	104	130	182	260	390	649	1039	1299
1.00	0.10	21	26	47	52	65	91	130	195	325	519	649
1.00	0.15	14	17	31	35	43	61	87	130	216	346	433
1.00	0.25	8	10	19	21	26	36	52	78	130	208	260
1.00	0.35	6	7	13	15	19	26	37	56	93	148	186
1.00	0.50	4	5	9	10	13	18	26	39	65	104	130
1.00	0.75	3	3	6	7	9	12	17	26	43	69	87
2.00	0.05	21	26	47	52	65	91	130	195	325	519	649
2.00	0.10	10	13	23	26	32	45	65	97	162	260	325
2.00	0.15	7	9	16	17	22	30	43	65	108	173	216
2.00	0.25	4	5	9	10	13	18	26	39	65	104	130
2.00	0.35	3	4	7	7	9	13	19	28	46	74	93
2.00	0.50	2	3	5	5	6	9	13	19	32	52	65
2.00	0.75	1	2	3	3	4	6	9	13	22	35	43
4.00	0.05	10	13	23	26	32	45	65	97	162	260	325
4.00	0.10	5	6	12	13	16	23	32	49	81	130	162
4.00	0.15	3	4	8	9	11	15	22	32	54	87	108
4.00	0.25	2	3	5	5	6	9	13	19	32	52	65
4.00	0.35	1	2	3	4	5	6	9	14	23	37	46
4.00	0.50	1	1	2	3	3	5	6	10	16	26	32
4.00	0.75	1	1	2	2	2	3	4	6	11	17	22

N=15   G= 5   I=11

VOC ($/KM)	VOCS %	CI ($/KM) 8000	10000	18000	20000	25000	35000	50000	75000	125000	200000	250000
0.10	0.05	443	554	997	1107	1384	1938	2768	4153	6921	11074	13842
0.10	0.10	221	277	498	554	692	969	1384	2076	3461	5537	6921
0.10	0.15	148	185	332	369	461	646	923	1384	2307	3691	4614
0.10	0.25	89	111	199	221	277	388	554	831	1384	2215	2768
0.10	0.35	63	79	142	158	198	277	395	593	989	1582	1977
0.10	0.50	44	55	100	111	138	194	277	415	692	1107	1384
0.10	0.75	30	37	66	74	92	129	185	277	461	738	923
0.25	0.05	177	221	399	443	554	775	1107	1661	2768	4430	5537
0.25	0.10	89	111	199	221	277	388	554	831	1384	2215	2768
0.25	0.15	59	74	133	148	185	258	369	554	923	1477	1846
0.25	0.25	35	44	80	89	111	155	221	332	554	886	1107
0.25	0.35	25	32	57	63	79	111	158	237	395	633	791
0.25	0.50	18	22	40	44	55	78	111	166	277	443	554
0.25	0.75	12	15	27	30	37	52	74	111	185	295	369
0.50	0.05	89	111	199	221	277	388	554	831	1384	2215	2768
0.50	0.10	44	55	100	111	138	194	277	415	692	1107	1384
0.50	0.15	30	37	66	74	92	129	185	277	461	738	923
0.50	0.25	18	22	40	44	55	78	111	166	277	443	554
0.50	0.35	13	16	28	32	40	55	79	119	198	316	395
0.50	0.50	9	11	20	22	28	39	55	83	138	221	277
0.50	0.75	6	7	13	15	18	26	37	55	92	148	185
1.00	0.05	44	55	100	111	138	194	277	415	692	1107	1384
1.00	0.10	22	28	50	55	69	97	138	208	346	554	692
1.00	0.15	15	18	33	37	46	65	92	138	231	369	461
1.00	0.25	9	11	20	22	28	39	55	83	138	221	277
1.00	0.35	6	8	14	16	20	28	40	59	99	158	198
1.00	0.50	4	6	10	11	14	19	28	42	69	111	138
1.00	0.75	3	4	7	7	9	13	18	28	46	74	92
2.00	0.05	22	28	50	55	69	97	138	208	346	554	692
2.00	0.10	11	14	25	28	35	48	69	104	173	277	346
2.00	0.15	7	9	17	18	23	32	46	69	115	185	231
2.00	0.25	4	6	10	11	14	19	28	42	69	111	138
2.00	0.35	3	4	7	8	10	14	20	30	49	79	99
2.00	0.50	2	3	5	6	7	10	14	21	35	55	69
2.00	0.75	1	2	3	4	5	6	9	14	23	37	46
4.00	0.05	11	14	25	28	35	48	69	104	173	277	346
4.00	0.10	6	7	12	14	17	24	35	52	87	138	173
4.00	0.15	4	5	8	9	12	16	23	35	58	92	115
4.00	0.25	2	3	5	6	7	10	14	21	35	55	69
4.00	0.35	2	2	4	4	5	7	10	15	25	40	49
4.00	0.50	1	1	2	3	3	5	7	10	17	28	35
4.00	0.75	1	1	2	2	2	3	5	7	12	18	23

N=15 G= 5 I=12

VOC ($/KM)	VOC3 %	CI ($/KM) 8000	10000	18000	20000	25000	35000	50000	75000	125000	200000	250000
0.10	0.05	471	589	1060	1178	1473	2062	2945	4418	7363	11780	14725
0.10	0.10	236	295	530	589	736	1031	1473	2209	3681	5890	7363
0.10	0.15	157	196	353	393	491	687	982	1473	2454	3927	4908
0.10	0.25	94	118	212	236	295	412	589	884	1473	2356	2945
0.10	0.35	67	84	151	168	210	295	421	631	1052	1683	2104
0.10	0.50	47	59	106	118	147	206	295	442	736	1178	1473
0.10	0.75	31	39	71	79	98	137	196	295	491	785	982
0.25	0.05	188	236	424	471	589	825	1178	1767	2945	4712	5890
0.25	0.10	94	118	212	236	295	412	589	884	1473	2356	2945
0.25	0.15	63	79	141	157	196	275	393	589	982	1571	1963
0.25	0.25	38	47	85	94	118	165	236	353	589	942	1178
0.25	0.35	27	34	61	67	84	118	168	252	421	673	841
0.25	0.50	19	24	42	47	59	82	118	177	295	471	589
0.25	0.75	13	16	28	31	39	55	79	118	196	314	393
0.50	0.05	94	118	212	236	295	412	589	884	1473	2356	2945
0.50	0.10	47	59	106	118	147	206	295	442	736	1178	1473
0.50	0.15	31	39	71	79	98	137	196	295	491	785	982
0.50	0.25	19	24	42	47	59	82	118	177	295	471	589
0.50	0.35	13	17	30	34	42	59	84	126	210	337	421
0.50	0.50	9	12	21	24	29	41	59	88	147	236	295
0.50	0.75	6	8	14	16	20	27	39	59	98	157	196
1.00	0.05	47	59	106	118	147	206	295	442	736	1178	1473
1.00	0.10	24	29	53	59	74	103	147	221	368	589	736
1.00	0.15	16	20	35	39	49	69	98	147	245	393	491
1.00	0.25	9	12	21	24	29	41	59	88	147	236	295
1.00	0.35	7	8	15	17	21	29	42	63	105	168	210
1.00	0.50	5	6	11	12	15	21	29	44	74	118	147
1.00	0.75	3	4	7	8	10	14	20	29	49	79	98
2.00	0.05	24	29	53	59	74	103	147	221	368	589	736
2.00	0.10	12	15	27	29	37	52	74	110	184	295	368
2.00	0.15	8	10	18	20	25	34	49	74	123	196	245
2.00	0.25	5	6	11	12	15	21	29	44	74	118	147
2.00	0.35	3	4	8	8	11	15	21	32	53	84	105
2.00	0.50	2	3	5	6	7	10	15	22	37	59	74
2.00	0.75	2	2	4	4	5	7	10	15	25	39	49
4.00	0.05	12	15	27	29	37	52	74	110	184	295	368
4.00	0.10	6	7	13	15	18	26	37	55	92	147	184
4.00	0.15	4	5	9	10	12	17	25	37	61	98	123
4.00	0.25	2	3	5	6	7	10	15	22	37	59	74
4.00	0.35	2	2	4	4	5	7	11	16	26	42	53
4.00	0.50	1	1	3	3	4	5	7	11	18	29	37
4.00	0.75	1	1	2	2	2	3	5	7	12	20	25

N=15 G= 5 I=13

VOC ($/KW)	VOCS %	CI ($/KW) 8000	10000	18000	20000	25000	35000	50000	75000	125000	200000	250000
0.10	0.05	500	625	1126	1251	1563	2189	3127	4690	7817	12507	15634
0.10	0.10	250	313	563	625	782	1094	1563	2345	3908	6254	7817
0.10	0.15	167	208	375	417	521	730	1042	1563	2606	4169	5211
0.10	0.25	100	125	225	250	313	438	625	938	1563	2501	3127
0.10	0.35	71	89	161	179	223	313	447	670	1117	1787	2233
0.10	0.50	50	63	113	125	156	219	313	469	782	1251	1563
0.10	0.75	33	42	75	83	104	146	208	313	521	834	1042
0.25	0.05	200	250	450	500	625	875	1251	1876	3127	5003	6254
0.25	0.10	100	125	225	250	313	438	625	938	1563	2501	3127
0.25	0.15	67	83	150	167	208	292	417	625	1042	1668	2085
0.25	0.25	40	50	90	100	125	175	250	375	625	1001	1251
0.25	0.35	29	36	64	71	89	125	179	268	447	715	893
0.25	0.50	20	25	45	50	63	88	125	188	313	500	625
0.25	0.75	13	17	30	33	42	58	83	125	208	334	417
0.50	0.05	100	125	225	250	313	438	625	938	1563	2501	3127
0.50	0.10	50	63	113	125	156	219	313	469	782	1251	1563
0.50	0.15	33	42	75	83	104	146	208	313	521	834	1042
0.50	0.25	20	25	45	50	63	88	125	188	313	500	625
0.50	0.35	14	18	32	36	45	63	89	134	223	357	447
0.50	0.50	10	13	23	25	31	44	63	94	156	250	313
0.50	0.75	7	8	15	17	21	29	42	63	104	167	208
1.00	0.05	50	63	113	125	156	219	313	469	782	1251	1563
1.00	0.10	25	31	56	63	78	109	156	235	391	625	782
1.00	0.15	17	21	38	42	52	73	104	156	261	417	521
1.00	0.25	10	13	23	25	31	44	63	94	156	250	313
1.00	0.35	7	9	16	18	22	31	45	67	112	179	223
1.00	0.50	5	6	11	13	16	22	31	47	78	125	156
1.00	0.75	3	4	8	8	10	15	21	31	52	83	104
2.00	0.05	25	31	56	63	78	109	156	235	391	625	782
2.00	0.10	13	16	28	31	39	55	78	117	195	313	391
2.00	0.15	8	10	19	21	26	36	52	78	130	208	261
2.00	0.25	5	6	11	13	16	22	31	47	78	125	156
2.00	0.35	4	4	8	9	11	16	22	34	56	89	112
2.00	0.50	3	3	6	6	8	11	16	23	39	63	78
2.00	0.75	2	2	4	4	5	7	10	16	26	42	52
4.00	0.05	13	16	28	31	39	55	78	117	195	313	391
4.00	0.10	6	8	14	16	20	27	39	59	98	156	195
4.00	0.15	4	5	9	10	13	18	26	39	65	104	130
4.00	0.25	3	3	6	6	8	11	16	23	39	63	78
4.00	0.35	2	2	4	4	6	8	11	17	28	45	56
4.00	0.50	1	2	3	3	4	5	8	12	20	31	39
4.00	0.75	1	1	2	2	3	4	5	8	13	21	26

N=15 G= 5 I=14

VOC ($/KM)	VOCS %	8000	10000	18000	20000	25000	35000	50000	75000	125000	200000	250000
		CI ($/KM)										
0.10	0.05	530	663	1193	1325	1657	2319	3313	4970	8283	13253	16567
0.10	0.10	265	331	596	663	828	1160	1657	2485	4142	6627	8283
0.10	0.15	177	221	398	442	552	773	1104	1657	2761	4418	5522
0.10	0.25	106	133	239	265	331	464	663	994	1657	2651	3313
0.10	0.35	76	95	170	189	237	331	473	710	1183	1893	2367
0.10	0.50	53	66	119	133	166	232	331	497	828	1325	1657
0.10	0.75	35	44	80	88	110	155	221	331	552	884	1104
0.25	0.05	212	265	477	530	663	928	1325	1988	3313	5301	6627
0.25	0.10	106	133	239	265	331	464	663	994	1657	2651	3313
0.25	0.15	71	88	159	177	221	309	442	663	1104	1767	2209
0.25	0.25	42	53	95	106	133	186	265	398	663	1060	1325
0.25	0.35	30	38	68	76	95	133	189	284	473	757	947
0.25	0.50	21	27	48	53	66	93	133	199	331	530	663
0.25	0.75	14	18	32	35	44	62	88	133	221	353	442
0.50	0.05	106	133	239	265	331	464	663	994	1657	2651	3313
0.50	0.10	53	66	119	133	166	232	331	497	828	1325	1657
0.50	0.15	35	44	80	88	110	155	221	331	552	884	1104
0.50	0.25	21	27	48	53	66	93	133	199	331	530	663
0.50	0.35	15	19	34	38	47	66	95	142	237	379	473
0.50	0.50	11	13	24	27	33	46	66	99	166	265	331
0.50	0.75	7	9	16	18	22	31	44	66	110	177	221
1.00	0.05	53	66	119	133	166	232	331	497	828	1325	1657
1.00	0.10	27	33	60	66	83	116	166	249	414	663	828
1.00	0.15	18	22	40	44	55	77	110	166	276	442	552
1.00	0.25	11	13	24	27	33	46	66	99	166	265	331
1.00	0.35	8	9	17	19	24	33	47	71	118	189	237
1.00	0.50	5	7	12	13	17	23	33	50	83	133	166
1.00	0.75	4	4	8	9	11	15	22	33	55	88	110
2.00	0.05	27	33	60	66	83	116	166	249	414	663	828
2.00	0.10	13	17	30	33	41	58	83	124	207	331	414
2.00	0.15	9	11	20	22	28	39	55	83	138	221	276
2.00	0.25	5	7	12	13	17	23	33	50	83	133	166
2.00	0.35	4	5	9	9	12	17	24	36	59	95	118
2.00	0.50	3	3	6	7	8	12	17	25	41	66	83
2.00	0.75	2	2	4	4	6	8	11	17	28	44	55
4.00	0.05	13	17	30	33	41	58	83	124	207	331	414
4.00	0.10	7	8	15	17	21	29	41	62	104	166	207
4.00	0.15	4	6	10	11	14	19	28	41	69	110	138
4.00	0.25	3	3	6	7	8	12	17	25	41	66	83
4.00	0.35	2	2	4	5	6	8	12	18	30	47	59
4.00	0.50	1	2	3	3	4	6	8	12	21	33	41
4.00	0.75	1	1	2	2	3	4	6	8	14	22	28

N=15 G= 5 I=15

VOC ($/KM)	VOCS %	CI ($/KM) 6000	10000	18000	20000	25000	35000	50000	75000	125000	200000	250000
0.10	0.05	561	701	1262	1402	1752	2453	3505	5257	8762	14019	17523
0.10	0.10	280	350	631	701	876	1227	1752	2628	4381	7009	8762
0.10	0.15	187	234	421	467	584	818	1168	1752	2921	4673	5841
0.10	0.25	112	140	252	280	350	491	701	1051	1752	2804	3505
0.10	0.35	80	100	180	200	250	350	501	751	1252	2003	2503
0.10	0.50	56	70	126	140	175	245	350	526	876	1402	1752
0.10	0.75	37	47	84	93	117	164	234	350	584	935	1168
0.25	0.05	224	280	505	561	701	981	1402	2103	3505	5607	7009
0.25	0.10	112	140	252	280	350	491	701	1051	1752	2804	3505
0.25	0.15	75	93	168	187	234	327	467	701	1168	1869	2336
0.25	0.25	45	56	101	112	140	196	280	421	701	1121	1402
0.25	0.35	32	40	72	80	100	140	200	300	501	801	1001
0.25	0.50	22	28	50	56	70	98	140	210	350	561	701
0.25	0.75	15	19	34	37	47	65	93	140	234	374	467
0.50	0.05	112	140	252	280	350	491	701	1051	1752	2804	3505
0.50	0.10	56	70	126	140	175	245	350	526	876	1402	1752
0.50	0.15	37	47	84	93	117	164	234	350	584	935	1168
0.50	0.25	22	28	50	56	70	98	140	210	350	561	701
0.50	0.35	16	20	36	40	50	70	100	150	250	401	501
0.50	0.50	11	14	25	28	35	49	70	105	175	280	350
0.50	0.75	7	9	17	19	23	33	47	70	117	187	234
1.00	0.05	56	70	126	140	175	245	350	526	876	1402	1752
1.00	0.10	28	35	63	70	88	123	175	263	438	701	876
1.00	0.15	19	23	42	47	58	82	117	175	292	467	584
1.00	0.25	11	14	25	28	35	49	70	105	175	280	350
1.00	0.35	8	10	18	20	25	35	50	75	125	200	250
1.00	0.50	6	7	13	14	18	25	35	53	88	140	175
1.00	0.75	4	5	8	9	12	16	23	35	58	93	117
2.00	0.05	28	35	63	70	88	123	175	263	438	701	876
2.00	0.10	14	18	32	35	44	61	88	131	219	350	438
2.00	0.15	9	12	21	23	29	41	58	88	146	234	292
2.00	0.25	6	7	13	14	18	25	35	53	88	140	175
2.00	0.35	4	5	9	10	13	18	25	38	63	100	125
2.00	0.50	3	4	6	7	9	12	18	26	44	70	88
2.00	0.75	2	2	4	5	6	8	12	18	29	47	58
4.00	0.05	14	18	32	35	44	61	88	131	219	350	438
4.00	0.10	7	9	16	18	22	31	44	66	110	175	219
4.00	0.15	5	6	11	12	15	20	29	44	73	117	146
4.00	0.25	3	4	8	7	9	12	18	26	44	70	88
4.00	0.35	2	3	5	5	6	9	13	19	31	50	63
4.00	0.50	1	2	3	4	4	6	9	13	22	35	44
4.00	0.75	1	1	2	2	3	4	6	9	15	23	29

N=15 G= 5 I=16

VOC ($/KM)	VOCS %	CI ($/KM) 8000	10000	18000	20000	25000	35000	50000	75000	125000	200000	250000
0.10	0.05	592	740	1332	1480	1850	2590	3700	5551	9251	14802	18502
0.10	0.10	296	370	666	740	925	1295	1850	2775	4626	7401	9251
0.10	0.15	197	247	444	493	617	863	1233	1850	3084	4934	6167
0.10	0.25	118	148	266	296	370	518	740	1110	1850	2960	3700
0.10	0.35	85	106	190	211	264	370	529	793	1322	2115	2643
0.10	0.50	59	74	133	148	185	259	370	555	925	1480	1850
0.10	0.75	39	49	89	99	123	173	247	370	617	987	1233
0.25	0.05	237	296	533	592	740	1036	1480	2220	3700	5921	7401
0.25	0.10	118	148	266	296	370	518	740	1110	1850	2960	3700
0.25	0.15	79	99	178	197	247	345	493	740	1233	1974	2467
0.25	0.25	47	59	107	118	148	207	296	444	740	1184	1480
0.25	0.35	34	42	76	85	106	148	211	317	529	846	1057
0.25	0.50	24	30	53	59	74	104	148	222	370	592	740
0.25	0.75	16	20	36	39	49	69	99	148	247	395	493
0.50	0.05	118	148	266	296	370	518	740	1110	1850	2960	3700
0.50	0.10	59	74	133	148	185	259	370	555	925	1480	1850
0.50	0.15	39	49	89	99	123	173	247	370	617	987	1233
0.50	0.25	24	30	53	59	74	104	148	222	370	592	740
0.50	0.35	17	21	38	42	53	74	106	159	264	423	529
0.50	0.50	12	15	27	30	37	52	74	111	185	296	370
0.50	0.75	8	10	18	20	25	35	49	74	123	197	247
1.00	0.05	59	74	133	148	185	259	370	555	925	1480	1850
1.00	0.10	30	37	67	74	93	130	185	278	463	740	925
1.00	0.15	20	25	44	49	62	86	123	185	308	493	617
1.00	0.25	12	15	27	30	37	52	74	111	185	296	370
1.00	0.35	8	11	19	21	26	37	53	79	132	211	264
1.00	0.50	6	7	13	15	19	26	37	56	93	148	185
1.00	0.75	4	5	9	10	12	17	25	37	62	99	123
2.00	0.05	30	37	67	74	93	130	185	278	463	740	925
2.00	0.10	15	19	33	37	46	65	93	139	231	370	463
2.00	0.15	10	12	22	25	31	43	62	93	154	247	308
2.00	0.25	6	7	13	15	19	26	37	56	93	148	185
2.00	0.35	4	5	10	11	13	19	26	40	66	106	132
2.00	0.50	3	4	7	7	9	13	19	28	46	74	93
2.00	0.75	2	2	4	5	6	9	12	19	31	49	62
4.00	0.05	15	19	33	37	46	65	93	139	231	370	463
4.00	0.10	7	9	17	19	23	32	46	69	116	185	231
4.00	0.15	5	6	11	12	15	22	31	46	77	123	154
4.00	0.25	3	4	7	7	9	13	19	28	46	74	93
4.00	0.35	2	3	5	5	7	9	13	20	33	53	66
4.00	0.50	1	2	3	4	5	6	9	14	23	37	46
4.00	0.75	1	1	2	2	3	4	6	9	15	25	31

N=15 G= 5 I=17

VOC ($/KM)	VOCS %	CI ($/KM) 6000	10000	18000	20000	25000	35000	50000	75000	125000	200000	250000
0.10	0.05	624	780	1404	1560	1950	2730	3901	5851	9751	15602	19503
0.10	0.10	312	390	702	780	975	1365	1950	2925	4876	7801	9751
0.10	0.15	208	260	468	520	650	910	1300	1950	3250	5201	6501
0.10	0.25	125	156	281	312	390	546	780	1170	1950	3120	3901
0.10	0.35	89	111	201	223	279	390	557	836	1393	2229	2786
0.10	0.50	62	78	140	156	195	273	390	585	975	1560	1950
0.10	0.75	42	52	94	104	130	182	260	390	650	1040	1300
0.25	0.05	250	312	562	624	780	1092	1560	2340	3901	6241	7801
0.25	0.10	125	156	281	312	390	546	780	1170	1950	3120	3901
0.25	0.15	83	104	187	208	260	364	520	780	1300	2080	2600
0.25	0.25	50	62	112	125	156	218	312	468	780	1248	1560
0.25	0.35	36	45	80	89	111	156	223	334	557	892	1114
0.25	0.50	25	31	56	62	78	109	156	234	390	624	780
0.25	0.75	17	21	37	42	52	73	104	156	260	416	520
0.50	0.05	125	156	281	312	390	546	780	1170	1950	3120	3901
0.50	0.10	62	78	140	156	195	273	390	585	975	1560	1950
0.50	0.15	42	52	94	104	130	182	260	390	650	1040	1300
0.50	0.25	25	31	56	62	78	109	156	234	390	624	780
0.50	0.35	18	22	40	45	56	78	111	167	279	446	557
0.50	0.50	12	16	28	31	39	55	78	117	195	312	390
0.50	0.75	8	10	19	21	26	36	52	78	130	208	260
1.00	0.05	62	78	140	156	195	273	390	585	975	1560	1950
1.00	0.10	31	39	70	78	98	137	195	293	488	780	975
1.00	0.15	21	26	47	52	65	91	130	195	325	520	650
1.00	0.25	12	16	28	31	39	55	78	117	195	312	390
1.00	0.35	9	11	20	22	28	39	56	84	139	223	279
1.00	0.50	6	8	14	16	20	27	39	59	98	156	195
1.00	0.75	4	5	9	10	13	18	26	39	65	104	130
2.00	0.05	31	39	70	78	98	137	195	293	488	780	975
2.00	0.10	16	20	35	39	49	68	98	146	244	390	488
2.00	0.15	10	13	23	26	33	46	65	98	163	260	325
2.00	0.25	6	8	14	16	20	27	39	59	98	156	195
2.00	0.35	4	6	10	11	14	20	28	42	70	111	139
2.00	0.50	3	4	7	8	10	14	20	29	49	78	98
2.00	0.75	2	3	5	5	7	9	13	20	33	52	65
4.00	0.05	16	20	35	39	49	68	98	146	244	390	488
4.00	0.10	8	10	18	20	24	34	49	73	122	195	244
4.00	0.15	5	7	12	13	16	23	33	49	81	130	163
4.00	0.25	3	4	7	8	10	14	20	29	49	78	98
4.00	0.35	2	3	5	6	7	10	14	21	35	56	70
4.00	0.50	2	2	4	4	5	7	10	15	24	39	49
4.00	0.75	1	1	2	3	3	5	7	10	16	26	33

N=15 G= 5 I=18

VOC ($/KM)	VOCS %	CI ($/KM) 8000	10000	18000	20000	25000	35000	50000	75000	125000	200000	250000
0.10	0.05	657	821	1478	1642	2052	2873	4105	6157	10262	16419	20524
0.10	0.10	328	410	739	821	1026	1437	2052	3079	5131	8209	10262
0.10	0.15	219	274	493	547	684	958	1368	2052	3421	5473	6841
0.10	0.25	131	164	296	328	410	575	821	1231	2052	3284	4105
0.10	0.35	94	117	211	235	293	410	586	880	1466	2346	2932
0.10	0.50	66	82	148	164	205	287	410	616	1026	1642	2052
0.10	0.75	44	55	99	109	137	192	274	410	684	1095	1368
0.25	0.05	263	328	591	657	821	1149	1642	2463	4105	6568	8209
0.25	0.10	131	164	296	328	410	575	821	1231	2052	3284	4105
0.25	0.15	88	109	197	219	274	383	547	821	1368	2189	2736
0.25	0.25	53	66	118	131	164	230	328	493	821	1314	1642
0.25	0.35	38	47	84	94	117	164	235	352	586	938	1173
0.25	0.50	26	33	59	66	82	115	164	246	410	657	821
0.25	0.75	18	22	39	44	55	77	109	164	274	438	547
0.50	0.05	131	164	296	328	410	575	821	1231	2052	3284	4105
0.50	0.10	66	82	148	164	205	287	410	616	1026	1642	2052
0.50	0.15	44	55	99	109	137	192	274	410	684	1095	1368
0.50	0.25	26	33	59	66	82	115	164	246	410	657	821
0.50	0.35	19	23	42	47	59	82	117	176	293	469	586
0.50	0.50	13	16	30	33	41	57	82	123	205	328	410
0.50	0.75	9	11	20	22	27	38	55	82	137	219	274
1.00	0.05	66	82	148	164	205	287	410	616	1026	1642	2052
1.00	0.10	33	41	74	82	103	144	205	308	513	821	1026
1.00	0.15	22	27	49	55	68	96	137	205	342	547	684
1.00	0.25	13	16	30	33	41	57	82	123	205	328	410
1.00	0.35	9	12	21	23	29	41	59	88	147	235	293
1.00	0.50	7	8	15	16	21	29	41	62	103	164	205
1.00	0.75	4	5	10	11	14	19	27	41	68	109	137
2.00	0.05	33	41	74	82	103	144	205	308	513	821	1026
2.00	0.10	16	21	37	41	51	72	103	154	257	410	513
2.00	0.15	11	14	25	27	34	48	68	103	171	274	342
2.00	0.25	7	8	15	16	21	29	41	62	103	164	205
2.00	0.35	5	6	11	12	15	21	29	44	73	117	147
2.00	0.50	3	4	7	8	10	14	21	31	51	82	103
2.00	0.75	2	3	5	5	7	10	14	21	34	55	68
4.00	0.05	16	21	37	41	51	72	103	154	257	410	513
4.00	0.10	8	10	18	21	26	36	51	77	128	205	257
4.00	0.15	5	7	12	14	17	24	34	51	86	137	171
4.00	0.25	3	4	7	8	10	14	21	31	51	82	103
4.00	0.35	2	3	5	6	7	10	15	22	37	59	73
4.00	0.50	2	2	4	4	5	7	10	15	26	41	51
4.00	0.75	1	1	2	3	3	5	7	10	17	27	34

N=15 G= 8 I=10

VOC ($/KM)	VOCS %	CI ($/KM) 8000	10000	18000	20000	25000	35000	50000	75000	125000	200000	250000
0.10	0.05	337	422	759	843	1054	1476	2109	3163	5272	8435	10543
0.10	0.10	169	211	380	422	527	738	1054	1581	2636	4217	5272
0.10	0.15	112	141	253	281	351	492	703	1054	1757	2812	3514
0.10	0.25	67	84	152	169	211	295	422	633	1054	1687	2109
0.10	0.35	48	60	108	120	151	211	301	452	753	1205	1506
0.10	0.50	34	42	76	84	105	148	211	316	527	843	1054
0.10	0.75	22	28	51	56	70	98	141	211	351	562	703
0.25	0.05	135	169	304	337	422	590	843	1265	2109	3374	4217
0.25	0.10	67	84	152	169	211	295	422	633	1054	1687	2109
0.25	0.15	45	56	101	112	141	197	281	422	703	1125	1406
0.25	0.25	27	34	61	67	84	118	169	253	422	675	843
0.25	0.35	19	24	43	48	60	84	120	181	301	482	602
0.25	0.50	13	17	30	34	42	59	84	127	211	337	422
0.25	0.75	9	11	20	22	28	39	56	84	141	225	281
0.50	0.05	67	84	152	169	211	295	422	633	1054	1687	2109
0.50	0.10	34	42	76	84	105	148	211	316	527	843	1054
0.50	0.15	22	28	51	56	70	98	141	211	351	562	703
0.50	0.25	13	17	30	34	42	59	84	127	211	337	422
0.50	0.35	10	12	22	24	30	42	60	90	151	241	301
0.50	0.50	7	8	15	17	21	30	42	63	105	169	211
0.50	0.75	4	6	10	11	14	20	28	42	70	112	141
1.00	0.05	34	42	76	84	105	148	211	316	527	843	1054
1.00	0.10	17	21	38	42	53	74	105	158	264	422	527
1.00	0.15	11	14	25	28	35	49	70	105	176	281	351
1.00	0.25	7	8	15	17	21	30	42	63	105	169	211
1.00	0.35	5	6	11	12	15	21	30	45	75	120	151
1.00	0.50	3	4	8	8	11	15	21	32	53	84	105
1.00	0.75	2	3	5	6	7	10	14	21	35	56	70
2.00	0.05	17	21	38	42	53	74	105	158	264	422	527
2.00	0.10	8	11	19	21	26	37	53	79	132	211	264
2.00	0.15	6	7	13	14	18	25	35	53	88	141	176
2.00	0.25	3	4	8	8	11	15	21	32	53	84	105
2.00	0.35	2	3	5	6	8	11	15	23	38	60	75
2.00	0.50	2	2	4	4	5	7	11	16	26	42	53
2.00	0.75	1	1	3	3	4	5	7	11	18	28	35
4.00	0.05	8	11	19	21	26	37	53	79	132	211	264
4.00	0.10	4	5	9	11	13	18	26	40	66	105	132
4.00	0.15	3	4	6	7	9	12	18	26	44	70	88
4.00	0.25	2	2	4	4	5	7	11	16	26	42	53
4.00	0.35	1	2	3	3	4	5	8	11	19	30	38
4.00	0.50	1	1	2	2	3	4	5	8	13	21	26
4.00	0.75	1	1	1	1	2	2	4	5	9	14	18

N=15 G= 8 I=11

VOC ($/KM)	VOCS %	CI ($/KM) 8000	10000	18000	20000	25000	35000	50000	75000	125000	200000	250000
0.10	0.05	361	452	813	903	1129	1581	2258	3387	5646	9033	11291
0.10	0.10	181	226	406	452	565	790	1129	1694	2823	4516	5646
0.10	0.15	120	151	271	301	376	527	753	1129	1882	3011	3764
0.10	0.25	72	90	163	181	226	316	452	677	1129	1807	2258
0.10	0.35	52	65	116	129	161	226	323	484	807	1290	1613
0.10	0.50	36	45	81	90	113	158	226	339	565	903	1129
0.10	0.75	24	30	54	60	75	105	151	226	376	602	753
0.25	0.05	145	181	325	361	452	632	903	1355	2258	3613	4516
0.25	0.10	72	90	163	181	226	316	452	677	1129	1807	2258
0.25	0.15	48	60	108	120	151	211	301	452	753	1204	1505
0.25	0.25	29	36	65	72	90	126	181	271	452	723	903
0.25	0.35	21	26	46	52	65	90	129	194	323	516	645
0.25	0.50	14	18	33	36	45	63	90	135	226	361	452
0.25	0.75	10	12	22	24	30	42	60	90	151	241	301
0.50	0.05	72	90	163	181	226	316	452	677	1129	1807	2258
0.50	0.10	36	45	81	90	113	158	226	339	565	903	1129
0.50	0.15	24	30	54	60	75	105	151	226	376	602	753
0.50	0.25	14	18	33	36	45	63	90	135	226	361	452
0.50	0.35	10	13	23	26	32	45	65	97	161	258	323
0.50	0.50	7	9	16	18	23	32	45	68	113	181	226
0.50	0.75	5	6	11	12	15	21	30	45	75	120	151
1.00	0.05	36	45	81	90	113	158	226	339	565	903	1129
1.00	0.10	18	23	41	45	56	79	113	169	282	452	565
1.00	0.15	12	15	27	30	38	53	75	113	188	301	376
1.00	0.25	7	9	16	18	23	32	45	68	113	181	226
1.00	0.35	5	6	12	13	16	23	32	48	81	129	161
1.00	0.50	4	5	8	9	11	16	23	34	56	90	113
1.00	0.75	2	3	5	6	8	11	15	23	38	60	75
2.00	0.05	18	23	41	45	56	79	113	169	282	452	565
2.00	0.10	9	11	20	23	28	40	56	85	141	226	282
2.00	0.15	6	8	14	15	19	26	38	56	94	151	188
2.00	0.25	4	5	8	9	11	16	23	34	56	90	113
2.00	0.35	3	3	6	6	8	11	16	24	40	65	81
2.00	0.50	2	2	4	5	6	8	11	17	28	45	56
2.00	0.75	1	2	3	3	4	5	8	11	19	30	38
4.00	0.05	9	11	20	23	28	40	56	85	141	226	282
4.00	0.10	5	6	10	11	14	20	28	42	71	113	141
4.00	0.15	3	4	7	8	9	13	19	28	47	75	94
4.00	0.25	2	2	4	5	6	8	11	17	28	45	56
4.00	0.35	1	2	3	3	4	6	8	12	20	32	40
4.00	0.50	1	1	2	2	3	4	6	8	14	23	28
4.00	0.75	1	1	1	2	2	3	4	6	9	15	19

N=15 G= 8 I=12

VOC ($/KM)	VOCS %	CI ($/KM) 8000	10000	18000	20000	25000	35000	50000	75000	125000	200000	250000
0.10	0.05	386	483	669	965	1207	1689	2413	3620	6033	9653	12067
0.10	0.10	193	241	434	483	603	845	1207	1810	3017	4827	6033
0.10	0.15	129	161	290	322	402	563	804	1207	2011	3218	4022
0.10	0.25	77	97	174	193	241	338	483	724	1207	1931	2413
0.10	0.35	55	69	124	138	172	241	345	517	862	1379	1724
0.10	0.50	39	48	87	97	121	169	241	362	603	965	1207
0.10	0.75	26	32	58	64	80	113	161	241	402	644	804
0.25	0.05	154	193	348	386	483	676	965	1448	2413	3861	4827
0.25	0.10	77	97	174	193	241	338	483	724	1207	1931	2413
0.25	0.15	51	64	116	129	161	225	322	483	804	1287	1609
0.25	0.25	31	39	70	77	97	135	193	290	483	772	965
0.25	0.35	22	28	50	55	69	97	138	207	345	552	690
0.25	0.50	15	19	35	39	48	68	97	145	241	386	483
0.25	0.75	10	13	23	26	32	45	64	97	161	257	322
0.50	0.05	77	97	174	193	241	338	483	724	1207	1931	2413
0.50	0.10	39	48	87	97	121	169	241	362	603	965	1207
0.50	0.15	26	32	58	64	80	113	161	241	402	644	804
0.50	0.25	15	19	35	39	48	68	97	145	241	386	483
0.50	0.35	11	14	25	28	34	48	69	103	172	276	345
0.50	0.50	8	10	17	19	24	34	48	72	121	193	241
0.50	0.75	5	6	12	13	16	23	32	48	80	129	161
1.00	0.05	39	48	87	97	121	169	241	362	603	965	1207
1.00	0.10	19	24	43	48	60	84	121	181	302	483	603
1.00	0.15	13	16	29	32	40	56	80	121	201	322	402
1.00	0.25	8	10	17	19	24	34	48	72	121	193	241
1.00	0.35	6	7	12	14	17	24	34	52	86	138	172
1.00	0.50	4	5	9	10	12	17	24	36	60	97	121
1.00	0.75	3	3	6	6	8	11	16	24	40	64	80
2.00	0.05	19	24	43	48	60	84	121	181	302	483	603
2.00	0.10	10	12	22	24	30	42	60	91	151	241	302
2.00	0.15	6	8	14	16	20	28	40	60	101	161	201
2.00	0.25	4	5	9	10	12	17	24	36	60	97	121
2.00	0.35	3	3	6	7	9	12	17	26	43	69	86
2.00	0.50	2	2	4	5	6	8	12	18	30	48	60
2.00	0.75	1	2	3	3	4	6	8	12	20	32	40
4.00	0.05	10	12	22	24	30	42	60	91	151	241	302
4.00	0.10	5	6	11	12	15	21	30	45	75	121	151
4.00	0.15	3	4	7	8	10	14	20	30	50	80	101
4.00	0.25	2	2	4	5	6	8	12	18	30	48	60
4.00	0.35	1	2	3	3	4	6	9	13	22	34	43
4.00	0.50	1	1	2	2	3	4	6	9	15	24	30
4.00	0.75	1	1	1	2	2	3	4	6	10	16	20

N=15 G= 8 I=13

VOC ($/KM)	VOCS %	CI ($/KM): 8000	10000	18000	20000	25000	35000	50000	75000	125000	200000	250000
0.10	0.05	412	515	927	1030	1287	1802	2574	3861	6435	10295	12869
0.10	0.10	206	257	463	515	643	901	1287	1930	3217	5148	6435
0.10	0.15	137	172	309	343	429	601	858	1287	2145	3432	4290
0.10	0.25	82	103	185	206	257	360	515	772	1287	2059	2574
0.10	0.35	59	74	132	147	184	257	368	552	919	1471	1838
0.10	0.50	41	51	93	103	129	180	257	386	643	1030	1287
0.10	0.75	27	34	62	69	86	120	172	257	429	686	858
0.25	0.05	165	206	371	412	515	721	1030	1544	2574	4118	5148
0.25	0.10	82	103	185	206	257	360	515	772	1287	2059	2574
0.25	0.15	55	69	124	137	172	240	343	515	858	1373	1716
0.25	0.25	33	41	74	82	103	144	206	309	515	824	1030
0.25	0.35	24	29	53	59	74	103	147	221	368	588	735
0.25	0.50	16	21	37	41	51	72	103	154	257	412	515
0.25	0.75	11	14	25	27	34	48	69	103	172	275	343
0.50	0.05	82	103	185	206	257	360	515	772	1287	2059	2574
0.50	0.10	41	51	93	103	129	180	257	386	643	1030	1287
0.50	0.15	27	34	62	69	86	120	172	257	429	686	858
0.50	0.25	16	21	37	41	51	72	103	154	257	412	515
0.50	0.35	12	15	26	29	37	51	74	110	184	294	368
0.50	0.50	8	10	19	21	26	36	51	77	129	206	257
0.50	0.75	5	7	12	14	17	24	34	51	86	137	172
1.00	0.05	41	51	93	103	129	180	257	386	643	1030	1287
1.00	0.10	21	26	46	51	64	90	129	193	322	515	643
1.00	0.15	14	17	31	34	43	60	86	129	214	343	429
1.00	0.25	8	10	19	21	26	36	51	77	129	206	257
1.00	0.35	6	7	13	15	18	26	37	55	92	147	184
1.00	0.50	4	5	9	10	13	18	26	39	64	103	129
1.00	0.75	3	3	6	7	9	12	17	26	43	69	86
2.00	0.05	21	26	46	51	64	90	129	193	322	515	643
2.00	0.10	10	13	23	26	32	45	64	97	161	257	322
2.00	0.15	7	9	15	17	21	30	43	64	107	172	214
2.00	0.25	4	5	9	10	13	18	26	39	64	103	129
2.00	0.35	3	4	7	7	9	13	18	28	46	74	92
2.00	0.50	2	3	5	5	6	9	13	19	32	51	64
2.00	0.75	1	2	3	3	4	6	9	13	21	34	43
4.00	0.05	10	13	23	26	32	45	64	97	161	257	322
4.00	0.10	5	6	12	13	16	23	32	48	80	129	161
4.00	0.15	3	4	8	9	11	15	21	32	54	86	107
4.00	0.25	2	3	5	5	6	9	13	19	32	51	64
4.00	0.35	1	2	3	4	5	6	9	14	23	37	46
4.00	0.50	1	1	2	3	3	5	6	10	16	26	32
4.00	0.75	1	1	2	2	2	3	4	6	11	17	21

N=15 G= 8 I=14

VOC ($/KM)	VOCS %	CI ($/KM) 6000	10000	18000	20000	25000	35000	50000	75000	125000	200000	250000
0.10	0.05	438	548	986	1096	1370	1918	2740	4109	6849	10958	13698
0.10	0.10	219	274	493	548	685	959	1370	2055	3424	5479	6849
0.10	0.15	146	183	329	365	457	639	913	1370	2283	3653	4566
0.10	0.25	88	110	197	219	274	384	548	822	1370	2192	2740
0.10	0.35	63	78	141	157	196	274	391	587	978	1565	1957
0.10	0.50	44	55	99	110	137	192	274	411	685	1096	1370
0.10	0.75	29	37	66	73	91	128	183	274	457	731	913
0.25	0.05	175	219	394	438	548	767	1096	1644	2740	4383	5479
0.25	0.10	88	110	197	219	274	384	548	822	1370	2192	2740
0.25	0.15	58	73	131	146	183	256	365	548	913	1461	1826
0.25	0.25	35	44	79	88	110	153	219	329	548	877	1096
0.25	0.35	25	31	56	63	78	110	157	235	391	626	783
0.25	0.50	18	22	39	44	55	77	110	164	274	438	548
0.25	0.75	12	15	26	29	37	51	73	110	183	292	365
0.50	0.05	88	110	197	219	274	384	548	822	1370	2192	2740
0.50	0.10	44	55	99	110	137	192	274	411	685	1096	1370
0.50	0.15	29	37	66	73	91	128	183	274	457	731	913
0.50	0.25	18	22	39	44	55	77	110	164	274	438	548
0.50	0.35	13	16	28	31	39	55	78	117	196	313	391
0.50	0.50	9	11	20	22	27	38	55	82	137	219	274
0.50	0.75	6	7	13	15	18	26	37	55	91	146	183
1.00	0.05	44	55	99	110	137	192	274	411	685	1096	1370
1.00	0.10	22	27	49	55	68	96	137	205	342	548	685
1.00	0.15	15	18	33	37	46	64	91	137	228	365	457
1.00	0.25	9	11	20	22	27	38	55	82	137	219	274
1.00	0.35	6	8	14	16	20	27	39	59	98	157	196
1.00	0.50	4	5	10	11	14	19	27	41	68	110	137
1.00	0.75	3	4	7	7	9	13	18	27	46	73	91
2.00	0.05	22	27	49	55	68	96	137	205	342	548	685
2.00	0.10	11	14	25	27	34	48	68	103	171	274	342
2.00	0.15	7	9	16	18	23	32	46	68	114	183	228
2.00	0.25	4	5	10	11	14	19	27	41	68	110	137
2.00	0.35	3	4	7	8	10	14	20	29	49	78	98
2.00	0.50	2	3	5	5	7	10	14	21	34	55	68
2.00	0.75	1	2	3	4	5	6	9	14	23	37	46
4.00	0.05	11	14	25	27	34	48	68	103	171	274	342
4.00	0.10	5	7	12	14	17	24	34	51	86	137	171
4.00	0.15	4	5	8	9	11	16	23	34	57	91	114
4.00	0.25	2	3	5	5	7	10	14	21	34	55	68
4.00	0.35	2	2	4	4	5	7	10	15	24	39	49
4.00	0.50	1	1	2	3	3	5	7	10	17	27	34
4.00	0.75	1	1	2	2	2	3	5	7	11	18	23

N=15 G= 8 I=15

VJC (\$/KM)	VGCS %	CI (\$/KM) 8000	10000	18000	20000	25000	35000	50000	75000	125000	200000	250000
0.10	0.05	465	582	1046	1164	1455	2037	2910	4365	7276	11641	14551
0.10	0.10	233	291	524	582	728	1019	1455	2183	3638	5821	7276
0.10	0.15	155	194	349	388	485	679	970	1455	2425	3880	4850
0.10	0.25	93	116	210	233	291	407	582	873	1455	2328	2910
0.10	0.35	67	83	150	166	208	291	416	624	1039	1663	2079
0.10	0.50	47	58	105	116	146	204	291	437	728	1164	1455
0.10	0.75	31	39	70	78	97	136	194	291	485	776	970
0.25	0.05	186	233	419	466	582	815	1164	1746	2910	4656	5821
0.25	0.10	93	116	210	233	291	407	582	873	1455	2328	2910
0.25	0.15	62	78	140	155	194	272	388	582	970	1552	1940
0.25	0.25	37	47	84	93	116	163	233	349	582	931	1164
0.25	0.35	27	33	60	67	83	116	166	249	416	665	832
0.25	0.50	19	23	42	47	58	81	116	175	291	466	582
0.25	0.75	12	16	28	31	39	54	78	116	194	310	388
0.50	0.05	93	116	210	233	291	407	582	873	1455	2328	2910
0.50	0.10	47	58	105	116	146	204	291	437	728	1164	1455
0.50	0.15	31	39	70	78	97	136	194	291	485	776	970
0.50	0.25	19	23	42	47	58	81	116	175	291	466	582
0.50	0.35	13	17	30	33	42	58	83	125	208	333	416
0.50	0.50	9	12	21	23	29	41	58	87	146	233	291
0.50	0.75	6	8	14	16	19	27	39	58	97	155	194
1.00	0.05	47	58	105	116	146	204	291	437	728	1164	1455
1.00	0.10	23	27	52	58	73	102	146	218	364	582	728
1.00	0.15	16	19	35	39	49	68	97	146	243	388	485
1.00	0.25	9	12	21	23	29	41	58	87	146	233	291
1.00	0.35	7	8	15	17	21	29	42	62	104	166	208
1.00	0.50	5	6	10	12	15	20	29	44	73	116	146
1.00	0.75	3	4	7	8	10	14	19	29	49	78	97
2.00	0.05	23	29	52	58	73	102	146	218	364	582	728
2.00	0.10	12	15	26	29	36	51	73	109	182	291	364
2.00	0.15	8	10	17	19	24	34	49	73	121	194	243
2.00	0.25	5	6	10	12	15	20	29	44	73	116	146
2.00	0.35	3	4	7	8	10	15	21	31	52	83	104
2.00	0.50	2	3	5	6	7	10	15	22	36	58	73
2.00	0.75	2	2	3	4	5	7	10	15	24	39	49
4.00	0.05	12	15	26	29	36	51	73	109	182	291	364
4.00	0.10	6	7	13	15	18	25	36	55	91	146	182
4.00	0.15	4	5	9	10	12	17	24	36	61	97	121
4.00	0.25	2	3	5	6	7	10	15	22	36	58	73
4.00	0.35	2	2	4	4	5	7	10	16	26	42	52
4.00	0.50	1	1	3	3	4	5	7	11	18	29	36
4.00	0.75	1	1	2	2	2	3	5	7	12	19	24

N=15 G= 8 I=16

VOC ($/KM)	VOCS %	CI ($/KM) 6000	10000	18000	20000	25000	35000	50000	75000	125000	200000	250000
0.10	0.05	494	617	1111	1234	1543	2160	3086	4629	7715	12344	15430
0.10	0.10	247	309	555	617	771	1080	1543	2314	3857	6172	7715
0.10	0.15	165	206	370	411	514	720	1029	1543	2572	4115	5143
0.10	0.25	99	123	222	247	309	432	617	926	1543	2469	3086
0.10	0.35	71	88	159	176	220	309	441	661	1102	1763	2204
0.10	0.50	49	62	111	123	154	216	309	463	771	1234	1543
0.10	0.75	33	41	74	82	103	144	206	309	514	823	1029
0.25	0.05	197	247	444	494	617	864	1234	1852	3086	4937	6172
0.25	0.10	99	123	222	247	309	432	617	926	1543	2469	3086
0.25	0.15	66	82	148	165	206	288	411	617	1029	1646	2057
0.25	0.25	39	49	89	99	123	173	247	370	617	987	1234
0.25	0.35	28	35	63	71	88	123	176	265	441	705	882
0.25	0.50	20	25	44	49	62	86	123	185	309	494	617
0.25	0.75	13	16	30	33	41	58	82	123	206	329	411
0.50	0.05	99	123	222	247	309	432	617	926	1543	2469	3086
0.50	0.10	49	62	111	123	154	216	309	463	771	1234	1543
0.50	0.15	33	41	74	82	103	144	206	309	514	823	1029
0.50	0.25	20	25	44	49	62	86	123	185	309	494	617
0.50	0.35	14	18	32	35	44	62	88	132	220	353	441
0.50	0.50	10	12	22	25	31	43	62	93	154	247	309
0.50	0.75	7	8	15	16	21	29	41	62	103	165	206
1.00	0.05	49	62	111	123	154	216	309	463	771	1234	1543
1.00	0.10	25	31	56	62	77	108	154	231	386	617	771
1.00	0.15	16	21	37	41	51	72	103	154	257	411	514
1.00	0.25	10	12	22	25	31	43	62	93	154	247	309
1.00	0.35	7	9	16	18	22	31	44	66	110	176	220
1.00	0.50	5	6	11	12	15	22	31	46	77	123	154
1.00	0.75	3	4	7	8	10	14	21	31	51	82	103
2.00	0.05	25	31	56	62	77	108	154	231	386	617	771
2.00	0.10	12	15	28	31	39	54	77	116	193	309	386
2.00	0.15	8	10	19	21	26	36	51	77	129	206	257
2.00	0.25	5	6	11	12	15	22	31	46	77	123	154
2.00	0.35	4	4	8	9	11	15	22	33	55	88	110
2.00	0.50	2	3	6	6	8	11	15	23	39	62	77
2.00	0.75	2	2	4	4	5	7	10	15	26	41	51
4.00	0.05	12	15	28	31	39	54	77	116	193	309	386
4.00	0.10	6	8	14	15	19	27	39	58	96	154	193
4.00	0.15	4	5	9	10	13	18	26	39	64	103	129
4.00	0.25	2	3	6	6	8	11	15	23	39	62	77
4.00	0.35	2	2	4	4	6	8	11	17	28	44	55
4.00	0.50	1	2	3	3	4	5	8	12	19	31	39
4.00	0.75	1	1	2	2	3	4	5	8	13	21	26

N=15 G= 8 I=17

VOC ($/KM)	VOCS %	CI ($/KM) 8000	10000	18000	20000	25000	35000	50000	75000	125000	200000	250000
0.10	0.05	523	653	1176	1306	1633	2286	3266	4899	8166	13065	16331
0.10	0.10	261	327	588	653	817	1143	1633	2450	4083	6532	8166
0.10	0.15	174	218	392	435	544	762	1089	1633	2722	4355	5444
0.10	0.25	105	131	235	261	327	457	653	980	1633	2613	3266
0.10	0.35	75	93	168	187	233	327	467	700	1167	1866	2333
0.10	0.50	52	65	118	131	163	229	327	490	817	1306	1633
0.10	0.75	35	44	78	87	109	152	218	327	544	871	1089
0.25	0.05	209	261	470	523	653	915	1306	1960	3266	5226	6532
0.25	0.10	105	131	235	261	327	457	653	980	1633	2613	3266
0.25	0.15	70	87	157	174	218	305	435	653	1089	1742	2177
0.25	0.25	42	52	94	105	131	183	261	392	653	1045	1306
0.25	0.35	30	37	67	75	93	131	187	280	467	747	933
0.25	0.50	21	26	47	52	65	91	131	196	327	523	653
0.25	0.75	14	17	31	35	44	61	87	131	218	348	435
0.50	0.05	105	131	235	261	327	457	653	980	1633	2613	3266
0.50	0.10	52	65	118	131	163	229	327	490	817	1306	1633
0.50	0.15	35	44	78	87	109	152	218	327	544	871	1089
0.50	0.25	21	26	47	52	65	91	131	196	327	523	653
0.50	0.35	15	19	34	37	47	65	93	140	233	373	467
0.50	0.50	10	13	24	26	33	46	65	98	163	261	327
0.50	0.75	7	9	16	17	22	30	44	65	109	174	218
1.00	0.05	52	65	118	131	163	229	327	490	817	1306	1633
1.00	0.10	26	33	59	65	82	114	163	245	408	653	817
1.00	0.15	17	22	39	44	54	76	109	163	272	435	544
1.00	0.25	10	13	24	26	33	46	65	98	163	261	327
1.00	0.35	7	9	17	19	23	33	47	70	117	187	233
1.00	0.50	5	7	12	13	16	23	33	49	82	131	163
1.00	0.75	3	4	8	9	11	15	22	33	54	87	109
2.00	0.05	26	33	59	65	82	114	163	245	408	653	817
2.00	0.10	13	16	29	33	41	57	82	122	204	327	408
2.00	0.15	9	11	20	22	27	38	54	82	136	218	272
2.00	0.25	5	7	12	13	16	23	33	49	82	131	163
2.00	0.35	4	5	8	9	12	16	23	35	58	93	117
2.00	0.50	3	3	6	7	8	11	16	24	41	65	82
2.00	0.75	2	2	4	4	5	8	11	16	27	44	54
4.00	0.05	13	16	29	33	41	57	82	122	204	327	408
4.00	0.10	7	8	15	16	20	29	41	61	102	163	204
4.00	0.15	4	5	10	11	14	19	27	41	68	109	136
4.00	0.25	3	3	6	7	8	11	16	24	41	65	82
4.00	0.35	2	2	4	5	6	8	12	17	29	47	58
4.00	0.50	1	2	3	3	4	6	8	12	20	33	41
4.00	0.75	1	1	2	2	3	4	5	8	14	22	27

N=15 G= 8 I=18

VOC ($/KM)	VOCS %	CI ($/KM) 6000	10000	18000	20000	25000	35000	50000	75000	125000	200000	250000
0.10	0.05	552	690	1242	1380	1726	2416	3451	5177	8628	13804	17255
0.10	0.10	276	345	621	690	863	1208	1726	2588	4314	6902	8628
0.10	0.15	184	230	414	460	575	805	1150	1726	2876	4601	5752
0.10	0.25	110	138	248	276	345	483	690	1035	1726	2761	3451
0.10	0.35	79	99	177	197	247	345	493	740	1233	1972	2465
0.10	0.50	55	69	124	138	173	242	345	518	863	1380	1726
0.10	0.75	37	46	83	92	115	161	230	345	575	920	1150
0.25	0.05	221	276	497	552	690	966	1380	2071	3451	5522	6902
0.25	0.10	110	138	248	276	345	483	690	1035	1726	2761	3451
0.25	0.15	74	92	166	184	230	322	460	690	1150	1841	2301
0.25	0.25	44	55	99	110	138	193	276	414	690	1104	1380
0.25	0.35	32	39	71	79	99	138	197	296	493	789	986
0.25	0.50	22	28	50	55	69	97	138	207	345	552	690
0.25	0.75	15	18	33	37	46	64	92	138	230	368	460
0.50	0.05	110	138	248	276	345	483	690	1035	1726	2761	3451
0.50	0.10	55	69	124	138	173	242	345	518	863	1380	1726
0.50	0.15	37	46	83	92	115	161	230	345	575	920	1150
0.50	0.25	22	28	50	55	69	97	138	207	345	552	690
0.50	0.35	16	20	35	39	49	69	99	148	247	394	493
0.50	0.50	11	14	25	28	35	48	69	104	173	276	345
0.50	0.75	7	9	17	18	23	32	46	69	115	184	230
1.00	0.05	55	69	124	138	173	242	345	518	863	1380	1726
1.00	0.10	28	35	62	69	86	121	173	259	431	690	863
1.00	0.15	18	23	41	46	58	81	115	173	288	460	575
1.00	0.25	11	14	25	28	35	48	69	104	173	276	345
1.00	0.35	8	10	18	20	25	35	49	74	123	197	247
1.00	0.50	6	7	12	14	17	24	35	52	86	138	173
1.00	0.75	4	5	8	9	12	16	23	35	58	92	115
2.00	0.05	28	35	62	69	86	121	173	259	431	690	863
2.00	0.10	14	17	31	35	43	60	86	129	216	345	431
2.00	0.15	9	12	21	23	29	40	58	86	144	230	288
2.00	0.25	6	7	12	14	17	24	35	52	86	138	173
2.00	0.35	4	5	9	10	12	17	25	37	62	99	123
2.00	0.50	3	3	6	7	9	12	17	26	43	69	86
2.00	0.75	2	2	4	5	6	8	12	17	29	46	58
4.00	0.05	14	17	31	35	43	60	86	129	216	345	431
4.00	0.10	7	9	16	17	22	30	43	65	108	173	216
4.00	0.15	5	6	10	12	14	20	29	43	72	115	144
4.00	0.25	3	3	6	7	9	12	17	26	43	69	86
4.00	0.35	2	2	4	5	6	9	12	18	31	49	62
4.00	0.50	1	2	3	3	4	6	9	13	22	35	43
4.00	0.75	1	1	2	2	3	4	6	9	14	23	29

N=15 G=10 I=10

VOC ($/KM)	VOCS %	CI ($/KM) 8000	10000	18000	20000	25000	35000	50000	75000	125000	200000	250000
0.10	0.05	292	365	658	731	913	1279	1826	2740	4566	7306	9132
0.10	0.10	146	183	329	365	457	639	913	1370	2283	3653	4566
0.10	0.15	97	122	219	244	304	426	609	913	1522	2435	3044
0.10	0.25	58	73	132	146	183	256	365	548	913	1461	1826
0.10	0.35	42	52	94	104	130	183	261	391	652	1044	1305
0.10	0.50	29	37	66	73	91	128	183	274	457	731	913
0.10	0.75	19	24	44	49	61	85	122	183	304	487	609
0.25	0.05	117	146	263	292	365	511	731	1096	1826	2922	3653
0.25	0.10	58	73	132	146	183	256	365	548	913	1461	1826
0.25	0.15	39	49	88	97	122	170	244	365	609	974	1218
0.25	0.25	23	29	53	58	73	102	146	219	365	584	731
0.25	0.35	17	21	38	42	52	73	104	157	261	417	522
0.25	0.50	12	15	26	29	37	51	73	110	183	292	365
0.25	0.75	8	10	18	19	24	34	49	73	122	195	244
0.50	0.05	58	73	132	146	183	256	365	548	913	1461	1826
0.50	0.10	29	37	66	73	91	128	183	274	457	731	913
0.50	0.15	19	24	44	49	61	85	122	183	304	487	609
0.50	0.25	12	15	26	29	37	51	73	110	183	292	365
0.50	0.35	8	10	19	21	26	37	52	78	130	209	261
0.50	0.50	6	7	13	15	18	26	37	55	91	146	183
0.50	0.75	4	5	9	10	12	17	24	37	61	97	122
1.00	0.05	29	37	66	73	91	128	183	274	457	731	913
1.00	0.10	15	18	33	37	46	64	91	137	228	365	457
1.00	0.15	10	12	22	24	30	43	61	91	152	244	304
1.00	0.25	6	7	13	15	18	26	37	55	91	146	183
1.00	0.35	4	5	9	10	13	18	26	39	65	104	130
1.00	0.50	3	4	7	7	9	13	18	27	46	73	91
1.00	0.75	2	2	4	5	6	9	12	18	30	49	61
2.00	0.05	15	18	33	37	46	64	91	137	228	365	457
2.00	0.10	7	9	16	18	23	32	46	68	114	183	228
2.00	0.15	5	6	11	12	15	21	30	46	76	122	152
2.00	0.25	3	4	7	7	9	13	18	27	46	73	91
2.00	0.35	2	3	5	5	7	9	13	20	33	52	65
2.00	0.50	1	2	3	4	5	6	9	14	23	37	46
2.00	0.75	1	1	2	2	3	4	6	9	15	24	30
4.00	0.05	7	9	16	18	23	32	46	68	114	183	228
4.00	0.10	4	5	8	9	11	16	23	34	57	91	114
4.00	0.15	2	3	5	6	8	11	15	23	38	61	76
4.00	0.25	1	2	3	4	5	6	9	14	23	37	46
4.00	0.35	1	1	2	3	3	5	7	10	16	26	33
4.00	0.50	1	1	2	2	2	3	5	7	11	18	23
4.00	0.75	0	1	1	1	2	2	3	5	8	12	15

N=15 G=10 I=11

VOC ($/KM)	VOCS %	CI ($/KM) 8000	10000	18000	20000	25000	35000	50000	75000	125000	200000	250000
0.10	0.05	314	392	706	785	981	1373	1962	2943	4905	7848	9811
0.10	0.10	157	196	353	392	491	687	981	1472	2453	3924	4905
0.10	0.15	105	131	235	262	327	458	654	981	1635	2616	3270
0.10	0.25	63	78	141	157	196	275	392	589	981	1570	1962
0.10	0.35	45	56	101	112	140	196	280	420	701	1121	1402
0.10	0.50	31	39	71	78	98	137	196	294	491	785	981
0.10	0.75	21	26	47	52	65	92	131	196	327	523	654
0.25	0.05	126	157	283	314	392	549	785	1177	1962	3139	3924
0.25	0.10	63	78	141	157	196	275	392	589	981	1570	1962
0.25	0.15	42	52	94	105	131	183	262	392	654	1046	1308
0.25	0.25	25	31	57	63	78	110	157	235	392	628	785
0.25	0.35	18	22	40	45	56	78	112	168	280	448	561
0.25	0.50	13	16	28	31	39	55	78	118	196	314	392
0.25	0.75	8	10	19	21	26	37	52	78	131	209	262
0.50	0.05	63	78	141	157	196	275	392	589	981	1570	1962
0.50	0.10	31	39	71	78	98	137	196	294	491	785	981
0.50	0.15	21	26	47	52	65	92	131	196	327	523	654
0.50	0.25	13	16	28	31	39	55	78	118	196	314	392
0.50	0.35	9	11	20	22	28	39	56	84	140	224	280
0.50	0.50	6	8	14	16	20	27	39	59	98	157	196
0.50	0.75	4	5	9	10	13	18	26	39	65	105	131
1.00	0.05	31	39	71	78	98	137	196	294	491	785	981
1.00	0.10	16	20	35	39	49	69	98	147	245	392	491
1.00	0.15	10	13	24	26	33	46	65	98	164	262	327
1.00	0.25	6	8	14	16	20	27	39	59	98	157	196
1.00	0.35	4	6	10	11	14	20	28	42	70	112	140
1.00	0.50	3	4	7	8	10	14	20	29	49	78	98
1.00	0.75	2	3	5	5	7	9	13	20	33	52	65
2.00	0.05	16	20	35	39	49	69	98	147	245	392	491
2.00	0.10	8	10	18	20	25	34	49	74	123	196	245
2.00	0.15	5	7	12	13	16	23	33	49	82	131	164
2.00	0.25	3	4	7	8	10	14	20	29	49	78	98
2.00	0.35	2	3	5	6	7	10	14	21	35	56	70
2.00	0.50	2	2	4	4	5	7	10	15	25	39	49
2.00	0.75	1	1	2	3	3	5	7	10	16	26	33
4.00	0.05	8	10	18	20	25	34	49	74	123	196	245
4.00	0.10	4	5	9	10	12	17	25	37	61	98	123
4.00	0.15	3	3	6	7	8	11	16	25	41	65	82
4.00	0.25	2	2	4	4	5	7	10	15	25	39	49
4.00	0.35	1	1	3	3	4	5	7	11	18	28	35
4.00	0.50	1	1	2	2	2	3	5	7	12	20	25
4.00	0.75	1	1	1	1	2	2	3	5	8	13	16

N=15 G=10 I=12

VOC ($/KM)	VOCS %	CI ($/KM) 8000	10000	18000	20000	25000	35000	50000	75000	125000	200000	250000
0.10	0.05	337	421	757	841	1052	1472	2103	3155	5258	8413	10517
0.10	0.10	168	210	379	421	526	736	1052	1577	2629	4207	5258
0.10	0.15	112	140	252	280	351	491	701	1052	1753	2804	3506
0.10	0.25	67	84	151	168	210	294	421	631	1052	1683	2103
0.10	0.35	48	60	108	120	150	210	300	451	751	1202	1502
0.10	0.50	34	42	76	84	105	147	210	315	526	841	1052
0.10	0.75	22	28	50	56	70	98	140	210	351	561	701
0.25	0.05	135	168	303	337	421	589	841	1262	2103	3365	4207
0.25	0.10	67	84	151	168	210	294	421	631	1052	1683	2103
0.25	0.15	45	56	101	112	140	196	280	421	701	1122	1402
0.25	0.25	27	34	61	67	84	118	168	252	421	673	841
0.25	0.35	19	24	43	48	60	84	120	180	300	481	601
0.25	0.50	13	17	30	34	42	59	84	126	210	337	421
0.25	0.75	9	11	20	22	28	39	56	84	140	224	280
0.50	0.05	67	84	151	168	210	294	421	631	1052	1683	2103
0.50	0.10	34	42	76	84	105	147	210	315	526	841	1052
0.50	0.15	22	28	50	56	70	98	140	210	351	561	701
0.50	0.25	13	17	30	34	42	59	84	126	210	337	421
0.50	0.35	10	12	22	24	30	42	60	90	150	240	300
0.50	0.50	7	8	15	17	21	29	42	63	105	168	210
0.50	0.75	4	6	10	11	14	20	28	42	70	112	140
1.00	0.05	34	42	76	84	105	147	210	315	526	841	1052
1.00	0.10	17	21	38	42	53	74	105	158	263	421	526
1.00	0.15	11	14	25	28	35	49	70	105	175	280	351
1.00	0.25	7	8	15	17	21	29	42	63	105	168	210
1.00	0.35	5	6	11	12	15	21	30	45	75	120	150
1.00	0.50	3	4	8	8	11	15	21	32	53	84	105
1.00	0.75	2	3	5	6	7	10	14	21	35	56	70
2.00	0.05	17	21	38	42	53	74	105	158	263	421	526
2.00	0.10	8	11	19	21	26	37	53	79	131	210	263
2.00	0.15	6	7	13	14	18	25	35	53	88	140	175
2.00	0.25	3	4	8	8	11	15	21	32	53	84	105
2.00	0.35	2	3	5	6	8	11	15	23	38	60	75
2.00	0.50	2	2	4	4	5	7	11	16	26	42	53
2.00	0.75	1	1	3	3	4	5	7	11	18	28	35
4.00	0.05	8	11	19	21	26	37	53	79	131	210	263
4.00	0.10	4	5	9	11	13	18	26	39	66	105	131
4.00	0.15	3	4	6	7	9	12	18	26	44	70	88
4.00	0.25	2	2	4	4	5	7	11	16	26	42	53
4.00	0.35	1	2	3	3	4	5	8	11	19	30	38
4.00	0.50	1	1	2	2	3	4	5	8	13	21	26
4.00	0.75	1	1	1	1	2	2	4	5	9	14	18

N=15 G=10 I=13

VOC ($/KM)	VOCS %	CI ($/KM) 8000	10000	18000	20000	25000	35000	50000	75000	125000	200000	250000
0.10	0.05	360	450	810	900	1125	1575	2250	3375	5625	9000	11250
0.10	0.10	180	225	405	450	562	787	1125	1687	2812	4500	5625
0.10	0.15	120	150	270	300	375	525	750	1125	1875	3000	3750
0.10	0.25	72	90	162	180	225	315	450	675	1125	1800	2250
0.10	0.35	51	64	116	129	161	225	321	482	804	1286	1607
0.10	0.50	36	45	81	90	112	157	225	337	562	900	1125
0.10	0.75	24	30	54	60	75	105	150	225	375	600	750
0.25	0.05	144	180	324	360	450	630	900	1350	2250	3600	4500
0.25	0.10	72	90	162	180	225	315	450	675	1125	1800	2250
0.25	0.15	48	60	108	120	150	210	300	450	750	1200	1500
0.25	0.25	29	36	65	72	90	126	180	270	450	720	900
0.25	0.35	21	26	46	51	64	90	129	193	321	514	643
0.25	0.50	14	18	32	36	45	63	90	135	225	360	450
0.25	0.75	10	12	22	24	30	42	60	90	150	240	300
0.50	0.05	72	90	162	180	225	315	450	675	1125	1800	2250
0.50	0.10	36	45	81	90	112	157	225	337	562	900	1125
0.50	0.15	24	30	54	60	75	105	150	225	375	600	750
0.50	0.25	14	18	32	36	45	63	90	135	225	360	450
0.50	0.35	10	13	23	26	32	45	64	96	161	257	321
0.50	0.50	7	9	16	18	22	31	45	67	112	180	225
0.50	0.75	5	6	11	12	15	21	30	45	75	120	150
1.00	0.05	36	45	81	90	112	157	225	337	562	900	1125
1.00	0.10	18	22	40	45	56	79	112	169	281	450	562
1.00	0.15	12	15	27	30	37	52	75	112	187	300	375
1.00	0.25	7	9	16	18	22	31	45	67	112	180	225
1.00	0.35	5	6	12	13	16	22	32	48	80	129	161
1.00	0.50	4	4	8	9	11	16	22	34	56	90	112
1.00	0.75	2	3	5	6	7	10	15	22	37	60	75
2.00	0.05	18	22	40	45	56	79	112	169	281	450	562
2.00	0.10	9	11	20	22	28	39	56	84	141	225	281
2.00	0.15	6	7	13	15	19	26	37	56	94	150	187
2.00	0.25	4	4	8	9	11	16	22	34	56	90	112
2.00	0.35	3	3	6	6	8	11	16	24	40	64	80
2.00	0.50	2	2	4	4	6	8	11	17	28	45	56
2.00	0.75	1	1	3	3	4	5	7	11	19	30	37
4.00	0.05	9	11	20	22	28	39	56	84	141	225	281
4.00	0.10	4	6	10	11	14	20	28	42	70	112	141
4.00	0.15	3	4	7	7	9	13	19	28	47	75	94
4.00	0.25	2	2	4	4	6	8	11	17	28	45	56
4.00	0.35	1	2	3	3	4	6	8	12	20	32	40
4.00	0.50	1	1	2	2	3	4	6	8	14	22	28
4.00	0.75	1	1	1	1	2	3	4	6	9	15	19

N=15 G=10 I=14

VOC ($/KM)	VOCS %	CI ($/KM) 8000	10000	18000	20000	25000	35000	50000	75000	125000	200000	250000
0.10	0.05	384	480	865	961	1201	1681	2402	3603	6005	9608	12009
0.10	0.10	192	240	432	480	600	841	1201	1801	3002	4804	6005
0.10	0.15	128	160	288	320	400	560	801	1201	2002	3203	4003
0.10	0.25	77	96	173	192	240	336	480	721	1201	1922	2402
0.10	0.35	55	69	124	137	172	240	343	515	858	1373	1716
0.10	0.50	38	48	86	96	120	168	240	360	600	961	1201
0.10	0.75	26	32	58	64	80	112	160	240	400	641	801
0.25	0.05	154	192	346	384	480	673	961	1441	2402	3843	4804
0.25	0.10	77	96	173	192	240	336	480	721	1201	1922	2402
0.25	0.15	51	64	115	128	160	224	320	480	801	1281	1601
0.25	0.25	31	38	69	77	96	135	192	288	480	769	961
0.25	0.35	22	27	49	55	69	96	137	206	343	549	686
0.25	0.50	15	19	35	38	48	67	96	144	240	384	480
0.25	0.75	10	13	23	26	32	45	64	96	160	256	320
0.50	0.05	77	96	173	192	240	336	480	721	1201	1922	2402
0.50	0.10	38	48	86	96	120	168	240	360	600	961	1201
0.50	0.15	26	32	58	64	80	112	160	240	400	641	801
0.50	0.25	15	19	35	38	48	67	96	144	240	384	480
0.50	0.35	11	14	25	27	34	48	69	103	172	275	343
0.50	0.50	8	10	17	19	24	34	48	72	120	192	240
0.50	0.75	5	6	12	13	16	22	32	48	80	128	160
1.00	0.05	38	48	86	96	120	168	240	360	600	961	1201
1.00	0.10	19	24	43	48	60	84	120	180	300	480	600
1.00	0.15	13	16	29	32	40	56	80	120	200	320	400
1.00	0.25	8	10	17	19	24	34	48	72	120	192	240
1.00	0.35	5	7	12	14	17	24	34	51	86	137	172
1.00	0.50	4	5	9	10	12	17	24	36	60	96	120
1.00	0.75	3	3	6	6	8	11	16	24	40	64	80
2.00	0.05	19	24	43	48	60	84	120	180	300	480	600
2.00	0.10	10	12	22	24	30	42	60	90	150	240	300
2.00	0.15	6	8	14	16	20	28	40	60	100	160	200
2.00	0.25	4	5	9	10	12	17	24	36	60	96	120
2.00	0.35	3	3	6	7	9	12	17	26	43	69	86
2.00	0.50	2	2	4	5	6	8	12	18	30	48	60
2.00	0.75	1	2	3	3	4	6	8	12	20	32	40
4.00	0.05	10	12	22	24	30	42	60	90	150	240	300
4.00	0.10	5	6	11	12	15	21	30	45	75	120	150
4.00	0.15	3	4	7	8	10	14	20	30	50	80	100
4.00	0.25	2	2	4	5	6	8	12	18	30	48	60
4.00	0.35	1	2	3	3	4	6	9	13	21	34	43
4.00	0.50	1	1	2	2	3	4	6	9	15	24	30
4.00	0.75	1	1	1	2	2	3	4	6	10	16	20

N=15 G=10 I=15

VOC ($/KM)	VOCS %	8000	10000	18000	20000	25000	35000	50000	75000	125000	200000	250000
		CI ($/KM)										
0.10	0.05	409	512	921	1024	1280	1791	2559	3839	6398	10236	12795
0.10	0.10	205	256	461	512	640	896	1280	1919	3199	5118	6398
0.10	0.15	136	171	307	341	427	597	853	1280	2133	3412	4265
0.10	0.25	82	102	184	205	256	358	512	768	1280	2047	2559
0.10	0.35	58	73	132	146	183	256	366	548	914	1462	1828
0.10	0.50	41	51	92	102	128	179	256	384	640	1024	1280
0.10	0.75	27	34	61	68	85	119	171	256	427	682	853
0.25	0.05	164	205	369	409	512	717	1024	1535	2559	4094	5118
0.25	0.10	82	102	184	205	256	358	512	768	1280	2047	2559
0.25	0.15	55	68	123	136	171	239	341	512	853	1365	1706
0.25	0.25	33	41	74	82	102	143	205	307	512	819	1024
0.25	0.35	23	29	53	58	73	102	146	219	366	585	731
0.25	0.50	16	20	37	41	51	72	102	154	256	409	512
0.25	0.75	11	14	25	27	34	48	68	102	171	273	341
0.50	0.05	82	102	184	205	256	358	512	768	1280	2047	2559
0.50	0.10	41	51	92	102	128	179	256	384	640	1024	1280
0.50	0.15	27	34	61	68	85	119	171	256	427	682	853
0.50	0.25	16	20	37	41	51	72	102	154	256	409	512
0.50	0.35	12	15	26	29	37	51	73	110	183	292	366
0.50	0.50	8	10	18	20	26	36	51	77	128	205	256
0.50	0.75	5	7	12	14	17	24	34	51	85	136	171
1.00	0.05	41	51	92	102	128	179	256	384	640	1024	1280
1.00	0.10	20	26	46	51	64	90	128	192	320	512	640
1.00	0.15	14	17	31	34	43	60	85	128	213	341	427
1.00	0.25	8	10	18	20	26	36	51	77	128	205	256
1.00	0.35	6	7	13	15	18	26	37	55	91	146	183
1.00	0.50	4	5	9	10	13	18	26	38	64	102	128
1.00	0.75	3	3	6	7	9	12	17	26	43	68	85
2.00	0.05	20	26	46	51	64	90	128	192	320	512	640
2.00	0.10	10	13	23	26	32	45	64	96	160	256	320
2.00	0.15	7	9	15	17	21	30	43	64	107	171	213
2.00	0.25	4	5	9	10	13	18	26	38	64	102	128
2.00	0.35	3	4	7	7	9	13	18	27	46	73	91
2.00	0.50	2	3	5	5	6	9	13	19	32	51	64
2.00	0.75	1	2	3	3	4	6	9	13	21	34	43
4.00	0.05	10	13	23	26	32	45	64	96	160	256	320
4.00	0.10	5	6	12	13	16	22	32	48	80	128	160
4.00	0.15	3	4	8	9	11	15	21	32	53	85	107
4.00	0.25	2	3	5	5	6	9	13	19	32	51	64
4.00	0.35	1	2	3	4	5	6	9	14	23	37	46
4.00	0.50	1	1	2	3	3	4	6	10	16	26	32
4.00	0.75	1	1	2	2	2	3	4	6	11	17	21

N=15 G=10 I=16

VOC (\$/KM)	VOCS %	CI (\$/KM) 8000	10000	18000	20000	25000	35000	50000	75000	125000	200000	250000
0.10	0.05	435	544	980	1088	1361	1905	2721	4082	6803	10885	13606
0.10	0.10	218	272	490	544	680	952	1361	2041	3402	5442	6803
0.10	0.15	145	181	327	363	454	635	907	1361	2268	3628	4535
0.10	0.25	87	109	196	218	272	381	544	816	1361	2177	2721
0.10	0.35	62	78	140	155	194	272	389	583	972	1555	1944
0.10	0.50	44	54	98	109	136	190	272	408	680	1088	1361
0.10	0.75	29	36	65	73	91	127	181	272	454	726	907
0.25	0.05	174	218	392	435	544	762	1088	1633	2721	4354	5442
0.25	0.10	87	109	196	218	272	381	544	816	1361	2177	2721
0.25	0.15	58	73	131	145	181	254	363	544	907	1451	1814
0.25	0.25	35	44	70	87	109	152	218	327	544	871	1088
0.25	0.35	25	31	56	62	78	109	155	233	389	622	777
0.25	0.50	17	22	39	44	54	76	109	163	272	435	544
0.25	0.75	12	15	26	29	36	51	73	109	181	290	363
0.50	0.05	87	109	196	218	272	381	544	816	1361	2177	2721
0.50	0.10	44	54	98	109	136	190	272	408	680	1088	1361
0.50	0.15	29	36	65	73	91	127	181	272	454	726	907
0.50	0.25	17	22	39	44	54	76	109	163	272	435	544
0.50	0.35	12	16	28	31	39	54	78	117	194	311	389
0.50	0.50	9	11	20	22	27	38	54	82	136	218	272
0.50	0.75	6	7	13	15	18	25	36	54	91	145	181
1.00	0.05	44	54	98	109	136	190	272	408	680	1088	1361
1.00	0.10	22	27	49	54	68	95	136	204	340	544	680
1.00	0.15	15	18	33	36	45	63	91	136	227	363	454
1.00	0.25	9	11	20	22	27	38	54	82	136	218	272
1.00	0.35	6	8	14	16	19	27	39	58	97	155	194
1.00	0.50	4	5	10	11	14	19	27	41	68	109	136
1.00	0.75	3	4	7	7	9	13	18	27	45	73	91
2.00	0.05	22	27	49	54	68	95	136	204	340	544	680
2.00	0.10	11	14	24	27	34	48	68	102	170	272	340
2.00	0.15	7	9	16	18	23	32	45	68	113	181	227
2.00	0.25	4	5	10	11	14	19	27	41	68	109	136
2.00	0.35	3	4	7	8	10	14	19	29	49	78	97
2.00	0.50	2	3	5	5	7	10	14	20	34	54	68
2.00	0.75	1	2	3	4	5	6	9	14	23	36	45
4.00	0.05	11	14	24	27	34	48	68	102	170	272	340
4.00	0.10	5	7	12	14	17	24	34	51	85	136	170
4.00	0.15	4	5	8	9	11	16	23	34	57	91	113
4.00	0.25	2	3	5	5	7	10	14	20	34	54	68
4.00	0.35	2	2	3	4	5	7	10	15	24	39	49
4.00	0.50	1	1	2	3	3	5	7	10	17	27	34
4.00	0.75	1	1	2	2	2	3	5	7	11	18	23

N=15 G=10 I=17

VOC ($/KM)	VOCS %	6000	10000	18000	20000	25000	35000	50000	75000	125000	200000	250000
		CI ($/KM)										
0.10	0.05	462	578	1040	1155	1444	2022	2888	4332	7221	11553	14442
0.10	0.10	231	289	520	578	722	1011	1444	2166	3610	5777	7221
0.10	0.15	154	193	347	385	481	674	963	1444	2407	3851	4814
0.10	0.25	92	116	208	231	289	404	578	866	1444	2311	2888
0.10	0.35	66	83	149	165	206	289	413	619	1032	1650	2063
0.10	0.50	46	56	104	116	144	202	289	433	722	1155	1444
0.10	0.75	31	39	69	77	96	135	193	289	481	770	963
0.25	0.05	185	231	416	462	578	809	1155	1733	2888	4621	5777
0.25	0.10	92	116	208	231	289	404	578	866	1444	2311	2888
0.25	0.15	62	77	139	154	193	270	385	578	963	1540	1926
0.25	0.25	37	46	83	92	116	162	231	347	578	924	1155
0.25	0.35	26	33	59	66	83	116	165	248	413	660	825
0.25	0.50	18	23	42	46	58	81	116	173	289	462	578
0.25	0.75	12	15	28	31	39	54	77	116	193	308	385
0.50	0.05	92	116	208	231	289	404	578	866	1444	2311	2888
0.50	0.10	46	58	104	116	144	202	289	433	722	1155	1444
0.50	0.15	31	39	69	77	96	135	193	289	481	770	963
0.50	0.25	18	23	42	46	58	81	116	173	289	462	578
0.50	0.35	13	17	30	33	41	58	83	124	206	330	413
0.50	0.50	9	12	21	23	29	40	58	87	144	231	289
0.50	0.75	6	8	14	15	19	27	39	58	96	154	193
1.00	0.05	46	58	104	116	144	202	289	433	722	1155	1444
1.00	0.10	23	29	52	58	72	101	144	217	361	578	722
1.00	0.15	15	19	35	39	48	67	96	144	241	385	481
1.00	0.25	9	12	21	23	29	40	58	87	144	231	289
1.00	0.35	7	8	15	17	21	29	41	62	103	165	206
1.00	0.50	5	6	10	12	14	20	29	43	72	116	144
1.00	0.75	3	4	7	8	10	13	19	29	48	77	96
2.00	0.05	23	29	52	58	72	101	144	217	361	578	722
2.00	0.10	12	14	26	29	36	51	72	108	181	289	361
2.00	0.15	8	10	17	19	24	34	48	72	120	193	241
2.00	0.25	5	6	10	12	14	20	29	43	72	116	144
2.00	0.35	3	4	7	8	10	14	21	31	52	83	103
2.00	0.50	2	3	5	6	7	10	14	22	36	58	72
2.00	0.75	2	2	3	4	5	7	10	14	24	39	48
4.00	0.05	12	14	26	29	36	51	72	108	181	289	361
4.00	0.10	6	7	13	14	18	25	36	54	90	144	181
4.00	0.15	4	5	9	10	12	17	24	36	60	96	120
4.00	0.25	2	3	5	6	7	10	14	22	36	58	72
4.00	0.35	2	2	4	4	5	7	10	15	26	41	52
4.00	0.50	1	1	3	3	4	5	7	11	18	29	36
4.00	0.75	1	1	2	2	2	3	5	7	12	19	24

N=15 G=10 I=18

VOC ($/KM)	VOCS %	CI ($/KM) 6000	10000	18000	20000	25000	35000	50000	75000	125000	200000	250000
0.10	0.05	490	612	1102	1224	1530	2142	3060	4590	7650	12240	15300
0.10	0.10	245	306	551	612	765	1071	1530	2295	3825	6120	7650
0.10	0.15	163	204	367	408	510	714	1020	1530	2550	4080	5100
0.10	0.25	98	122	220	245	306	428	612	918	1530	2448	3060
0.10	0.35	70	87	157	175	219	306	437	656	1093	1749	2186
0.10	0.50	49	61	110	122	153	214	306	459	765	1224	1530
0.10	0.75	33	41	73	82	102	143	204	306	510	816	1020
0.25	0.05	196	245	441	490	612	857	1224	1836	3060	4896	6120
0.25	0.10	98	122	220	245	306	428	612	918	1530	2448	3060
0.25	0.15	65	82	147	163	204	286	408	612	1020	1632	2040
0.25	0.25	39	49	88	98	122	171	245	367	612	979	1224
0.25	0.35	28	35	63	70	87	122	175	262	437	699	874
0.25	0.50	20	24	44	49	61	86	122	184	306	490	612
0.25	0.75	13	16	29	33	41	57	82	122	204	326	408
0.50	0.05	98	122	220	245	306	428	612	918	1530	2448	3060
0.50	0.10	49	61	110	122	153	214	306	459	765	1224	1530
0.50	0.15	33	41	73	82	102	143	204	306	510	816	1020
0.50	0.25	20	24	44	49	61	86	122	184	306	490	612
0.50	0.35	14	17	31	35	44	61	87	131	219	350	437
0.50	0.50	10	12	22	24	31	43	61	92	153	245	306
0.50	0.75	7	8	15	16	20	29	41	61	102	163	204
1.00	0.05	49	61	110	122	153	214	306	459	765	1224	1530
1.00	0.10	24	31	55	61	77	107	153	230	383	612	765
1.00	0.15	16	20	37	41	51	71	102	153	255	408	510
1.00	0.25	10	12	22	24	31	43	61	92	153	245	306
1.00	0.35	7	9	16	17	22	31	44	66	109	175	219
1.00	0.50	5	6	11	12	15	21	31	46	77	122	153
1.00	0.75	3	4	7	8	10	14	20	31	51	82	102
2.00	0.05	24	31	55	61	77	107	153	230	383	612	765
2.00	0.10	12	15	28	31	38	54	77	115	191	306	383
2.00	0.15	8	10	18	20	26	36	51	77	128	204	255
2.00	0.25	5	6	11	12	15	21	31	46	77	122	153
2.00	0.35	3	4	8	9	11	15	22	33	55	87	109
2.00	0.50	2	3	6	6	8	11	15	23	38	61	77
2.00	0.75	2	2	4	4	5	7	10	15	26	41	51
4.00	0.05	12	15	28	31	38	54	77	115	191	306	383
4.00	0.10	6	8	14	15	19	27	38	57	96	153	191
4.00	0.15	4	5	9	10	13	18	26	38	64	102	128
4.00	0.25	2	3	6	6	8	11	15	23	38	61	77
4.00	0.35	2	2	4	4	5	8	11	16	27	44	55
4.00	0.50	1	2	3	3	4	5	8	11	19	31	38
4.00	0.75	1	1	2	2	3	4	5	8	13	20	26

N=15 G=12 I=10

VOC ($/KM)	VOCS %	CI ($/KM) 8000	10000	18000	20000	25000	35000	50000	75000	125000	200000	250000
0.10	0.05	252	315	568	631	788	1104	1577	2365	3941	6306	7883
0.10	0.10	126	158	284	315	394	552	788	1182	1971	3153	3941
0.10	0.15	84	105	189	210	263	368	526	788	1314	2102	2628
0.10	0.25	50	63	114	126	158	221	315	473	788	1261	1577
0.10	0.35	36	45	81	90	113	158	225	338	563	901	1126
0.10	0.50	25	32	57	63	79	110	158	236	394	631	788
0.10	0.75	17	21	38	42	53	74	105	158	263	420	526
0.25	0.05	101	126	227	252	315	441	631	946	1577	2522	3153
0.25	0.10	50	63	114	126	158	221	315	473	788	1261	1577
0.25	0.15	34	42	76	84	105	147	210	315	526	841	1051
0.25	0.25	20	25	45	50	63	88	126	189	315	504	631
0.25	0.35	14	18	32	36	45	63	90	135	225	360	450
0.25	0.50	10	13	23	25	32	44	63	95	158	252	315
0.25	0.75	7	8	15	17	21	29	42	63	105	168	210
0.50	0.05	50	63	114	126	158	221	315	473	788	1261	1577
0.50	0.10	25	32	57	63	79	110	158	236	394	631	788
0.50	0.15	17	21	38	42	53	74	105	158	263	420	526
0.50	0.25	10	13	23	25	32	44	63	95	158	252	315
0.50	0.35	7	9	16	18	23	32	45	68	113	180	225
0.50	0.50	5	6	11	13	16	22	32	47	79	126	158
0.50	0.75	3	4	8	8	11	15	21	32	53	84	105
1.00	0.05	25	32	57	63	79	110	158	236	394	631	788
1.00	0.10	13	16	28	32	39	55	79	118	197	315	394
1.00	0.15	8	11	19	21	26	37	53	79	131	210	263
1.00	0.25	5	6	11	13	16	22	32	47	79	126	158
1.00	0.35	4	5	8	9	11	16	23	34	56	90	113
1.00	0.50	3	3	6	6	8	11	16	24	39	63	79
1.00	0.75	2	2	4	4	5	7	11	16	26	42	53
2.00	0.05	13	16	28	32	39	55	79	118	197	315	394
2.00	0.10	6	8	14	16	20	28	39	59	99	158	197
2.00	0.15	4	5	9	11	13	18	26	39	66	105	131
2.00	0.25	3	3	6	6	8	11	16	24	39	63	79
2.00	0.35	2	2	4	5	6	8	11	17	28	45	56
2.00	0.50	1	2	3	3	4	6	8	12	20	32	39
2.00	0.75	1	1	2	2	3	4	5	8	13	21	26
4.00	0.05	6	8	14	16	20	28	39	59	99	158	197
4.00	0.10	3	4	7	8	10	14	20	30	49	79	99
4.00	0.15	2	3	5	5	7	9	13	20	33	53	66
4.00	0.25	1	2	3	3	4	6	8	12	20	32	39
4.00	0.35	1	1	2	2	3	4	6	8	14	23	28
4.00	0.50	1	1	1	2	2	3	4	6	10	16	20
4.00	0.75	0	1	1	1	1	2	3	4	7	11	13

N=15 G=12 I=11

VOC ($/KM)	VOCS %	CI ($/KM) 8000	10000	18000	20000	25000	35000	50000	75000	125000	200000	250000
0.10	0.05	272	340	612	679	849	1189	1699	2548	4247	6795	8494
0.10	0.10	136	170	306	340	425	595	849	1274	2123	3397	4247
0.10	0.15	91	113	204	226	283	396	566	849	1416	2265	2831
0.10	0.25	54	68	122	136	170	238	340	510	849	1359	1699
0.10	0.35	39	49	87	97	121	170	243	364	607	971	1213
0.10	0.50	27	34	61	68	85	119	170	255	425	679	849
0.10	0.75	18	23	41	45	57	79	113	170	283	453	566
0.25	0.05	109	136	245	272	340	476	679	1019	1699	2718	3397
0.25	0.10	54	68	122	136	170	238	340	510	849	1359	1699
0.25	0.15	36	45	82	91	113	159	226	340	566	906	1132
0.25	0.25	22	27	49	54	68	95	136	204	340	544	679
0.25	0.35	16	19	35	39	49	68	97	146	243	388	485
0.25	0.50	11	14	24	27	34	48	68	102	170	272	340
0.25	0.75	7	9	16	18	23	32	45	68	113	181	226
0.50	0.05	54	68	122	136	170	238	340	510	849	1359	1699
0.50	0.10	27	34	61	68	85	119	170	255	425	679	849
0.50	0.15	18	23	41	45	57	79	113	170	283	453	566
0.50	0.25	11	14	24	27	34	48	68	102	170	272	340
0.50	0.35	8	10	17	19	24	34	49	73	121	194	243
0.50	0.50	5	7	12	14	17	24	34	51	85	136	170
0.50	0.75	4	5	8	9	11	16	23	34	57	91	113
1.00	0.05	27	34	61	68	85	119	170	255	425	679	849
1.00	0.10	14	17	31	34	42	59	85	127	212	340	425
1.00	0.15	9	11	20	23	28	40	57	85	142	226	283
1.00	0.25	5	7	12	14	17	24	34	51	85	136	170
1.00	0.35	4	5	9	10	12	17	24	36	61	97	121
1.00	0.50	3	3	6	7	8	12	17	25	42	68	85
1.00	0.75	2	2	4	5	6	8	11	17	28	45	57
2.00	0.05	14	17	31	34	42	59	85	127	212	340	425
2.00	0.10	7	8	15	17	21	30	42	64	106	170	212
2.00	0.15	5	6	10	11	14	20	28	42	71	113	142
2.00	0.25	3	3	6	7	8	12	17	25	42	68	85
2.00	0.35	2	2	4	5	6	8	12	18	30	49	61
2.00	0.50	1	2	3	3	4	6	8	13	21	34	42
2.00	0.75	1	1	2	2	3	4	6	8	14	23	28
4.00	0.05	7	8	15	17	21	30	42	64	106	170	212
4.00	0.10	3	4	8	8	11	15	21	32	53	85	106
4.00	0.15	2	3	5	6	7	10	14	21	35	57	71
4.00	0.25	1	2	3	3	4	6	8	13	21	34	42
4.00	0.35	1	1	2	2	3	4	6	9	15	24	30
4.00	0.50	1	1	2	2	2	3	4	6	11	17	21
4.00	0.75	0	1	1	1	1	2	3	4	7	11	14

N=15 G=12 I=12

VOC ($/KW)	VOCS %	CI ($/KW) 8000	10000	18000	20000	25000	35000	50000	75000	125000	200000	250000
0.10	0.05	292	365	658	731	913	1279	1826	2740	4566	7306	9132
0.10	0.10	146	183	329	365	457	639	913	1370	2283	3653	4566
0.10	0.15	97	122	219	244	304	426	609	913	1522	2435	3044
0.10	0.25	58	73	132	146	183	256	365	548	913	1461	1826
0.10	0.35	42	52	94	104	130	183	261	391	652	1044	1305
0.10	0.50	29	37	66	73	91	128	183	274	457	731	913
0.10	0.75	19	24	44	49	61	85	122	183	304	487	609
0.25	0.05	117	146	263	292	365	511	731	1096	1826	2922	3653
0.25	0.10	58	73	132	146	183	256	365	548	913	1461	1826
0.25	0.15	39	49	88	97	122	170	244	365	609	974	1218
0.25	0.25	23	29	53	58	73	102	146	219	365	584	731
0.25	0.35	17	21	38	42	52	73	104	157	261	417	522
0.25	0.50	12	15	26	29	37	51	73	110	183	292	365
0.25	0.75	8	10	18	19	24	34	49	73	122	195	244
0.50	0.05	58	73	132	146	183	256	365	548	913	1461	1826
0.50	0.10	29	37	66	73	91	128	183	274	457	731	913
0.50	0.15	19	24	44	49	61	85	122	183	304	487	609
0.50	0.25	12	15	26	29	37	51	73	110	183	292	365
0.50	0.35	8	10	19	21	26	37	52	78	130	209	261
0.50	0.50	6	7	13	15	18	26	37	55	91	146	183
0.50	0.75	4	5	9	10	12	17	24	37	61	97	122
1.00	0.05	29	37	66	73	91	128	183	274	457	731	913
1.00	0.10	15	18	33	37	46	64	91	137	228	365	457
1.00	0.15	10	12	22	24	30	43	61	91	152	244	304
1.00	0.25	6	7	13	15	18	26	37	55	91	146	183
1.00	0.35	4	5	9	10	13	18	26	39	65	104	130
1.00	0.50	3	4	7	7	9	13	18	27	46	73	91
1.00	0.75	2	2	4	5	6	9	12	18	30	49	61
2.00	0.05	15	18	33	37	46	64	91	137	228	365	457
2.00	0.10	7	9	16	18	23	32	46	68	114	183	228
2.00	0.15	5	6	11	12	15	21	30	46	76	122	152
2.00	0.25	3	4	7	7	9	13	18	27	46	73	91
2.00	0.35	2	3	5	5	7	9	13	20	33	52	65
2.00	0.50	1	2	3	4	5	6	9	14	23	37	46
2.00	0.75	1	1	2	2	3	4	6	9	15	24	30
4.00	0.05	7	9	16	18	23	32	46	68	114	183	228
4.00	0.10	4	5	8	9	11	16	23	34	57	91	114
4.00	0.15	2	3	5	6	8	11	15	23	38	61	76
4.00	0.25	1	2	3	4	5	6	9	14	23	37	46
4.00	0.35	1	1	2	3	3	5	7	10	16	26	33
4.00	0.50	1	1	2	2	2	3	5	7	11	18	23
4.00	0.75	0	1	1	1	2	2	3	5	8	12	15

N=15 G=12 I=13

VOC ($/KH)	VOCS %	CI ($/KH) 8000	10000	18000	20000	25000	35000	50000	75000	125000	200000	250000
0.10	0.05	314	392	705	784	980	1372	1960	2939	4899	7839	9798
0.10	0.10	157	196	353	392	490	686	980	1470	2450	3919	4899
0.10	0.15	105	131	235	261	327	457	653	980	1633	2613	3266
0.10	0.25	63	78	141	157	196	274	392	588	980	1568	1960
0.10	0.35	45	56	101	112	140	196	280	420	700	1120	1400
0.10	0.50	31	39	71	78	98	137	196	294	490	784	980
0.10	0.75	21	26	47	52	65	91	131	196	327	523	653
0.25	0.05	125	157	282	314	392	549	784	1176	1960	3135	3919
0.25	0.10	63	78	141	157	196	274	392	588	980	1568	1960
0.25	0.15	42	52	94	105	131	183	261	392	653	1045	1306
0.25	0.25	25	31	56	63	78	110	157	235	392	627	784
0.25	0.35	18	22	40	45	56	78	112	168	280	448	560
0.25	0.50	13	16	28	31	39	55	78	118	196	314	392
0.25	0.75	8	10	19	21	26	37	52	78	131	209	261
0.50	0.05	63	78	141	157	196	274	392	588	980	1568	1960
0.50	0.10	31	39	71	78	98	137	196	294	490	784	980
0.50	0.15	21	26	47	52	65	91	131	196	327	523	653
0.50	0.25	13	16	28	31	39	55	78	118	196	314	392
0.50	0.35	9	11	20	22	28	39	56	84	140	224	280
0.50	0.50	6	8	14	16	20	27	39	59	98	157	196
0.50	0.75	4	5	9	10	13	18	26	39	65	105	131
1.00	0.05	31	39	71	78	98	137	196	294	490	784	980
1.00	0.10	16	20	35	39	49	69	98	147	245	392	490
1.00	0.15	10	13	24	26	33	46	65	98	163	261	327
1.00	0.25	6	8	14	16	20	27	39	59	98	157	196
1.00	0.35	4	6	10	11	14	20	28	42	70	112	140
1.00	0.50	3	4	7	8	10	14	20	29	49	78	98
1.00	0.75	2	3	5	5	7	9	13	20	33	52	65
2.00	0.05	16	20	35	39	49	69	98	147	245	392	490
2.00	0.10	8	10	18	20	24	34	49	73	122	196	245
2.00	0.15	5	7	12	13	16	23	33	49	82	131	163
2.00	0.25	3	4	7	8	10	14	20	29	49	78	98
2.00	0.35	2	3	5	6	7	10	14	21	35	56	70
2.00	0.50	2	2	4	4	5	7	10	15	24	39	49
2.00	0.75	1	1	2	3	3	5	7	10	16	26	33
4.00	0.05	8	10	18	20	24	34	49	73	122	196	245
4.00	0.10	4	5	9	10	12	17	24	37	61	98	122
4.00	0.15	3	3	6	7	8	11	16	24	41	65	82
4.00	0.25	2	2	4	4	5	7	10	15	24	39	49
4.00	0.35	1	1	3	3	3	5	7	10	17	28	35
4.00	0.50	1	1	2	2	2	3	5	7	12	20	24
4.00	0.75	1	1	1	1	2	2	3	5	8	13	16

N=15 G=12 I=14

VOC ($/KM)	VOCS %	CI ($/KM) 8000	10000	18000	20000	25000	35000	50000	75000	125000	200000	250000
0.10	0.05	336	420	755	839	1049	1469	2098	3147	5245	8393	10491
0.10	0.10	168	210	378	420	525	734	1049	1574	2623	4196	5245
0.10	0.15	112	140	252	280	350	490	699	1049	1748	2798	3497
0.10	0.25	67	84	151	168	210	294	420	629	1049	1679	2098
0.10	0.35	48	60	108	120	150	210	300	450	749	1199	1499
0.10	0.50	34	42	76	84	105	147	210	315	525	839	1049
0.10	0.75	22	28	50	56	70	98	140	210	350	560	699
0.25	0.05	134	168	302	336	420	587	839	1259	2098	3357	4196
0.25	0.10	67	84	151	168	210	294	420	629	1049	1679	2098
0.25	0.15	45	56	101	112	140	196	280	420	699	1119	1399
0.25	0.25	27	34	60	67	84	117	168	252	420	671	839
0.25	0.35	19	24	43	48	60	84	120	180	300	480	599
0.25	0.50	13	17	30	34	42	59	84	126	210	336	420
0.25	0.75	9	11	20	22	28	39	56	84	140	224	280
0.50	0.05	67	84	151	168	210	294	420	629	1049	1679	2098
0.50	0.10	34	42	76	84	105	147	210	315	525	839	1049
0.50	0.15	22	28	50	56	70	98	140	210	350	560	699
0.50	0.25	13	17	30	34	42	59	84	126	210	336	420
0.50	0.35	10	12	22	24	30	42	60	90	150	240	300
0.50	0.50	7	8	15	17	21	29	42	63	105	168	210
0.50	0.75	4	6	10	11	14	20	28	42	70	112	140
1.00	0.05	34	42	76	84	105	147	210	315	525	839	1049
1.00	0.10	17	21	38	42	52	73	105	157	262	420	525
1.00	0.15	11	14	25	28	35	49	70	105	175	280	350
1.00	0.25	7	8	15	17	21	29	42	63	105	168	210
1.00	0.35	5	6	11	12	15	21	30	45	75	120	150
1.00	0.50	3	4	8	8	10	15	21	31	52	84	105
1.00	0.75	2	3	5	6	7	10	14	21	35	56	70
2.00	0.05	17	21	38	42	52	73	105	157	262	420	525
2.00	0.10	8	10	19	21	26	37	52	79	131	210	262
2.00	0.15	6	7	13	14	17	24	35	52	87	140	175
2.00	0.25	3	4	8	8	10	15	21	31	52	84	105
2.00	0.35	2	3	5	6	7	10	15	22	37	60	75
2.00	0.50	2	2	4	4	5	7	10	16	26	42	52
2.00	0.75	1	1	3	3	3	5	7	10	17	28	35
4.00	0.05	8	10	19	21	26	37	52	79	131	210	262
4.00	0.10	4	5	9	10	13	18	26	39	66	105	131
4.00	0.15	3	3	6	7	9	12	17	26	44	70	87
4.00	0.25	2	2	4	4	5	7	10	16	26	42	52
4.00	0.35	1	1	3	3	4	5	7	11	19	30	37
4.00	0.50	1	1	2	2	3	4	5	8	13	21	26
4.00	0.75	1	1	1	1	2	2	3	5	9	14	17

N=15 G=12 I=15

VOC ($/KM)	VOCS %	CI ($/KM) 8000	10000	18000	20000	25000	35000	50000	75000	125000	200000	250000
0.10	0.05	359	448	807	897	1121	1569	2242	3363	5605	8968	11210
0.10	0.10	179	224	404	448	560	785	1121	1681	2802	4484	5605
0.10	0.15	120	149	269	299	374	523	747	1121	1868	2989	3737
0.10	0.25	72	90	161	179	224	314	448	673	1121	1794	2242
0.10	0.35	51	64	115	128	160	224	320	480	801	1281	1601
0.10	0.50	36	45	81	90	112	157	224	336	560	897	1121
0.10	0.75	24	30	54	60	75	105	149	224	374	598	747
0.25	0.05	143	179	323	359	448	628	897	1345	2242	3587	4484
0.25	0.10	72	90	161	179	224	314	448	673	1121	1794	2242
0.25	0.15	49	60	108	120	149	209	299	448	747	1196	1495
0.25	0.25	29	36	65	72	90	126	179	269	448	717	897
0.25	0.35	20	26	46	51	64	90	128	192	320	512	641
0.25	0.50	14	18	32	36	45	63	90	135	224	359	448
0.25	0.75	10	12	22	24	30	42	60	90	149	239	299
0.50	0.05	72	90	161	179	224	314	448	673	1121	1794	2242
0.50	0.10	36	45	81	90	112	157	224	336	560	897	1121
0.50	0.15	24	30	54	60	75	105	149	224	374	598	747
0.50	0.25	14	18	32	36	45	63	90	135	224	359	448
0.50	0.35	10	13	23	26	32	45	64	96	160	256	320
0.50	0.50	7	9	16	18	22	31	45	67	112	179	224
0.50	0.75	5	6	11	12	15	21	30	45	75	120	149
1.00	0.05	36	45	81	90	112	157	224	336	560	897	1121
1.00	0.10	18	22	40	45	56	78	112	168	280	448	560
1.00	0.15	12	15	27	30	37	52	75	112	187	299	374
1.00	0.25	7	9	16	18	22	31	45	67	112	179	224
1.00	0.35	5	6	12	13	16	22	32	48	80	128	160
1.00	0.50	4	4	8	9	11	16	22	34	56	90	112
1.00	0.75	2	3	5	6	7	10	15	22	37	60	75
2.00	0.05	18	22	40	45	56	78	112	168	280	448	560
2.00	0.10	9	11	20	22	28	39	56	84	140	224	280
2.00	0.15	6	7	13	15	19	26	37	56	93	149	187
2.00	0.25	4	4	8	9	11	16	22	34	56	90	112
2.00	0.35	3	3	6	6	8	11	16	24	40	64	80
2.00	0.50	2	2	4	4	6	8	11	17	28	45	56
2.00	0.75	1	1	3	3	4	5	7	11	19	30	37
4.00	0.05	9	11	20	22	28	39	56	84	140	224	280
4.00	0.10	4	6	10	11	14	20	28	42	70	112	140
4.00	0.15	3	4	7	7	9	13	19	28	47	75	93
4.00	0.25	2	2	4	4	6	8	11	17	28	45	56
4.00	0.35	1	2	3	3	4	6	8	12	20	32	40
4.00	0.50	1	1	2	2	3	4	6	8	14	22	28
4.00	0.75	1	1	1	1	2	3	4	6	9	15	19

N=15 G=12 I=16

VOC ($/KM)	VOCS %	CI ($/KM) 8000	10000	18000	20000	25000	35000	50000	75000	125000	200000	250000
0.10	0.05	383	478	861	956	1195	1674	2391	3586	5977	9563	11954
0.10	0.10	191	239	430	478	598	837	1195	1793	2989	4782	5977
0.10	0.15	128	159	287	319	398	558	797	1195	1992	3188	3985
0.10	0.25	77	96	172	191	239	335	478	717	1195	1913	2391
0.10	0.35	55	68	123	137	171	239	342	512	854	1366	1708
0.10	0.50	38	48	86	96	120	167	239	359	598	956	1195
0.10	0.75	26	32	57	64	80	112	159	239	398	638	797
0.25	0.05	153	191	344	383	478	669	956	1435	2391	3825	4782
0.25	0.10	77	96	172	191	239	335	478	717	1195	1913	2391
0.25	0.15	51	64	115	128	159	223	319	478	797	1275	1594
0.25	0.25	31	38	69	77	96	134	191	287	478	765	956
0.25	0.35	22	27	49	55	68	96	137	205	342	546	683
0.25	0.50	15	19	34	38	48	67	96	143	239	383	478
0.25	0.75	10	13	23	26	32	45	64	96	159	255	319
0.50	0.05	77	96	172	191	239	335	478	717	1195	1913	2391
0.50	0.10	38	48	86	96	120	167	239	359	598	956	1195
0.50	0.15	26	32	57	64	80	112	159	239	398	638	797
0.50	0.25	15	19	34	38	48	67	96	143	239	383	478
0.50	0.35	11	14	25	27	34	48	68	102	171	273	342
0.50	0.50	8	10	17	19	24	33	48	72	120	191	239
0.50	0.75	5	6	11	13	16	22	32	48	80	128	159
1.00	0.05	38	48	86	96	120	167	239	359	598	956	1195
1.00	0.10	19	24	43	48	60	84	120	179	299	478	598
1.00	0.15	13	16	29	32	40	56	80	120	199	319	398
1.00	0.25	8	10	17	19	24	33	48	72	120	191	239
1.00	0.35	5	7	12	14	17	24	34	51	85	137	171
1.00	0.50	4	5	9	10	12	17	24	36	60	96	120
1.00	0.75	3	3	6	6	8	11	16	24	40	64	80
2.00	0.05	19	24	43	48	60	84	120	179	299	478	598
2.00	0.10	10	12	22	24	30	42	60	90	149	239	299
2.00	0.15	6	8	14	16	20	28	40	60	100	159	199
2.00	0.25	4	5	9	10	12	17	24	36	60	96	120
2.00	0.35	3	3	6	7	9	12	17	26	43	68	85
2.00	0.50	2	2	4	5	6	8	12	18	30	48	60
2.00	0.75	1	2	3	3	4	6	8	12	20	32	40
4.00	0.05	10	12	22	24	30	42	60	90	149	239	299
4.00	0.10	5	6	11	12	15	21	30	45	75	120	149
4.00	0.15	3	4	7	8	10	14	20	30	50	80	100
4.00	0.25	2	2	4	5	6	8	12	18	30	48	60
4.00	0.35	1	2	3	3	4	6	9	13	21	34	43
4.00	0.50	1	1	2	2	3	4	6	9	15	24	30
4.00	0.75	1	1	1	2	2	3	4	6	10	16	20

N=15 G=12 I=17

VOC ($/KM)	VOCS %	CI ($/KM) 8000	10000	18000	20000	25000	35000	50000	75000	125000	200000	250000
0.10	0.05	407	509	916	1018	1272	1781	2545	3817	6362	10179	12724
0.10	0.10	204	254	458	509	636	891	1272	1909	3181	5090	6362
0.10	0.15	136	170	305	339	424	594	848	1272	2121	3393	4241
0.10	0.25	81	102	183	204	254	356	509	763	1272	2036	2545
0.10	0.35	58	73	131	145	182	254	364	545	909	1454	1818
0.10	0.50	41	51	92	102	127	178	254	382	636	1018	1272
0.10	0.75	27	34	61	68	85	119	170	254	424	679	848
0.25	0.05	163	204	366	407	509	713	1018	1527	2545	4072	5090
0.25	0.10	81	102	183	204	254	356	509	763	1272	2036	2545
0.25	0.15	54	68	122	136	170	238	339	509	848	1357	1697
0.25	0.25	33	41	73	81	102	143	204	305	509	814	1018
0.25	0.35	23	29	52	58	73	102	145	218	364	582	727
0.25	0.50	16	20	37	41	51	71	102	153	254	407	509
0.25	0.75	11	14	24	27	34	48	68	102	170	271	339
0.50	0.05	81	102	183	204	254	356	509	763	1272	2036	2545
0.50	0.10	41	51	92	102	127	178	254	382	636	1018	1272
0.50	0.15	27	34	61	68	85	119	170	254	424	679	848
0.50	0.25	16	20	37	41	51	71	102	153	254	407	509
0.50	0.35	12	15	26	29	36	51	73	109	182	291	364
0.50	0.50	8	10	18	20	25	36	51	76	127	204	254
0.50	0.75	5	7	12	14	17	24	34	51	85	136	170
1.00	0.05	41	51	92	102	127	178	254	382	636	1018	1272
1.00	0.10	20	25	46	51	64	89	127	191	318	509	636
1.00	0.15	14	17	31	34	42	59	85	127	212	339	424
1.00	0.25	8	10	18	20	25	36	51	76	127	204	254
1.00	0.35	6	7	13	15	18	25	36	55	91	145	182
1.00	0.50	4	5	9	10	13	18	25	38	64	102	127
1.00	0.75	3	3	6	7	8	12	17	25	42	68	85
2.00	0.05	20	25	46	51	64	89	127	191	318	509	636
2.00	0.10	10	13	23	25	32	45	64	95	159	254	318
2.00	0.15	7	8	15	17	21	30	42	64	106	170	212
2.00	0.25	4	5	9	10	13	18	25	38	64	102	127
2.00	0.35	3	4	7	7	9	13	18	27	45	73	91
2.00	0.50	2	3	5	5	6	9	13	19	32	51	64
2.00	0.75	1	2	3	3	4	6	8	13	21	34	42
4.00	0.05	10	13	23	25	32	45	64	95	159	254	318
4.00	0.10	5	6	11	13	16	22	32	48	80	127	159
4.00	0.15	3	4	8	8	11	15	21	32	53	85	106
4.00	0.25	2	3	5	5	6	9	13	19	32	51	64
4.00	0.35	1	2	3	4	5	6	9	14	23	36	45
4.00	0.50	1	1	2	3	3	4	6	10	16	25	32
4.00	0.75	1	1	2	2	2	3	4	6	11	17	21

N=15 G=12 I=18

VOC ($/KM)	VUCS %	CI ($/KM) 8000	10000	18000	20000	25000	35000	50000	75000	125000	200000	250000
0.10	0.05	433	541	973	1081	1352	1893	2704	4055	6759	10814	13518
0.10	0.10	216	270	487	541	676	946	1352	2028	3380	5407	6759
0.10	0.15	144	180	324	360	451	631	901	1352	2253	3605	4506
0.10	0.25	87	108	195	216	270	379	541	811	1352	2163	2704
0.10	0.35	62	77	139	154	193	270	386	579	966	1545	1931
0.10	0.50	43	54	97	108	135	189	270	406	676	1081	1352
0.10	0.75	29	36	65	72	90	126	180	270	451	721	901
0.25	0.05	173	216	389	433	541	757	1081	1622	2704	4326	5407
0.25	0.10	87	108	195	216	270	379	541	811	1352	2163	2704
0.25	0.15	58	72	130	144	180	252	360	541	901	1442	1802
0.25	0.25	35	43	78	87	108	151	216	324	541	865	1081
0.25	0.35	25	31	56	62	77	108	154	232	386	618	772
0.25	0.50	17	22	39	43	54	76	108	162	270	433	541
0.25	0.75	12	14	26	29	36	50	72	108	180	288	360
0.50	0.05	87	108	195	216	270	379	541	811	1352	2163	2704
0.50	0.10	43	54	97	108	135	189	270	406	676	1081	1352
0.50	0.15	29	36	65	72	90	126	180	270	451	721	901
0.50	0.25	17	22	39	43	54	76	108	162	270	433	541
0.50	0.35	12	15	28	31	39	54	77	116	193	309	386
0.50	0.50	9	11	19	22	27	38	54	81	135	216	270
0.50	0.75	6	7	13	14	18	25	36	54	90	144	180
1.00	0.05	43	54	97	108	135	189	270	406	676	1081	1352
1.00	0.10	22	27	49	54	68	95	135	203	338	541	676
1.00	0.15	14	18	32	36	45	63	90	135	225	360	451
1.00	0.25	9	11	19	22	27	38	54	81	135	216	270
1.00	0.35	6	8	14	15	19	27	39	58	97	154	193
1.00	0.50	4	5	10	11	14	19	27	41	68	108	135
1.00	0.75	3	4	6	7	9	13	18	27	45	72	90
2.00	0.05	22	27	49	54	68	95	135	203	338	541	676
2.00	0.10	11	14	24	27	34	47	68	101	169	270	338
2.00	0.15	7	9	16	18	23	32	45	68	113	180	225
2.00	0.25	4	5	10	11	14	19	27	41	68	108	135
2.00	0.35	3	4	7	8	10	14	19	29	48	77	97
2.00	0.50	2	3	5	5	7	9	14	20	34	54	68
2.00	0.75	1	2	3	4	5	6	9	14	23	36	45
4.00	0.05	11	14	24	27	34	47	68	101	169	270	338
4.00	0.10	5	7	12	14	17	24	34	51	84	135	169
4.00	0.15	4	5	8	9	11	16	23	34	56	90	113
4.00	0.25	2	3	5	5	7	9	14	20	34	54	68
4.00	0.35	2	2	3	4	5	7	10	14	24	39	48
4.00	0.50	1	1	2	3	3	5	7	10	17	27	34
4.00	0.75	1	1	2	2	2	3	5	7	11	18	23

N=15 G=15 I=10

VOC ($/KM)	VOCS %	CI ($/KM) 8000	10000	18000	20000	25000	35000	50000	75000	125000	200000	250000
0.10	0.05	201	251	452	503	628	880	1257	1885	3141	5026	6283
0.10	0.10	101	126	226	251	314	440	628	942	1571	2513	3141
0.10	0.15	67	84	151	168	209	293	419	628	1047	1675	2094
0.10	0.25	40	50	90	101	126	176	251	377	628	1005	1257
0.10	0.35	29	36	65	72	90	126	180	269	449	718	898
0.10	0.50	20	25	45	50	63	88	126	188	314	503	628
0.10	0.75	13	17	30	34	42	59	84	126	209	335	419
0.25	0.05	80	101	181	201	251	352	503	754	1257	2011	2513
0.25	0.10	40	50	90	101	126	176	251	377	628	1005	1257
0.25	0.15	27	34	60	67	84	117	168	251	419	670	838
0.25	0.25	16	20	36	40	50	70	101	151	251	402	503
0.25	0.35	11	14	26	29	36	50	72	108	180	287	359
0.25	0.50	8	10	18	20	25	35	50	75	126	201	251
0.25	0.75	5	7	12	13	17	23	34	50	84	134	168
0.50	0.05	40	50	90	101	126	176	251	377	628	1005	1257
0.50	0.10	20	25	45	50	63	88	126	188	314	503	628
0.50	0.15	13	17	30	34	42	59	84	126	209	335	419
0.50	0.25	8	10	18	20	25	35	50	75	126	201	251
0.50	0.35	6	7	13	14	18	25	36	54	90	144	180
0.50	0.50	4	5	9	10	13	18	25	38	63	101	126
0.50	0.75	3	3	6	7	8	12	17	25	42	67	84
1.00	0.05	20	25	45	50	63	88	126	188	314	503	628
1.00	0.10	10	13	23	25	31	44	63	94	157	251	314
1.00	0.15	7	8	15	17	21	29	42	63	105	168	209
1.00	0.25	4	5	9	10	13	18	25	38	63	101	126
1.00	0.35	3	4	6	7	9	13	18	27	45	72	90
1.00	0.50	2	3	5	5	6	9	13	19	31	50	63
1.00	0.75	1	2	3	3	4	6	8	13	21	34	42
2.00	0.05	10	13	23	25	31	44	63	94	157	251	314
2.00	0.10	5	6	11	13	16	22	31	47	79	126	157
2.00	0.15	3	4	8	8	10	15	21	31	52	84	105
2.00	0.25	2	3	5	5	6	9	13	19	31	50	63
2.00	0.35	1	2	3	4	4	6	9	13	22	36	45
2.00	0.50	1	1	2	3	3	4	6	9	16	25	31
2.00	0.75	1	1	2	2	2	3	4	6	10	17	21
4.00	0.05	5	6	11	13	16	22	31	47	79	126	157
4.00	0.10	3	3	6	6	8	11	16	24	39	63	79
4.00	0.15	2	2	4	4	5	7	10	16	26	42	52
4.00	0.25	1	1	2	3	3	4	6	9	16	25	31
4.00	0.35	1	1	2	2	2	3	4	7	11	18	22
4.00	0.50	1	1	1	1	2	2	3	5	8	13	16
4.00	0.75	0	0	1	1	1	1	2	3	5	8	10

N=15 G=15 I=11

VOC ($/KM)	VOCS %	CI ($/KM) 8000	10000	18000	20000	25000	35000	50000	75000	125000	200000	250000
0.10	0.05	218	272	490	544	680	952	1360	2040	3400	5440	6800
0.10	0.10	109	136	245	272	340	476	680	1020	1700	2720	3400
0.10	0.15	73	91	163	181	227	317	453	680	1133	1813	2267
0.10	0.25	44	54	98	109	136	190	272	408	680	1088	1360
0.10	0.35	31	39	70	78	97	136	194	291	486	777	971
0.10	0.50	22	27	49	54	68	95	136	204	340	544	680
0.10	0.75	15	18	33	36	45	63	91	136	227	363	453
0.25	0.05	87	109	196	218	272	381	544	816	1360	2176	2720
0.25	0.10	44	54	98	109	136	190	272	408	680	1088	1360
0.25	0.15	29	36	65	73	91	127	181	272	453	725	907
0.25	0.25	17	22	39	44	54	76	109	163	272	435	544
0.25	0.35	12	16	28	31	39	54	78	117	194	311	389
0.25	0.50	9	11	20	22	27	38	54	82	136	218	272
0.25	0.75	6	7	13	15	18	25	36	54	91	145	181
0.50	0.05	44	54	98	109	136	190	272	408	680	1088	1360
0.50	0.10	22	27	49	54	68	95	136	204	340	544	680
0.50	0.15	15	18	33	36	45	63	91	136	227	363	453
0.50	0.25	9	11	20	22	27	38	54	82	136	218	272
0.50	0.35	6	8	14	16	19	27	39	58	97	155	194
0.50	0.50	4	5	10	11	14	19	27	41	68	109	136
0.50	0.75	3	4	7	7	9	13	18	27	45	73	91
1.00	0.05	22	27	49	54	68	95	136	204	340	544	680
1.00	0.10	11	14	24	27	34	48	68	102	170	272	340
1.00	0.15	7	9	16	18	23	32	45	68	113	181	227
1.00	0.25	4	5	10	11	14	19	27	41	68	109	136
1.00	0.35	3	4	7	8	10	14	19	29	49	78	97
1.00	0.50	2	3	5	5	7	10	14	20	34	54	68
1.00	0.75	1	2	3	4	5	6	9	14	23	36	45
2.00	0.05	11	14	24	27	34	48	68	102	170	272	340
2.00	0.10	5	7	12	14	17	24	34	51	85	136	170
2.00	0.15	4	5	8	9	11	16	23	34	57	91	113
2.00	0.25	2	3	5	5	7	10	14	20	34	54	68
2.00	0.35	2	2	3	4	5	7	10	15	24	39	49
2.00	0.50	1	1	2	3	3	5	7	10	17	27	34
2.00	0.75	1	1	2	2	2	3	5	7	11	18	23
4.00	0.05	5	7	12	14	17	24	34	51	85	136	170
4.00	0.10	3	3	6	7	9	12	17	26	43	68	85
4.00	0.15	2	2	4	5	6	8	11	17	28	45	57
4.00	0.25	1	1	2	3	3	5	7	10	17	27	34
4.00	0.35	1	1	2	2	2	3	5	7	12	19	24
4.00	0.50	1	1	1	1	2	2	3	5	9	14	17
4.00	0.75	0	0	1	1	1	2	2	3	6	9	11

N=15 G=15 I=12

VOC (S/KM)	VOCS %	CI (S/KM) 8000	10000	14000	20000	25000	35000	50000	75000	125000	200000	250000
0.10	0.05	235	294	529	588	734	1028	1469	2203	3672	5875	7344
0.10	0.10	118	147	264	294	367	514	734	1102	1836	2938	3672
0.10	0.15	78	98	176	196	245	343	490	734	1224	1958	2448
0.10	0.25	47	59	106	118	147	206	294	441	734	1175	1469
0.10	0.35	34	42	76	84	105	147	210	315	525	839	1049
0.10	0.50	24	29	53	59	73	103	147	220	367	588	734
0.10	0.75	16	20	35	39	49	69	98	147	245	392	490
0.25	0.05	94	118	212	235	294	411	588	881	1469	2350	2938
0.25	0.10	47	59	106	118	147	206	294	441	734	1175	1469
0.25	0.15	31	39	71	78	98	137	196	294	490	783	979
0.25	0.25	19	24	42	47	59	82	118	176	294	470	588
0.25	0.35	13	17	30	34	42	59	84	126	210	336	420
0.25	0.50	9	12	21	24	29	41	59	88	147	235	294
0.25	0.75	6	8	14	16	20	27	39	59	98	157	196
0.50	0.05	47	59	106	118	147	206	294	441	734	1175	1469
0.50	0.10	24	29	53	59	73	103	147	220	367	588	734
0.50	0.15	16	20	35	39	49	69	98	147	245	392	490
0.50	0.25	9	12	21	24	29	41	59	88	147	235	294
0.50	0.35	7	8	15	17	21	29	42	63	105	168	210
0.50	0.50	5	6	11	12	15	21	29	44	73	118	147
0.50	0.75	3	4	7	8	10	14	20	29	49	78	98
1.00	0.05	24	29	53	59	73	103	147	220	367	588	734
1.00	0.10	12	15	26	29	37	51	73	110	184	294	367
1.00	0.15	8	10	18	20	24	34	49	73	122	196	245
1.00	0.25	5	6	11	12	15	21	29	44	73	118	147
1.00	0.35	3	4	8	8	10	15	21	31	52	84	105
1.00	0.50	2	3	5	6	7	10	15	22	37	59	73
1.00	0.75	2	2	4	4	5	7	10	15	24	39	49
2.00	0.05	12	15	26	29	37	51	73	110	184	294	367
2.00	0.10	6	7	13	15	18	26	37	55	92	147	184
2.00	0.15	4	5	9	10	12	17	24	37	61	98	122
2.00	0.25	2	3	5	6	7	10	15	22	37	59	73
2.00	0.35	2	2	4	4	5	7	10	16	26	42	52
2.00	0.50	1	1	3	3	4	5	7	11	18	29	37
2.00	0.75	1	1	2	2	2	3	5	7	12	20	24
4.00	0.05	6	7	13	15	18	26	37	55	92	147	184
4.00	0.10	3	4	7	7	9	13	18	28	46	73	92
4.00	0.15	2	2	4	5	6	9	12	18	31	49	61
4.00	0.25	1	1	3	3	4	5	7	11	18	29	37
4.00	0.35	1	1	2	2	3	4	5	8	13	21	26
4.00	0.50	1	1	1	1	2	3	4	6	9	15	18
4.00	0.75	0	0	1	1	1	2	2	4	6	10	12

N=15 G=15 I=13

VOC ($/KM)	VOCS %	CI ($/KM) 8000	10000	18000	20000	25000	35000	50000	75000	125000	200000	250000
0.10	0.05	253	317	570	633	791	1108	1583	2374	3957	6331	7914
0.10	0.10	127	158	285	317	396	554	791	1187	1978	3166	3957
0.10	0.15	84	106	190	211	264	369	528	791	1319	2110	2638
0.10	0.25	51	63	114	127	158	222	317	475	791	1266	1583
0.10	0.35	36	45	81	90	113	156	226	339	565	904	1131
0.10	0.50	25	32	57	63	79	111	158	237	396	633	791
0.10	0.75	17	21	38	42	53	74	106	158	264	422	528
0.25	0.05	101	127	228	253	317	443	633	950	1583	2532	3166
0.25	0.10	51	63	114	127	158	222	317	475	791	1266	1583
0.25	0.15	34	42	76	84	106	148	211	317	528	844	1055
0.25	0.25	20	25	46	51	63	89	127	190	317	506	633
0.25	0.35	14	18	33	36	45	63	90	136	226	362	452
0.25	0.50	10	13	23	25	32	44	63	95	158	253	317
0.25	0.75	7	8	15	17	21	30	42	63	106	169	211
0.50	0.05	51	63	114	127	158	222	317	475	791	1266	1583
0.50	0.10	25	32	57	63	79	111	158	237	396	633	791
0.50	0.15	17	21	38	42	53	74	106	158	264	422	528
0.50	0.25	10	13	23	25	32	44	63	95	158	253	317
0.50	0.35	7	9	16	18	23	32	45	68	113	181	226
0.50	0.50	5	6	11	13	16	22	32	47	79	127	158
0.50	0.75	3	4	8	8	11	15	21	32	53	84	106
1.00	0.05	25	32	57	63	79	111	158	237	396	633	791
1.00	0.10	13	16	28	32	40	55	79	119	198	317	396
1.00	0.15	8	11	19	21	26	37	53	79	132	211	264
1.00	0.25	5	6	11	13	16	22	32	47	79	127	158
1.00	0.35	4	5	8	9	11	16	23	34	57	90	113
1.00	0.50	3	3	6	6	8	11	16	24	40	63	79
1.00	0.75	2	2	4	4	5	7	11	16	26	42	53
2.00	0.05	13	16	28	32	40	55	79	119	198	317	396
2.00	0.10	6	8	14	16	20	28	40	59	99	158	198
2.00	0.15	4	5	9	11	13	18	26	40	66	106	132
2.00	0.25	3	3	6	6	8	11	16	24	40	63	79
2.00	0.35	2	2	4	5	6	8	11	17	28	45	57
2.00	0.50	1	2	3	3	4	6	8	12	20	32	40
2.00	0.75	1	1	2	2	3	4	5	8	13	21	26
4.00	0.05	6	8	14	16	20	28	40	59	99	158	198
4.00	0.10	3	4	7	8	10	14	20	30	49	79	99
4.00	0.15	2	3	5	5	7	9	13	20	33	53	66
4.00	0.25	1	2	3	3	4	6	8	12	20	32	40
4.00	0.35	1	1	2	2	3	4	6	8	14	23	28
4.00	0.50	1	1	1	2	2	3	4	6	10	16	20
4.00	0.75	0	1	1	1	1	2	3	4	7	11	13

N=15 G=15 I=14

VOC ($/KM)	VOCS %	CI ($/KM) 6000	10000	18000	20000	25000	35000	50000	75000	125000	200000	250000
0.10	0.05	272	340	613	681	851	1191	1702	2553	4255	6808	8510
0.10	0.10	136	170	306	340	426	596	851	1277	2128	3404	4255
0.10	0.15	91	113	204	227	284	397	567	851	1418	2269	2837
0.10	0.25	54	68	123	136	170	238	340	511	851	1362	1702
0.10	0.35	39	49	88	97	122	170	243	365	608	973	1216
0.10	0.50	27	34	61	68	85	119	170	255	426	681	851
0.10	0.75	18	23	41	45	57	79	113	170	284	454	567
0.25	0.05	109	136	245	272	340	477	681	1021	1702	2723	3404
0.25	0.10	54	68	123	136	170	238	340	511	851	1362	1702
0.25	0.15	36	45	82	91	113	159	227	340	567	908	1135
0.25	0.25	22	27	49	54	68	95	136	204	340	545	681
0.25	0.35	16	19	35	39	49	68	97	146	243	389	486
0.25	0.50	11	14	25	27	34	48	68	102	170	272	340
0.25	0.75	7	9	16	18	23	32	45	68	113	182	227
0.50	0.05	54	68	123	136	170	238	340	511	851	1362	1702
0.50	0.10	27	34	61	68	85	119	170	255	426	681	851
0.50	0.15	18	23	41	45	57	79	113	170	284	454	567
0.50	0.25	11	14	25	27	34	48	68	102	170	272	340
0.50	0.35	8	10	18	19	24	34	49	73	122	195	243
0.50	0.50	5	7	12	14	17	24	34	51	85	136	170
0.50	0.75	4	5	8	9	11	16	23	34	57	91	113
1.00	0.05	27	34	61	68	85	119	170	255	426	681	851
1.00	0.10	14	17	31	34	43	60	85	128	213	340	426
1.00	0.15	9	11	20	23	28	40	57	85	142	227	284
1.00	0.25	5	7	12	14	17	24	34	51	85	136	170
1.00	0.35	4	5	9	10	12	17	24	36	61	97	122
1.00	0.50	3	3	6	7	9	12	17	26	43	68	85
1.00	0.75	2	2	4	5	6	8	11	17	28	45	57
2.00	0.05	14	17	31	34	43	60	85	128	213	340	426
2.00	0.10	7	9	15	17	21	30	43	64	106	170	213
2.00	0.15	5	6	10	11	14	20	28	43	71	113	142
2.00	0.25	3	3	6	7	9	12	17	26	43	68	85
2.00	0.35	2	2	4	5	6	9	12	18	30	49	61
2.00	0.50	1	2	3	3	4	6	9	13	21	34	43
2.00	0.75	1	1	2	2	3	4	6	9	14	23	28
4.00	0.05	7	9	15	17	21	30	43	64	106	170	213
4.00	0.10	3	4	8	9	11	15	21	32	53	85	106
4.00	0.15	2	3	5	6	7	10	14	21	35	57	71
4.00	0.25	1	2	3	3	4	6	9	13	21	34	43
4.00	0.35	1	1	2	2	3	4	6	9	15	24	30
4.00	0.50	1	1	2	2	2	3	4	6	11	17	21
4.00	0.75	0	1	1	1	1	2	3	4	7	11	14

N=15 G=15 I=15

VOC (\$/KM)	VOCS %	CI (\$/KM) 6000	10000	18000	20000	25000	35000	50000	75000	125000	200000	250000
0.10	0.05	292	365	658	731	913	1279	1826	2740	4566	7306	9132
0.10	0.10	146	183	329	365	457	639	913	1370	2283	3653	4566
0.10	0.15	97	122	219	244	304	426	609	913	1522	2435	3044
0.10	0.25	58	73	132	146	183	256	365	548	913	1461	1826
0.10	0.35	42	52	94	104	130	183	261	391	652	1044	1305
0.10	0.50	29	37	66	73	91	128	183	274	457	731	913
0.10	0.75	19	24	44	49	61	85	122	183	304	487	609
0.25	0.05	117	146	263	292	365	511	731	1096	1826	2922	3653
0.25	0.10	58	73	132	146	183	256	365	548	913	1461	1826
0.25	0.15	39	49	88	97	122	170	244	365	609	974	1218
0.25	0.25	23	29	53	58	73	102	146	219	365	584	731
0.25	0.35	17	21	38	42	52	73	104	157	261	417	522
0.25	0.50	12	15	26	29	37	51	73	110	183	292	365
0.25	0.75	8	10	18	19	24	34	49	73	122	195	244
0.50	0.05	58	73	132	146	183	256	365	548	913	1461	1826
0.50	0.10	29	37	66	73	91	128	183	274	457	731	913
0.50	0.15	19	24	44	49	61	85	122	183	304	487	609
0.50	0.25	12	15	26	29	37	51	73	110	183	292	365
0.50	0.35	8	10	19	21	26	37	52	78	130	209	261
0.50	0.50	6	7	13	15	18	26	37	55	91	146	183
0.50	0.75	4	5	9	10	12	17	24	37	61	97	122
1.00	0.05	29	37	66	73	91	128	183	274	457	731	913
1.00	0.10	15	18	33	37	46	64	91	137	228	365	457
1.00	0.15	10	12	22	24	30	43	61	91	152	244	304
1.00	0.25	6	7	13	15	18	26	37	55	91	146	183
1.00	0.35	4	5	9	10	13	18	26	39	65	104	130
1.00	0.50	3	4	7	7	9	13	18	27	46	73	91
1.00	0.75	2	2	4	5	6	9	12	18	30	49	61
2.00	0.05	15	18	33	37	46	64	91	137	228	365	457
2.00	0.10	7	9	16	18	23	32	46	68	114	183	228
2.00	0.15	5	6	11	12	15	21	30	46	76	122	152
2.00	0.25	3	4	7	7	9	13	18	27	46	73	91
2.00	0.35	2	3	5	5	7	9	13	20	33	52	65
2.00	0.50	1	2	3	4	5	6	9	14	23	37	46
2.00	0.75	1	1	2	2	3	4	6	9	15	24	30
4.00	0.05	7	9	16	18	23	32	46	68	114	183	228
4.00	0.10	4	5	8	9	11	16	23	34	57	91	114
4.00	0.15	2	3	5	6	8	11	15	23	38	61	76
4.00	0.25	1	2	3	4	5	6	9	14	23	37	46
4.00	0.35	1	1	2	3	3	5	7	10	16	26	33
4.00	0.50	1	1	2	2	2	3	5	7	11	18	23
4.00	0.75	0	1	1	1	2	2	3	5	8	12	15

N=15 G=15 I=16

VUC ($/KM)	VUC3 %	CI ($/KM) 8000	10000	18000	20000	25000	35000	50000	75000	125000	200000	250000
0.10	0.05	313	391	704	782	978	1369	1956	2934	4890	7824	9781
0.10	0.10	156	196	352	391	489	685	978	1467	2445	3912	4890
0.10	0.15	104	130	235	261	326	456	652	978	1630	2608	3260
0.10	0.25	63	78	141	156	196	274	391	587	978	1565	1956
0.10	0.35	45	56	101	112	140	196	279	419	699	1118	1397
0.10	0.50	31	39	70	78	98	137	196	293	489	782	978
0.10	0.75	21	26	47	52	65	91	130	196	326	522	652
0.25	0.05	125	156	282	313	391	548	782	1174	1956	3130	3912
0.25	0.10	63	78	141	156	196	274	391	587	978	1565	1956
0.25	0.15	42	52	94	104	130	183	261	391	652	1043	1304
0.25	0.25	25	31	56	63	78	110	156	235	391	626	782
0.25	0.35	18	22	40	45	56	78	112	168	279	447	559
0.25	0.50	13	16	28	31	39	55	78	117	196	313	391
0.25	0.75	8	10	19	21	26	37	52	78	130	209	261
0.50	0.05	63	78	141	156	196	274	391	587	978	1565	1956
0.50	0.10	31	39	70	78	98	137	196	293	489	782	978
0.50	0.15	21	26	47	52	65	91	130	196	326	522	652
0.50	0.25	13	16	28	31	39	55	78	117	196	313	391
0.50	0.35	9	11	20	22	28	39	56	84	140	224	279
0.50	0.50	6	8	14	16	20	27	39	59	98	156	196
0.50	0.75	4	5	9	10	13	18	26	39	65	104	130
1.00	0.05	31	39	70	78	98	137	196	293	489	782	978
1.00	0.10	16	20	35	39	49	68	98	147	245	391	489
1.00	0.15	10	13	23	26	33	46	65	98	163	261	326
1.00	0.25	6	8	14	16	20	27	39	59	98	156	196
1.00	0.35	4	6	10	11	14	20	28	42	70	112	140
1.00	0.50	3	4	7	8	10	14	20	29	49	78	98
1.00	0.75	2	3	5	5	7	9	13	20	33	52	65
2.00	0.05	16	20	35	39	49	68	98	147	245	391	489
2.00	0.10	8	10	18	20	24	34	49	73	122	196	245
2.00	0.15	5	7	12	13	16	23	33	49	82	130	163
2.00	0.25	3	4	7	8	10	14	20	29	49	78	98
2.00	0.35	2	3	5	6	7	10	14	21	35	56	70
2.00	0.50	2	2	4	4	5	7	10	15	24	39	49
2.00	0.75	1	1	2	3	3	5	7	10	16	26	33
4.00	0.05	8	10	18	20	24	34	49	73	122	196	245
4.00	0.10	4	5	9	10	12	17	24	37	61	98	122
4.00	0.15	3	3	6	7	8	11	16	24	41	65	82
4.00	0.25	2	2	4	4	5	7	10	15	24	39	49
4.00	0.35	1	1	3	3	3	5	7	10	17	28	35
4.00	0.50	1	1	2	2	2	3	5	7	12	20	24
4.00	0.75	1	1	1	1	2	2	3	5	8	13	16

N=15 G=15 I=17

VOC ($/KM)	VOCS %	CI ($/KM) 8000	10000	18000	20000	25000	35000	50000	75000	125000	200000	250000
0.10	0.05	335	418	753	836	1045	1464	2091	3136	5227	8363	10454
0.10	0.10	167	209	376	418	523	732	1045	1568	2614	4182	5227
0.10	0.15	112	139	251	279	348	488	697	1045	1742	2788	3485
0.10	0.25	67	84	151	167	209	293	418	627	1045	1673	2091
0.10	0.35	48	60	108	119	149	209	299	448	747	1195	1493
0.10	0.50	33	42	75	84	105	146	209	314	523	836	1045
0.10	0.75	22	28	50	56	70	98	139	209	348	558	697
0.25	0.05	134	167	301	335	418	585	836	1254	2091	3345	4182
0.25	0.10	67	84	151	167	209	293	418	627	1045	1673	2091
0.25	0.15	45	56	100	112	139	195	279	418	697	1115	1394
0.25	0.25	27	33	60	67	84	117	167	251	418	669	836
0.25	0.35	19	24	43	48	60	84	119	179	299	478	597
0.25	0.50	13	17	30	33	42	59	84	125	209	335	418
0.25	0.75	9	11	20	22	28	39	56	84	139	223	279
0.50	0.05	67	84	151	167	209	293	418	627	1045	1673	2091
0.50	0.10	33	42	75	84	105	146	209	314	523	836	1045
0.50	0.15	22	28	50	56	70	98	139	209	348	558	697
0.50	0.25	13	17	30	33	42	59	84	125	209	335	418
0.50	0.35	10	12	22	24	30	42	60	90	149	239	299
0.50	0.50	7	8	15	17	21	29	42	63	105	167	209
0.50	0.75	4	6	10	11	14	20	28	42	70	112	139
1.00	0.05	33	42	75	84	105	146	209	314	523	836	1045
1.00	0.10	17	21	38	42	52	73	105	157	261	418	523
1.00	0.15	11	14	25	28	35	49	70	105	174	279	348
1.00	0.25	7	8	15	17	21	29	42	63	105	167	209
1.00	0.35	5	6	11	12	15	21	30	45	75	119	149
1.00	0.50	3	4	8	8	10	15	21	31	52	84	105
1.00	0.75	2	3	5	6	7	10	14	21	35	56	70
2.00	0.05	17	21	38	42	52	73	105	157	261	418	523
2.00	0.10	8	10	19	21	26	37	52	78	131	209	261
2.00	0.15	6	7	13	14	17	24	35	52	87	139	174
2.00	0.25	3	4	8	8	10	15	21	31	52	84	105
2.00	0.35	2	3	5	6	7	10	15	22	37	60	75
2.00	0.50	2	2	4	4	5	7	10	16	26	42	52
2.00	0.75	1	1	3	3	3	5	7	10	17	28	35
4.00	0.05	8	10	19	21	26	37	52	78	131	209	261
4.00	0.10	4	5	9	10	13	18	26	39	65	105	131
4.00	0.15	3	3	6	7	9	12	17	26	44	70	87
4.00	0.25	2	2	4	4	5	7	10	16	26	42	52
4.00	0.35	1	1	3	3	4	5	7	11	19	30	37
4.00	0.50	1	1	2	2	3	4	5	8	13	21	26
4.00	0.75	1	1	1	1	2	2	3	5	9	14	17

N=15 G=15 I=18

VOC (\$/KM)	VOCS %	CI (\$/KM) 8000	10000	18000	20000	25000	35000	50000	75000	125000	200000	250000
0.10	0.05	357	446	803	892	1115	1561	2231	3346	5576	8922	11153
0.10	0.10	178	223	401	446	558	781	1115	1673	2788	4461	5576
0.10	0.15	119	149	268	297	372	520	744	1115	1859	2974	3718
0.10	0.25	71	89	161	178	223	312	446	669	1115	1784	2231
0.10	0.35	51	64	115	127	159	223	319	478	797	1275	1593
0.10	0.50	36	45	80	89	112	156	223	335	558	892	1115
0.10	0.75	24	30	54	59	74	104	149	223	372	595	744
0.25	0.05	143	178	321	357	446	625	892	1338	2231	3569	4461
0.25	0.10	71	89	161	178	223	312	446	669	1115	1784	2231
0.25	0.15	48	59	107	119	149	208	297	446	744	1190	1487
0.25	0.25	29	36	64	71	89	125	178	268	446	714	892
0.25	0.35	20	25	46	51	64	89	127	191	319	510	637
0.25	0.50	14	18	32	36	45	62	89	134	223	357	446
0.25	0.75	10	12	21	24	30	42	59	89	149	238	297
0.50	0.05	71	89	161	178	223	312	446	669	1115	1784	2231
0.50	0.10	36	45	80	89	112	156	223	335	558	892	1115
0.50	0.15	24	30	54	59	74	104	149	223	372	595	744
0.50	0.25	14	18	32	36	45	62	89	134	223	357	446
0.50	0.35	10	13	23	25	32	45	64	96	159	255	319
0.50	0.50	7	9	16	18	22	31	45	67	112	178	223
0.50	0.75	5	6	11	12	15	21	30	45	74	119	149
1.00	0.05	36	45	80	89	112	156	223	335	558	892	1115
1.00	0.10	18	22	40	45	56	78	112	167	279	446	558
1.00	0.15	12	15	27	30	37	52	74	112	186	297	372
1.00	0.25	7	9	16	18	22	31	45	67	112	178	223
1.00	0.35	5	6	11	13	16	22	32	48	80	127	159
1.00	0.50	4	4	8	9	11	16	22	33	56	89	112
1.00	0.75	2	3	5	6	7	10	15	22	37	59	74
2.00	0.05	18	22	40	45	56	78	112	167	279	446	558
2.00	0.10	9	11	20	22	28	39	56	84	139	223	279
2.00	0.15	6	7	13	15	19	26	37	56	93	149	186
2.00	0.25	4	4	8	9	11	16	22	33	56	89	112
2.00	0.35	3	3	6	6	8	11	16	24	40	64	80
2.00	0.50	2	2	4	4	6	8	11	17	28	45	56
2.00	0.75	1	1	3	3	4	5	7	11	19	30	37
4.00	0.05	9	11	20	22	28	39	56	84	139	223	279
4.00	0.10	4	6	10	11	14	20	28	42	70	112	139
4.00	0.15	3	4	7	7	9	13	19	28	46	74	93
4.00	0.25	2	2	4	4	6	8	11	17	28	45	56
4.00	0.35	1	2	3	3	4	6	8	12	20	32	40
4.00	0.50	1	1	2	2	3	4	6	8	14	22	28
4.00	0.75	1	1	1	1	2	3	4	6	9	15	19

DETAILS ON SIMPLE APPRAISAL METHODS

1. This annex presents the mathematical derivations of the simplified appraisal methods presented in Section III of the report.

2. Simplified Method I. The first method presented in Section III is concerned with the economic justification of rural roads (RRs) solely based on vehicle operating cost (VOC) savings. Consequently, for a road to be economically feasible, the present value of the VOC savings must be equal to or exceed the present value of the costs of construction and maintenance of the road. Thus:

$$C_R \leqslant \sum_{t=1}^{N} \frac{B_t}{(1+i)^t} \qquad \text{.............(1)}$$

where, C_R = present value of the costs of construction and maintenance of the road,

B_t = benefits during year t, in this case defined in terms of VOC savings,

i = opportunity cost of capital, and

N = years of expected life of the road.

Note that:

$$B_t = (KM)\ (365)\left\{(ADT_{1t})(VOC_{1t}) - (ADT_{2t})\ (VOC_{2t})\right\} \qquad \text{.............(2)}$$

where, KM = length of the road in kilometers,

ADT_{1t}, ADT_{2t} = the average daily vehicle traffic on the road in year t in the without- and with-project situation, respectively, and

VOC_{1t}, VOC_{2t} = the weighted average (based on composition of typical vehicles) vehicle operating cost per vehicle-kilometer during year t in the without- and with-project situation, respectively.

Expression (2) ignores benefits related to generated traffic in view of assumptions (iii) and (iv) of para. 37 of the text. The relation between the present value of benefits growing at an annual compound rate g and the first year benefit is: 9/

$$\sum_{t=1}^{N} \frac{B_t}{(1+i)^t} = B_1 \left[\frac{\frac{(1+g)}{(1+i)}^N - 1}{\frac{(1+g)}{(1+i)} - 1} \right] \left(\frac{1}{1+i}\right) \qquad \ldots\ldots\ldots\ldots\ldots(3)$$

where, B_1 = first year benefits (or B_t for t=1),

g = annual compound growth rate of benefits, and

i and N are as defined above.

The terms by which B_1 is multiplied in expression (3) may be referred to as the Present Value Factor for a given i, N, and g. Thus, expression (3) may be written as:

$$\sum_{t=1}^{N} \frac{B_t}{(1+i)^t} = B_1 \, (PVF_{i,g,N}) \qquad \ldots\ldots\ldots\ldots\ldots\ldots(4)$$

where, $PVF_{i,g,N}$ = present value factor of a pecuniary benefit unit growing at an annual compound rate of g over N years and discounted at rate i.

Combining expressions (2) and (4) gives:

$$\sum_{t=1}^{N} \frac{B_t}{(1+i)^t} = (KM)\,(365) \left[ADT_{11} \, (VOC_{11} - VOC_{21}) \right] (PVF_{i,g,N}) \ldots\ldots\ldots(5)$$

9/ M. Martinez, Benefit-Cost Calculations: Tables for Internal Rates of Return and Sensitivity Tests, World Bank, January 1979.

The initial condition to justify the road solely on VOC savings, expression (1), may now be written as:

$$C_R \leq (KM)\ (365) \left[ADT_{11}\ (VOC_{11} - VOC_{21}) \right] (PVF_{i,g,N}) \qquad \text{..............(6)}$$

or,

$$\frac{C_R}{KM} \leq 365 \left[ADT_{11}\ (VOC_{11} - VOC_{21}) \right] (PVF_{i,g,N}) \qquad \text{..............(7)}$$

From equation (7) the initial level of traffic required to justify the road on VOC savings may be calculated as:

$$ADT_{11} \geq \frac{C_{R/}\ KM}{365\ (VOC_{11} - VOC_{21})\ (PVF_{i,g,N})} \qquad \text{..............(8)}$$

or,

$$ADT_{11} \geq \frac{C_{R/}\ KM}{(365)\ (VOC_{11}) \left(\frac{VOC_{11} - VOC_{21}}{VOC_{11}} \right) (PVF_{i,g,N})} \qquad \text{..............(9)}$$

The ADT figures of Annex L, which are minimum ADTs required to economically justify the construction or improvement of a RR, have been calculated with expression (9).

3. Simplified Method III.[10/] This simplification justifies the RR and agricultural investments, if any, in the RR's zone of influence on the basis of the producer surplus concept. For economically feasible investments the following inequality has to be satisfied:

$$C \leq \sum_{t=1}^{N} \frac{VA_{2t} - VA_{1t}}{(1+i)^t} \qquad \text{.............(10)}$$

10/ See V. Wouters, Internal Rates of Return Tables, World Bank, Washington, D.C., 1967, for the derivation of Simplified Method II.

where, C = present value of the costs of construction and maintenance of rural road and agricultural components, if any, in the zone of influence,

VA_{1t}, VA_{2t} = agricultural value added in the zone of influence during year t of the without- and with-project situation, respectively, and

i and N are as defined earlier.

Define year p as the year when the agricultural value added in both with- and without-project situations is at maximum. In addition, year p_1 is defined as the year in which the full agricultural production or maximum value added is first achieved in the without-project situation, while p_2 corresponds to the year when full agricultural production or maximum value added in the with-project situation is first achieved.

Case $p_1 > p_2$. Assuming proportional linear growth of agricultural production between year 1 and year p_1 in the without-project situation and similarly between year 1 and year p_2 in the with-project situation, the present value of benefits may be calculated for situations where $p_1 > p_2$. Thus, defining x as $x = p_1 - p_2$, the present value of benefits is given by:

$$\sum_{t=1}^{N} \frac{VA_{2t} - VA_{1t}}{(1+i)^t} = \frac{\left(\frac{1}{p_2}\right) VA_{2p_2} - \left(\frac{1}{p_1}\right) VA_{1p_1}}{(1+i)} + \frac{\left(\frac{2}{p_2}\right) VA_{2p_2} - \left(\frac{1}{p_1}\right) VA_{1p_1}}{(1+i)^2} +$$

$$+ \frac{\left(\frac{3}{p_2}\right) VA_{2p_2} - \left(\frac{3}{p_1}\right) VA_{1p_1}}{(1+i)^3} + \ldots + \frac{\left(\frac{p_1-x-1}{p_2}\right) VA_{2p_2} - \left(\frac{p_1-x-1}{p_1}\right) VA_{1p_1}}{(1+i)^{p_1-x-1}} +$$

$$\frac{\left(\frac{p_1-x}{p_2}\right) VA_{2p_2} - \left(\frac{p_1-x}{p_1}\right) VA_{1p_1}}{(1+i)^{p_1-x}} + \ldots + \frac{VA_{2p_2} - \left(\frac{p_1-1}{p_1}\right) VA_{1p_1}}{(1+i)^{p_1-1}} +$$

$$+ \frac{VA_{2p_2} - VA_{1p_1}}{(1+i)^{p_1}} + \ldots + \frac{VA_{2p_2} - VA_{1p_1}}{(1+i)^N} \qquad \ldots\ldots\ldots\ldots\ldots\ldots (11)$$

A similar expression is later derived for the case $p_1 < p_2$.

Consider now what happens to equation (11) when benefits in both the with-project and without-project situations are evaluated at p_1, the largest of the two time periods for full production maturity. In this case equation (11) may be rewritten as follows after substituting p_1 for p_2:

$$\sum_{t=1}^{N} \frac{\widehat{VA}_{2t} - \widehat{VA}_{1t}}{(1+i)^t} = \frac{\left(\frac{1}{p_1}\right) VA_{2p_2} - \left(\frac{1}{p_1}\right) VA_{1p_1}}{(1+i)} + \frac{\left(\frac{2}{p_1}\right) VA_{2p_2} - \left(\frac{2}{p_1}\right) VA_{1p_1}}{(1+i)^2} +$$

$$+ \frac{\left(\frac{3}{p_1}\right) VA_{2p_2} - \left(\frac{3}{p_1}\right) VA_{1p_1}}{(1+i)^3} + \dots + \frac{\left(\frac{p_1-x-1}{p_1}\right) VA_{2p_2} - \left(\frac{p_1-x-1}{p_1}\right) VA_{1p_1}}{(1+i)^{p_1-x-1}} +$$

$$+ \frac{\left(\frac{p_1-x}{p_1}\right) VA_{2p_2} - \left(\frac{p_1-x}{p_1}\right) VA_{1p_1}}{(1+i)^{p_1-x}} + \dots + \frac{\left(\frac{p_1-1}{p_1}\right) VA_{2p_2} - \left(\frac{p_1-1}{p_1}\right) VA_{1p_1}}{(1+i)^{p_1-1}} +$$

$$+ \frac{VA_{2p_2} - VA_{1p_1}}{(1+i)^{p_1}} + \dots + \frac{VA_{2p_2} - VA_{1p_1}}{(1+i)^N} \qquad \dots\dots\dots\dots (12)$$

As shown below expression (12) underestimates the true value of benefits as denoted in expression (11):

$$\sum_{t=1}^{N} \frac{VA_{2t} - VA_{1t}}{(1+i)^t} - \sum_{t=1}^{N} \frac{\widehat{VA}_{2t} - \widehat{VA}_{1t}}{(1+i)^t} = VA_{2p_2}\left[\frac{\left(\frac{1}{p_2} - \frac{1}{p_1}\right)}{(1+i)} + \frac{\left(\frac{2}{p_2} - \frac{2}{p_1}\right)}{(1+i)^2}\right] +$$

$$+ \frac{\left(\frac{3}{p_2} - \frac{3}{p_1}\right)}{(1+i)^3} + \ldots + \frac{\left(\frac{p_1-x-1}{p_2}\right) - \left(\frac{p_1-x-1}{p_1}\right)}{(1+i)^{p_1-x-1}} +$$

$$+ \frac{1 - \left(\frac{p_1-x}{p_1}\right)}{(1+i)^{p_1-x}} + \ldots + \frac{1 - \left(\frac{p_1-1}{p_1}\right)}{(1+i)^{p_1-1}} \qquad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (13)$$

since $p_1 > p_2$ expression (13) results in:

$$\sum_{t=1}^{N} \frac{VA_{2t} - VA_{1t}}{(1+i)^t} - \sum_{t=1}^{N} \frac{\widehat{VA}_{2t} - \widehat{VA}_{1t}}{(1+i)^t} > 0 \qquad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (14)$$

and:

$$\sum_{t=1}^{N} \frac{VA_{2t} - VA_{1t}}{(1+i)^t} > \sum_{t=1}^{N} \frac{\widehat{VA}_{2t} - \widehat{VA}_{1t}}{(1+i)^t} \qquad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (15)$$

so that the true benefits are underestimated. Conversely it may also be shown that evaluating expression (11) at p_2 would result in an overestimate of the true benefits.

Case $p_1 < p_2$. Consider now the case $p_1 < p_2$, in which case x is defined as $x = p_2 - p_1$. In this case the formula for estimating the present value of benefits is given by:

$$\sum_{t=1}^{N} \frac{VA_{2t} - VA_{1t}}{(1+i)^t} = \frac{\left(\frac{1}{p_2}\right) VA_{2p_2} - \left(\frac{1}{p_1}\right) VA_{1p_1}}{(1+i)} + \frac{\left(\frac{2}{p_2}\right) VA_{2p_2} - \left(\frac{1}{p_1}\right) VA_{1p_1}}{(1+i)^2} +$$

$$+ \frac{\left(\frac{3}{p_2}\right) VA_{2p_2} - \left(\frac{3}{p_1}\right) VA_{1p_1}}{(1+i)^3} + \ldots\ldots + \frac{\left(\frac{p_2-x-1}{p_2}\right) VA_{2p_2} - \left(\frac{p_2-x-1}{p_1}\right) VA_{1p_1}}{(1+i)^{p_2-x-1}} +$$

$$+ \frac{\left(\frac{p_2-x}{p_2}\right) VA_{2p_2} - VA_{1p_1}}{(1+i)^{p_2-x}} + \ldots\ldots + \frac{\left(\frac{p_2-1}{p_2}\right) VA_{2p_2} - VA_{1p_1}}{(1+i)^{p_2-1}} +$$

$$+ \frac{VA_{2p_2} - VA_{1p_1}}{(1+i)^{p_1}} + \ldots\ldots + \frac{VA_{2p_2} - VA_{1p_1}}{(1+i)^N} \qquad \ldots\ldots\ldots\ldots\ldots (16)$$

Expression (16) may be evaluated by substituting p_1 for p_2 in which case, equation (16) becomes:

$$\sum_{t=1}^{N} \frac{\hat{\hat{VA}}_{2t} - \hat{\hat{VA}}_{1t}}{(1+i)^t} = \frac{\left(\frac{1}{p_1}\right)VA_{2p_2} - \left(\frac{1}{p_1}\right)VA_{1p_1}}{(1+i)} + \frac{\left(\frac{2}{p_1}\right)VA_{2p_2} - \left(\frac{2}{p_1}\right)VA_{1p_1}}{(1+i)^2} +$$

$$+ \frac{\left(\frac{3}{p_1}\right)VA_{2p_2} - \left(\frac{3}{p_1}\right)VA_{1p_1}}{(1+i)^3} + \ldots + \frac{\left(\frac{p_2-x-1}{p_1}\right)VA_{2p_2} - \left(\frac{p_2-x-1}{p_2}\right)VA_{1p_1}}{(1+i)^{p_2-x-1}} +$$

$$+ \frac{VA_{2p_2} - VA_{1p_1}}{(1+i)^{p_1}} + \ldots + \frac{VA_{2p_2} - VA_{1p_1}}{(1+i)^N} \qquad \ldots\ldots\ldots\ldots(17)$$

As shown next, expression (17) results in an overestimate of the true benefits as calculated in expression (16).

$$\sum_{t=1}^{N} \frac{VA_{2t} - VA_{1t}}{(1+i)^t} - \sum_{t=1}^{N} \frac{\hat{\hat{VA}}_{2t} - \hat{\hat{VA}}_{1t}}{(1+i)^t} = VA_{2p_2}\left[\frac{\left(\frac{1}{p_2} - \frac{1}{p_1}\right)}{(1+i)} + \frac{\left(\frac{2}{p_2} - \frac{2}{p_1}\right)}{(1+i)^2}\right] +$$

$$+ \frac{\left(\frac{3}{p_2}\right) - \left(\frac{3}{p_1}\right)}{(1+i)^3} + \ldots + \frac{\left(\frac{p_2-x-1}{p_2}\right) - \left(\frac{p_2-x-1}{p_1}\right)}{(1+i)^{p_2-x-1}} +$$

$$+ \frac{\left(\frac{p_2 - x}{p_2}\right) - 1}{(1+i)^{p_2-x}} + \ldots + \frac{\left(\frac{p_2 - 1}{p_2}\right) - 1}{(1+i)^{p_2-1}} \qquad \ldots\ldots\ldots\ldots(18)$$

Given that, $p_1 < p_2$, expression (18) results in:

$$\sum_{t=1}^{N} \frac{VA_{2t} - VA_{1t}}{(1+i)^t} - \sum_{t=1}^{N} \frac{\hat{\hat{VA}}_{2t} - \hat{\hat{VA}}_{1t}}{(1+i)^t} < 0 \qquad \text{..............(19)}$$

and:

$$\sum_{t=1}^{N} \frac{VA_{2t} - VA_{1t}}{(1+i)^t} < \sum_{t=1} \frac{\hat{\hat{VA}}_{2t} - \hat{\hat{VA}}_{1t}}{(1+i)^t} \qquad \text{..............(20)}$$

so that the true benefits are overestimated by the selection of p_1 as the year representing full maturity. Conversely, it may also be shown that evaluating expression (16) at p_2 would result in an underestimation of the true benefits.

In summary, the definition of the full production maturity in terms of the with-project situation (p_2) will result in the following biases in the estimation of benefits, depending on the relationship between p_1 and p_2:

Actual Situation	Impact on the Estimation of Benefits in Equations (11) and (16)
$p_1 > p_2$	If p_2 used ——> Overestimation If p_1 used ——> Underestimation
$p_1 = p_2$	Correct estimation
$p_1 < p_2$	If p_2 used ——> Underestimation If p_1^2 used ——> Overestimation

In view of these results, assumption (v) of para. 46 of the text has been introduced.

By defining p as the larger of p_1 and p_2, expressions (11) and (16) can be further simplified as:

$$\sum_{t=1}^{N} \frac{VA_{2t} - VA_{1t}}{(1+i)^t} = \left(VA_p\right)\left[\frac{\frac{1}{p}}{(1+i)} + \frac{\frac{2}{p}}{(1+i)^2} + \ldots + \frac{\frac{p-1}{p}}{(1+i)^{p-1}} + \frac{1}{(1+i)^p} + \frac{1}{(1+i)^{p+1}} + \ldots\ldots + \frac{1}{(1+i)^N}\right]$$

..............(21)

The terms in brackets may be expressed as the crop unit value factors ($CPV_{i,N,p}$) corresponding to the present value of one pecuniary unit benefit in year p, discounted at the opportunity cost of capital i during N years. These crop unit value factors have been calculated and are presented in Table 5 of the text. Introduction of these crop unit value factors into equation (21) results in:

$$\sum_{t=1}^{N} \frac{VA_{2t} - VA_{1t}}{(1+i)^t} = (VA_p)\left(CPV_{i,N,p}\right) \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots(22)$$

Substituting equation (22) into expression (10) results in the following decision rule: for the investment in RR and agricultural components, if any, in its zone of influence to be economically justified:

$$C \leq (VA_p) \left(CPV_{i,N,p}\right) \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots(23)$$

The ERs of Table 5 of the text have been established with expression (23).

4. Simplified Method IV. Expression (10) of the text may be derived from expression (9) of Annex 1 of Staff Working Paper No. 362 (H.L. Beenhakker and A. Chammari, October 1979) as follows:

$$B = P_m q_2 - R_2 - P_m q_1 + R_1 +$$
$$[-P_1 (H_1 - H_2) - 1/2 (H_1 - H_2)(P_2 - P_1)] \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots(24)$$

Note that $q_2 = Q_2$ and $q_1 = Q_1$, since $H_1 = H_2$.

Expression (24) therefore becomes:

$$B = P_m (Q_2 - Q_1) - C_2 - Q_2 k_2 + C_1 + Q_1 k_1 \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots(25)$$

since $R_2 = C_2 + k_2 Q_2$ and $R_1 = C_1 + k_1 Q_1$

where all terms are defined as in the aforementioned Annex 1, which is reproduced in Annex O of this paper. Expression (25) is the same as expression (10) of the text.

5. Simplified Method V. Expression (11) of the text may be derived by substituting (Q_2-H_2) for q_2 and (Q_1-H_1) for q_1, in expression (24):

$$B = P_m(Q_2-H_2) - R_2 - P_m(Q_1-H_1) + R_1$$
$$- P_1(H_1-H_2) - 1/2(H_1-H_2)(P_2-P_1)$$

Note that $R_1 = C_1 + (Q_1-H_1)\ k_1 = C_1 + q_1\ k_1$, and

$$R_2 = C_2 + (Q_2-H_2)k_2 = C_2 + q_2\ k_2$$

Therefore:

$$B = P_mQ_2 - P_mQ_1 - C_2 - (Q_2-H_2)k_2 + C_1 +$$
$$+ (Q_1-H_1)k_1 - P_mH_2 + P_mH_1 - P_1(H_1-H_2) -$$
$$- 1/2(H_1-H_2)(P_2-P_1) = P_mQ_2 - P_mQ_1 - C_2 -$$
$$- (Q_2-H_2)k_2 + C_1 + (Q_1-H_1)k_1 +$$
$$+ (P_m-P_1)(H_1-H_2) - 1/2(H_1-H_2)(P_2-P_1) =$$
$$P_mQ_2 - P_mQ_1 - C_2 - (Q_2-H_2)k_2 + C_1 +$$
$$+ (Q_1-H_1)k_1 + (H_1-H_2)\ (P_m-1/2P_1 - 1/2P_2)$$

Ignoring $(H_1-H_2)(P_m-1/2P_1-1/2P_2)$ since the value of this expression is normally close to zero, one obtains:

$$B = P_mQ_2 - P_mQ_1 - C_2 - Q_2k_2 + C_1 + Q_1k_1 + H_2k_2 - H_1k_1$$

where the first six terms and the last two terms represent expressions (10) and (11) of the text, respectively.

6. Simplified Method VII.[11/] Expression (12) of the text may be derived by substituting (P_1+F_1) for P_m, (Q_1-H_1) for q_1 and (Q_2-H_2) for q_2 in expression (24):

$$B = (P_1+F_1)[(Q_2-H_2) - (Q_1-H_1)] - R_2 + R_1 +$$
$$- P_1(H_1-H_2) - 1/2(H_1-H_2)(P_2-P_1) =$$
$$= P_1(Q_2-H_2) + F_1(Q_2-H_2) - P_1(Q_1-H_1) -$$
$$- F_1(Q_1-H_1) - R_2 + R_1 - P_1(H_1-H_2) -$$
$$- 1/2(H_1-H_2)(P_2-P_1) = F_1(q_2-q_1) - R_2 + R_1 + P_1Q_2 - P_1Q_1 -$$
$$- 1/2(H_1-H_2)(P_2-P_1)$$
$$= F_1(q_2-q_1) - C_2 + C_1 - q_2k_2 + q_1k_1 + P_1(Q_2-Q_1) - 1/2(H_1-H_2)(P_2-P_1) =$$
$$= P_1(Q_2-Q_1) - C_2 - Q_2k_2 + C_1 + Q_1k_1 + k_2H_2 - k_1H_1 + F_1(q_2-q_1) +$$
$$- 1/2(H_1-H_2)(P_2-P_1)$$

Ignoring $1/2(H_1-H_2)(P_2-P_1)$ since the value of this expression is normally close to zero, one obtains:

$$B = P_1(Q_2-Q_1) - C_2 - Q_2k_2 + C_1 + Q_1k_1 + k_2H_2 - k_1H_1 + F_1(q_2-q_1) \quad \text{or}$$

B = (expression (10) of the text with $P_m = P_1$) -

- (expression (11) of the text) +

+ (the expression mentioned in para. 62 of the text).

11/ Simplified Methods VI and VIII are explained in the text.

ANNEX N
Page 1

ECONOMIC RETURNS (ERs) FOR NET BENEFITS GROWING AT A COMPOUND RATE

Present Value of One Dollar Growing at 5%

ER \ N	=10 YRS	15 YRS	20 YRS	25 YRS	30 YRS	40 YRS
1	12.4587	20.7554	30.8305	43.0650	57.9219	97.8713
2	11.7691	19.0636	27.4958	37.2431	48.5107	76.5920
3	11.1327	17.5552	24.6260	32.4105	40.9806	60.8032
4	10.5444	16.2073	22.1477	28.3793	34.9162	48.9670
5	10.0000	15.0000	20.0000	25.0000	30.0000	40.0000
6	9.4955	13.9163	18.1324	22.1533	25.9881	33.1335
7	9.0275	12.9413	16.5027	19.7435	22.6925	27.8180
8	8.5927	12.0622	15.0759	17.6936	19.9674	23.6580
9	8.1884	11.2679	13.8225	15.9414	17.6991	20.3664
10	7.8118	10.5487	12.7177	14.4365	15.7986	17.7335
11	7.4608	9.8962	11.7408	13.1379	14.1961	15.6046
12	7.1331	9.3028	10.8741	12.0121	12.8361	13.8651
13	6.8269	8.7622	10.1028	11.0315	11.6748	12.4291
14	6.5405	8.2687	9.4143	10.1737	10.6770	11.2318
15	6.2723	7.8174	8.7978	9.4199	9.8146	10.2240
16	6.0209	7.4037	8.2440	8.7546	9.0649	9.3680
17	5.7849	7.0239	7.7452	8.1651	8.4095	8.6346
18	5.5632	6.6746	7.2946	7.6405	7.8334	8.0011
19	5.3547	6.3526	6.8864	7.1718	7.3245	7.4498
20	5.1585	6.0555	6.5155	6.7515	6.8726	6.9665
21	4.9736	5.7806	6.1778	6.3732	6.4693	6.5399
22	4.7991	5.5261	5.8693	6.0314	6.1080	6.1612
23	4.6345	5.2899	5.5870	5.7216	5.7827	5.8229
24	4.4789	5.0703	5.3278	5.4399	5.4887	5.5192
25	4.3318	4.8660	5.0894	5.1828	5.2219	5.2451
26	4.1975	4.6755	4.8696	4.9476	4.9789	4.9966
27	4.0605	4.4976	4.6664	4.7317	4.7569	4.7704
28	3.9353	4.3313	4.4783	4.5329	4.5532	4.5636
29	3.8166	4.1755	4.3037	4.3495	4.3659	4.3738
30	3.7037	4.0294	4.1414	4.1798	4.1931	4.1992

Present Value of One Dollar Growing at 6%

ER \ N =	10 YRS	15 YRS	20 YRS	25 YRS	30 YRS	40 YRS
1	13.1701	22.5626	34.5219	49.7493	69.1380	125.2588
2	12.4316	20.6880	30.6952	42.8247	57.5266	96.9450
3	11.7504	19.0185	27.4085	37.0937	48.2739	76.0782
4	11.1211	17.5284	24.5758	32.3275	40.8537	60.5473
5	10.5391	16.1953	22.1260	28.3445	34.8649	48.8704
6	10.0000	15.0000	20.0000	25.0000	30.0000	40.0000
7	9.5001	13.9260	18.1488	22.1780	26.0224	33.1903
8	9.0360	12.9588	16.5315	19.7854	22.7490	27.9065
9	8.6046	12.0859	15.1138	17.7473	20.0378	23.7626
10	8.2031	11.2965	13.8669	16.0028	17.7775	20.4775
11	7.8290	10.5811	12.7668	14.5026	15.8811	17.8453
12	7.4800	9.9315	11.7930	13.2065	14.2799	15.7138
13	7.1540	9.3403	10.9283	12.0816	12.9194	13.9698
14	6.8493	8.8013	10.1580	11.1010	11.7564	12.5285
15	6.5641	8.3089	9.4698	10.2422	10.7561	11.3255
16	6.2969	7.8583	8.8531	9.4870	9.8908	10.3121
17	6.0462	7.4450	8.2988	8.8199	9.1380	9.4507
18	5.8109	7.0653	7.7991	8.2284	8.4795	8.7122
19	5.5896	6.7159	7.3475	7.7016	7.9003	8.0741
20	5.3815	6.3937	6.9380	7.2308	7.3882	7.5184
21	5.1855	6.0961	6.5659	6.8083	6.9334	7.0312
22	5.0008	5.8208	6.2268	6.4278	6.5274	6.6011
23	4.8264	5.5656	5.9170	6.0840	6.1634	6.2190
24	4.6618	5.3287	5.6332	5.7722	5.8356	5.8778
25	4.5062	5.1085	5.3727	5.4885	5.5393	5.5713
26	4.3589	4.9034	5.1329	5.2296	5.2703	5.2947
27	4.2195	4.7122	4.9117	4.9926	5.0253	5.0440
28	4.0873	4.5335	4.7073	4.7750	4.8014	4.8156
29	3.9619	4.3664	4.5179	4.5747	4.5960	4.6069
30	3.8429	4.2099	4.3421	4.3898	4.4070	4.4154

Present Value of One Dollar Growing at 7%

1	13.9249	24.5474	38.7229	57.6398	82.8841	161.5280
2	13.1342	22.4700	34.3296	49.3952	68.5336	123.7303
3	12.4052	20.6220	30.5632	42.5906	57.1420	96.0465
4	11.7321	18.9744	27.3233	36.9479	48.0430	75.5782
5	11.1098	17.5021	24.5267	32.2464	40.7298	60.2975
6	10.5338	16.1835	22.1047	28.3105	34.8147	48.7759
7	10.0000	15.0000	20.0000	25.0000	30.0000	40.0000
8	9.5046	13.9355	18.1650	22.2022	26.0560	33.2462
9	9.0444	12.9759	16.5598	19.8267	22.8047	27.9938
10	8.6163	12.1092	15.1511	17.8002	20.1072	23.8660
11	8.2176	11.3246	13.9107	16.0633	17.8550	20.5875
12	7.8459	10.6130	12.8152	14.5678	15.9627	17.9562
13	7.4989	9.9663	11.8445	13.2744	14.3628	15.8222
14	7.1747	9.3773	10.9818	12.1506	13.0019	14.0739
15	6.8714	8.8399	10.2126	11.1698	11.8373	12.6273
16	6.5874	8.3487	9.5248	10.3102	10.8347	11.4188
17	6.3211	7.8987	8.9080	9.5536	9.9666	10.3999
18	6.0713	7.4859	8.3531	8.8848	9.2108	9.5332
19	5.8365	7.1063	7.8527	8.2913	8.5491	8.7897
20	5.6158	6.7568	7.4000	7.7625	7.9668	8.1469
21	5.4081	6.4344	6.9894	7.2895	7.4518	7.5870
22	5.2123	6.1364	6.6160	6.8649	6.9940	7.0958
23	5.0277	5.8606	6.2756	6.4823	6.5853	6.6621
24	4.8535	5.6049	5.9644	6.1364	6.2186	6.2768
25	4.6889	5.3674	5.6792	5.8226	5.8884	5.9326
26	4.5332	5.1465	5.4173	5.5370	5.5898	5.6234
27	4.3858	4.9407	5.1762	5.2762	5.3187	5.3444
28	4.2462	4.7487	4.9538	5.0375	5.0717	5.0913
29	4.1139	4.5693	4.7481	4.8183	4.8458	4.8609
30	3.9883	4.4014	4.5574	4.6164	4.6387	4.6502

Present Value of One Dollar Growing at 8%

ER \ N =	10 YRS	15 YRS	20 YRS	25 YRS	30 YRS	40 YRS
1	14.7257	26.7276	43.5064	66.9635	99.7568	209.6951
2	13.8793	24.4254	38.4604	57.1384	81.9954	159.0989
3	13.0992	22.3796	34.1422	49.0508	67.9467	122.2517
4	12.3793	20.5576	30.4344	42.3624	56.7676	95.1745
5	11.7141	18.9312	27.2400	36.8055	47.8178	75.0915
6	11.0988	17.4763	24.4787	32.1670	40.6086	60.0537
7	10.5287	16.1719	22.0838	28.2772	34.7654	48.6834
8	10.0000	15.0000	20.0000	25.0000	30.0000	40.0000
9	9.5090	13.9448	18.1809	22.2261	26.0891	33.3011
10	9.0526	12.9928	16.5876	19.8673	22.8595	28.0799
11	8.6278	12.1321	15.1878	17.8523	20.1757	23.9681
12	8.2319	11.3523	13.9540	16.1231	17.9315	20.6963
13	7.8625	10.6445	12.8630	14.6323	16.0433	18.0660
14	7.5176	10.0006	11.8955	13.3415	14.4450	15.9297
15	7.1951	9.4139	11.0347	12.2188	13.0838	14.1773
16	6.8932	8.8781	10.2667	11.2381	11.9176	12.7256
17	6.6104	8.3880	9.5793	10.3777	10.9128	11.5117
18	6.3451	7.9388	8.9624	9.6198	10.0420	10.4873
19	6.0960	7.5263	8.4071	8.9493	9.2832	9.6154
20	5.8619	7.1470	7.9058	8.3539	8.6185	8.8670
21	5.6417	6.7974	7.4521	7.8230	8.0331	8.2196
22	5.4343	6.4748	7.0404	7.3479	7.5151	7.6554
23	5.2388	6.1764	6.6658	6.9212	7.0545	7.1604
24	5.0544	5.9002	6.3241	6.5365	6.6430	6.7231
25	4.8802	5.6439	6.0116	6.1886	6.2738	6.3346
26	4.7157	5.4058	5.7251	5.8728	5.9411	5.9874
27	4.5599	5.1842	5.4618	5.5853	5.6402	5.6755
28	4.4125	4.9777	5.2194	5.3228	5.3670	5.3940
29	4.2728	4.7850	4.9957	5.0823	5.1180	5.1386
30	4.1403	4.6049	4.7887	4.8614	4.8902	4.9061

Present Value of One Dollar Growing at 9%

1	15.5753	29.1228	48.9555	77.9896	120.4940	273.8112
2	14.6693	26.5714	43.1579	66.2725	98.4846	205.9325
3	13.8347	24.3065	38.2050	56.6515	81.1343	156.7561
4	13.0649	22.2914	33.9596	48.7156	67.3767	120.8208
5	12.3539	20.4946	30.3086	42.1399	56.4032	94.3278
6	11.6966	18.8890	27.1585	36.6664	47.5980	74.6175
7	11.0879	17.4511	24.4316	32.0894	40.4900	59.8155
8	10.5237	16.1606	22.0634	28.2445	34.7172	48.5927
9	10.0000	15.0000	20.0000	25.0000	30.0000	40.0000
10	9.5134	13.9540	18.1965	22.2495	26.1217	33.3552
11	9.0607	13.0094	16.6150	19.9073	22.9135	28.1648
12	8.6391	12.1547	15.2240	17.9037	20.2432	24.0690
13	8.2459	11.3796	13.9966	16.1820	18.0071	20.8040
14	7.8789	10.6755	12.9103	14.6961	16.1232	18.1749
15	7.5360	10.0345	11.9458	13.4079	14.5264	16.0365
16	7.2151	9.4500	11.0671	12.2864	13.1649	14.2800
17	6.9147	8.9158	10.3202	11.3057	11.9974	12.8234
18	6.6330	8.4268	9.6333	10.4446	10.9903	11.6042
19	6.3687	7.9784	9.0163	9.6855	10.1169	10.5745
20	6.1204	7.5664	8.4605	9.0134	9.3552	9.6973
21	5.8870	7.1872	7.9586	8.4161	8.6875	8.9441
22	5.6672	6.8376	7.5039	7.8833	8.0992	8.2921
23	5.4602	6.5148	7.0911	7.4061	7.5783	7.7237
24	5.2650	6.2161	6.7153	6.9773	7.1148	7.2248
25	5.0808	5.9394	6.3723	6.5906	6.7006	6.7841
26	4.9068	5.6826	6.0585	6.2406	6.3288	6.3923
27	4.7422	5.4439	5.7707	5.9229	5.9938	6.0422
28	4.5865	5.2217	5.5062	5.6335	5.6906	5.7276
29	4.4390	5.0145	5.2624	5.3692	5.4152	5.4435
30	4.2991	4.8211	5.0374	5.1270	5.1642	5.1860

Present Value of One Dollar Growing at 10%

ER \ N =	10 YRS	15 YRS	20 YRS	25 YRS	30 YRS	40 YRS
1	16.4765	31.7542	55.1648	91.0380	146.0080	359.3153
2	15.5069	28.9267	48.5019	77.0562	118.7080	268.0904
3	14.6141	26.4191	42.8191	65.6027	97.2545	202.3142
4	13.7911	24.1904	37.9563	56.1785	80.2996	154.4951
5	13.0313	22.2052	33.7815	48.3894	66.8228	119.4354
6	12.3291	20.4330	30.1858	41.9230	56.0482	93.5056
7	11.6793	18.8477	27.0788	36.5305	47.3835	74.1558
8	11.0773	17.4264	24.3855	32.0134	40.3741	59.5829
9	10.5187	16.1495	22.0433	28.2125	34.6699	48.5040
10	10.0000	15.0000	20.0000	25.0000	30.0000	40.0000
11	9.5177	13.9631	18.2118	22.2726	26.1537	33.4084
12	9.0686	13.0258	16.6420	19.9467	22.9666	28.2484
13	8.6502	12.1769	15.2596	17.9544	20.3099	24.1686
14	8.2597	11.4065	14.0386	16.2403	18.0818	20.9106
15	7.8951	10.7061	12.9569	14.7591	16.2021	18.2828
16	7.5541	10.0680	11.9956	13.4736	14.6070	16.1424
17	7.2349	9.4856	11.1389	12.3533	13.2454	14.3821
18	6.9359	8.9531	10.3731	11.3728	12.0765	12.9207
19	6.6554	8.4653	9.6867	10.5111	11.0674	11.6962
20	6.3921	8.0176	9.0697	9.7507	10.1914	10.6613
21	6.1446	7.6061	8.5136	9.0770	9.4269	9.7791
22	5.9117	7.2271	8.0109	8.4780	8.7563	9.0209
23	5.6925	6.8775	7.5554	7.9432	8.1650	8.3645
24	5.4859	6.5545	7.1415	7.4640	7.6412	7.7920
25	5.2910	6.2555	6.7645	7.0332	7.1749	7.2892
26	5.1070	5.9784	6.4203	6.6444	6.7581	6.8449
27	4.9330	5.7211	6.1052	6.2925	6.3838	6.4500
28	4.7685	5.4818	5.8161	5.9729	6.0463	6.0969
29	4.6128	5.2590	5.5503	5.6816	5.7409	5.7796
30	4.4652	5.0511	5.3053	5.4156	5.4634	5.4931

Present Value of One Dollar Growing at 11%

ER \ N =	10 YRS	15 YRS	20 YRS	25 YRS	30 YRS	40 YRS
1	17.4324	34.6454	62.2424	106.4880	177.4260	473.5044
2	16.3949	31.5119	54.5837	89.7960	143.5374	350.7387
3	15.4400	28.7358	48.0617	76.1529	116.9846	262.6048
4	14.5602	26.2707	42.4898	64.9530	96.0645	198.8322
5	13.7484	24.0772	37.7141	55.7188	79.4901	152.3122
6	12.9985	22.1210	33.6078	48.0718	66.2844	118.0935
7	12.3048	20.3728	30.0659	41.7113	55.7024	92.7067
8	11.6624	18.8072	27.0009	36.3977	47.1741	73.7059
9	11.0668	17.4021	24.3404	31.9390	40.2607	59.3556
10	10.5139	16.1386	22.0236	28.1811	34.6236	48.4170
11	10.0000	15.0000	20.0000	25.0000	30.0000	40.0000
12	9.5219	13.9719	18.2769	22.2953	26.1852	33.4608
13	9.0765	13.0419	16.6685	19.9854	23.0190	28.3310
14	8.6611	12.1987	15.2948	18.0043	20.3756	24.2671
15	8.2733	11.4330	14.0801	16.2977	18.1556	21.0161
16	7.9110	10.7362	13.0029	14.8213	16.2803	18.3898
17	7.5719	10.1010	12.0447	13.5387	14.6868	16.2475
18	7.2544	9.5208	11.1901	12.4196	13.3252	14.4835
19	6.9568	8.9899	10.4255	11.4392	12.1551	13.0174
20	6.6775	8.5033	9.7397	10.5769	11.1439	11.7879
21	6.4151	8.0564	9.1227	9.8154	10.2655	10.7478
22	6.1684	7.6454	8.5662	9.1403	9.4982	9.8605
23	5.9362	7.2666	8.0629	8.5395	8.8247	9.0976
24	5.7175	6.9170	7.6065	8.0028	8.2306	8.4367
25	5.5113	6.5939	7.1916	7.5216	7.7039	7.8601
26	5.3167	6.2946	6.8135	7.0888	7.2349	7.3535
27	5.1328	6.0171	6.4681	6.6981	6.8154	6.9057
28	4.9590	5.7593	6.1517	6.3442	6.4386	6.5076
29	4.7946	5.5195	5.8614	6.0227	6.0987	6.1516
30	4.6388	5.2960	5.5943	5.7296	5.7911	5.8316

Present Value of One Dollar Growing at 12%

ER \ N =	10 YRS	15 YRS	20 YRS	25 YRS	30 YRS	40 YRS
1	18.4462	37.8219	70.3112	124.7895	216.1392	626.1613
2	17.3362	34.3497	61.5068	104.8551	174.0480	460.7891
3	16.3152	31.2763	54.0203	88.5961	141.1585	342.5385
4	15.3748	28.5499	47.6342	75.2781	115.3208	257.3409
5	14.5075	26.1261	42.1694	64.3226	94.9128	195.4798
6	13.7067	23.9667	37.4782	55.2719	78.7048	150.2036
7	12.9664	22.0387	33.4384	47.7624	65.7608	116.7931
8	12.2810	20.3139	29.9487	41.5048	55.3654	91.9302
9	11.6459	18.7675	26.9247	36.2679	46.9696	73.2673
10	11.0566	17.3784	24.2962	31.8661	40.1497	59.1334
11	10.5091	16.1279	22.0043	28.1503	34.5782	48.3318
12	10.0000	15.0000	20.0000	25.0000	30.0000	40.0000
13	9.5260	13.9807	18.2417	22.3175	26.2162	33.5124
14	9.0841	13.0577	16.6947	20.0236	23.0706	28.4123
15	8.6719	12.2203	15.3294	18.0536	20.4405	24.3644
16	8.2867	11.4591	14.1210	16.3545	18.2285	21.1205
17	7.9266	10.7660	13.0483	14.8829	16.3576	18.4958
18	7.5895	10.1336	12.0933	13.6030	14.7659	16.3519
19	7.2737	9.5555	11.2407	12.4852	13.4043	14.5843
20	6.9774	9.0263	10.4774	11.5051	12.2330	13.1137
21	6.6993	8.5408	9.7921	10.6423	11.2200	11.8791
22	6.4379	8.0948	9.1752	9.8797	10.3391	10.8339
23	6.1920	7.6842	8.6184	9.2031	9.5692	9.9417
24	5.9605	7.3057	8.1144	8.6006	8.8929	9.1742
25	5.7423	6.9562	7.6572	8.0671	8.2959	8.5088
26	5.5364	6.6329	7.2414	7.5790	7.7664	7.9281
27	5.3421	6.3334	6.8621	7.1442	7.2947	7.4177
28	5.1585	6.0555	6.5155	6.7515	6.8725	6.9665
29	4.9848	5.7972	6.1980	6.3957	6.4933	6.5651
30	4.8204	5.5568	5.9064	6.0723	6.1511	6.2062

Present Value of One Dollar Growing at 13%

1	19.5213	41.3120	79.5114	146.4754	263.8643	830.3915
2	18.3340	37.4648	69.3893	122.6633	211.5642	607.4828
3	17.2424	34.0625	60.7946	103.2800	170.8022	448.6677
4	16.2374	31.0471	53.4739	87.4360	138.8665	334.6927
5	15.3111	28.3688	47.2189	74.4308	113.7138	252.2872
6	14.4561	25.9850	41.8577	63.7108	93.7977	192.2504
7	13.6660	23.8587	37.2483	54.8372	77.9426	148.1657
8	12.9349	21.9583	33.2730	47.4609	65.2515	115.5325
9	12.2577	20.2562	29.8341	41.3032	55.0369	91.1753
10	11.6297	18.7287	26.8501	36.1409	46.7698	72.8398
11	11.0465	17.3551	24.2528	31.7948	40.0411	58.9163
12	10.5045	16.1174	21.9854	28.1201	34.5336	48.2484
13	10.0000	15.0000	20.0000	25.0000	30.0000	40.0000
14	9.5300	13.9893	18.2563	22.3395	26.2467	33.5631
15	9.0917	13.0732	16.7204	20.0612	23.1215	28.4926
16	8.6824	12.2415	15.3635	18.1022	20.5046	24.4605
17	8.2993	11.4849	14.1613	16.4105	18.3006	21.2238
18	7.9421	10.7953	13.0931	14.9437	16.4340	18.6009
19	7.6069	10.1657	12.1413	13.6666	14.8443	16.4555
20	7.2927	9.5899	11.2908	12.5502	13.4828	14.6845
21	6.9978	9.0623	10.5287	11.5704	12.3104	13.2094
22	6.7208	8.5780	9.8441	10.7071	11.2955	11.9700
23	6.4604	8.1328	9.2273	9.9435	10.4123	10.9198
24	6.2153	7.7227	8.6701	9.2656	9.6397	10.0227
25	5.9844	7.3445	8.1656	8.6614	8.9607	9.2505
26	5.7667	6.9950	7.7076	8.1210	8.3609	8.5808
27	5.5613	6.6716	7.2908	7.6361	7.8287	7.9959
28	5.3673	6.3718	6.9105	7.1994	7.3543	7.4818
29	5.1839	6.0936	6.5628	6.8048	6.9296	7.0271
30	5.0103	5.8349	6.2440	6.4471	6.5478	6.6226

Present Value of One Dollar Growing at 14%

ER \ N =	10 YRS	15 YRS	20 YRS	25 YRS	30 YRS	40 YRS
1	20.6612	45.1463	90.0021	172.1766	322.7173	1103.7327
2	19.3915	40.8841	78.3653	143.7289	257.7170	803.1636
3	18.2247	37.1181	68.4978	120.6157	207.1774	589.7278
4	17.1509	33.7833	60.1048	101.7599	167.6813	437.1030
5	16.1616	30.8240	52.9438	86.3142	136.6571	327.1811
6	15.2488	28.1924	46.8153	73.6097	112.1609	247.4324
7	14.4057	25.8473	41.5543	63.1167	92.7174	189.1376
8	13.6261	23.7533	37.0242	54.4144	77.2025	146.1952
9	12.9041	21.8797	33.1116	47.1671	64.7559	114.3100
10	12.2349	20.1998	29.7221	41.1064	54.7166	90.4410
11	11.6138	18.6907	26.7770	36.0168	46.5746	72.4227
12	11.0367	17.3323	24.2104	31.7249	39.9348	58.7039
13	10.4999	16.1071	21.9668	28.0905	34.4900	48.1665
14	10.0000	15.0000	20.0000	25.0000	30.0000	40.0000
15	9.5340	13.9977	18.2707	22.3610	26.2767	33.6131
16	9.0991	13.0885	16.7457	20.0983	23.1717	28.5718
17	8.6929	12.2624	15.3971	18.1501	20.5678	24.5555
18	8.3129	11.5102	14.2011	16.4658	18.3718	21.3260
19	7.9573	10.8242	13.1374	15.0038	16.5097	18.7050
20	7.6240	10.1975	12.1888	13.7296	14.9219	16.5583
21	7.3114	9.6238	11.3404	12.6146	13.5606	14.7840
22	7.0179	9.0978	10.5796	11.6352	12.3877	13.3046
23	6.7421	8.6148	9.8955	10.7715	11.3705	12.0604
24	6.4826	8.1704	9.2789	10.0069	10.4850	11.0053
25	6.2383	7.7609	8.7215	9.3276	9.7100	10.1034
26	6.0081	7.3829	8.2165	8.7218	9.0282	9.3266
27	5.7909	7.0335	7.7577	8.1797	8.4257	8.6525
28	5.5859	6.7100	7.3399	7.6929	7.8907	8.0637
29	5.3922	6.4100	6.9586	7.2543	7.4137	7.5459
30	5.2090	6.1314	6.6098	6.8578	6.9864	7.0877

Present Value of One Dollar Growing at 15%

1	21.8696	49.3584	-101.9648	202.6396	395.3046	1469.6296
2	20.5122	44.6373	88.5872	168.6530	314.5125	1064.3058
3	19.2651	40.4692	77.2585	141.0885	251.8345	777.3562
4	18.1181	36.7814	67.6354	118.6429	202.9679	572.8363
5	17.0616	33.5118	59.4363	100.2922	164.6790	426.0618
6	16.0875	30.6068	52.4293	85.2287	134.5263	319.9848
7	15.1880	28.0204	46.4230	72.8135	110.6595	242.7654
8	14.3565	25.7130	41.2589	62.5396	91.6706	186.1358
9	13.5870	23.6504	36.8057	54.0028	76.4838	144.2891
10	12.8740	21.8028	32.9540	46.8806	64.2735	113.1238
11	12.2125	20.1446	29.6127	40.9142	54.4041	89.7265
12	11.5982	18.6534	26.7055	35.8954	46.3838	72.0159
13	11.0270	17.3099	24.1687	31.6564	39.8307	58.4962
14	10.4954	16.0970	21.9486	28.0614	34.4471	48.0863
15	10.0000	15.0000	20.0000	25.0000	30.0000	40.0000
16	9.5379	14.0060	18.2848	22.3823	26.3062	33.6623
17	9.1064	13.1036	16.7707	20.1348	23.2211	28.6499
18	8.7031	12.2830	15.4303	18.1974	20.6301	24.6494
19	8.3257	11.5352	14.2404	16.5205	18.4422	21.4273
20	7.9723	10.8528	13.1812	15.0633	16.5846	18.8083
21	7.6409	10.2288	12.2357	13.7919	14.9987	16.6603
22	7.3299	9.6573	11.3894	12.6784	13.6377	14.8829
23	7.0377	9.1330	10.6299	11.6994	12.4634	13.3093
24	6.7630	8.6511	9.9465	10.8353	11.4451	12.1504
25	6.5045	8.2076	9.3300	10.0698	10.5574	11.0705
26	6.2610	7.7986	8.7724	9.3892	9.7798	10.1839
27	6.0315	7.4210	8.2669	8.7819	9.0954	9.4025
28	5.8148	7.0717	7.8074	8.2351	8.4902	8.7242
29	5.6102	6.7461	7.3888	7.7495	7.9526	8.1313
30	5.4168	6.4479	7.0064	7.3090	7.4729	7.6098

Present Value of One Dollar Growing at 16%

ER \ N=	10 YRS	15 YRS	20 YRS	25 YRS	30 YRS	40 YRS
1	23.1506	53.9853	115.6053	238.7469	484.8336	1959.3894
2	21.6996	48.7566	100.2284	198.1455	384.4175	1412.8732
3	20.3671	44.1441	87.2227	165.2712	306.6774	1027.0426
4	19.1420	40.0665	76.1892	138.5486	246.2015	752.8735
5	18.0142	36.4543	66.8008	116.7411	198.9265	556.7546
6	16.9745	33.2477	58.7883	98.8743	161.7891	415.5133
7	16.0151	30.3952	51.9297	84.1779	132.4701	313.0859
8	15.1285	27.8527	46.0414	72.0414	109.2072	238.2769
9	14.3084	25.5819	40.9712	61.9788	90.6557	183.2397
10	13.5488	23.5498	36.5925	53.6022	75.7854	142.4445
11	12.8444	21.7276	32.8000	46.6013	63.8038	111.9725
12	12.1906	20.0905	29.5056	40.7264	54.0992	89.0312
13	11.5829	18.6169	26.6355	35.7766	46.1973	71.6189
14	11.0175	17.2879	24.1279	31.5894	39.7287	58.2930
15	10.4910	16.0870	21.9307	28.0329	34.4051	48.0076
16	10.0000	15.0000	20.0000	25.0000	30.0000	40.0000
17	9.5418	14.0142	18.2987	22.4032	26.3352	33.7108
18	9.1136	13.1185	16.7952	20.1708	23.2693	28.7270
19	8.7132	12.3032	15.4630	18.2440	20.6917	24.7422
20	8.3383	11.5599	14.2792	16.5744	18.5118	21.5275
21	7.9870	10.8809	13.2244	15.1220	16.6587	18.9106
22	7.6575	10.2597	12.2820	13.8536	15.0749	16.7616
23	7.3481	9.6904	11.4379	12.7416	13.7142	14.9811
24	7.0573	9.1677	10.6797	11.7630	12.5391	13.4935
25	6.7838	8.6871	9.9970	10.8986	11.5191	12.2401
26	6.5262	8.2444	9.3807	10.1323	10.6293	11.1754
27	6.2835	7.8360	8.8230	9.4504	9.8493	10.2641
28	6.0546	7.4587	8.3170	8.8416	9.1623	9.4782
29	5.8385	7.1095	7.8568	8.2961	8.5545	8.7957
30	5.6343	6.7859	7.4373	7.8058	8.0142	8.1988

Present Value of One Dollar Growing at 17%

1	24.5083	59.0669	131.1575	281.5413	595.2478	2614.7642
2	22.9575	53.2773	113.4854	233.0445	470.4613	1878.1148
3	21.5341	48.1740	98.5559	193.8394	374.0421	1359.3822
4	20.2259	43.6660	85.9058	162.0234	299.1897	991.7908
5	19.0220	39.6757	75.1555	136.1041	240.8040	729.6287
6	17.9128	36.1364	65.9926	114.9068	195.0441	541.4323
7	16.8895	32.9907	58.1598	97.5038	159.0058	405.4278
8	15.9444	30.1892	51.4444	83.1603	130.4850	306.4681
9	15.0704	27.6892	45.6703	71.2922	107.8019	233.9574
10	14.2613	25.4540	40.6909	61.4336	89.6714	180.4439
11	13.5114	23.4514	36.3846	53.2121	75.1065	140.6584
12	12.8155	21.6540	32.6496	46.3287	63.3463	110.8547
13	12.1690	20.0375	29.4008	40.5429	53.8017	88.3541
14	11.5679	18.5811	26.5669	35.6603	46.0149	71.2313
15	11.0082	17.2663	24.0879	31.5236	39.6288	58.0941
16	10.4866	16.0773	21.9131	28.0049	34.3638	47.9304
17	10.0000	15.0000	20.0000	25.0000	30.0000	40.0000
18	9.5455	14.0222	18.3123	22.4237	26.3638	33.7585
19	9.1207	13.1331	16.8194	20.2062	23.3178	28.8030
20	8.7231	12.3232	15.4952	18.2900	20.7525	24.8339
21	8.3507	11.5842	14.3174	16.6277	18.5806	21.6267
22	8.0016	10.9087	13.2670	15.1801	16.7320	19.0121
23	7.6739	10.2903	12.3278	13.9146	15.1503	16.8621
24	7.3661	9.7231	11.4859	12.8041	13.7900	15.0788
25	7.0766	9.2021	10.7291	11.8261	12.6142	13.5872
26	6.8042	8.7227	10.0471	10.9614	11.5926	12.3293
27	6.5476	8.7809	9.4310	10.1943	10.7008	11.2600
28	6.3057	7.8730	8.8731	9.5113	9.9185	10.3441
29	6.0775	7.4960	8.3667	8.9010	9.2289	9.5537
30	5.8619	7.1470	7.9058	8.3539	8.6185	8.8670

Present Value of One Dollar Growing at 18%

ER \ N =	10 YRS	15 YRS	20 YRS	25 YRS	30 YRS	40 YRS
1	25.9470	64.6472	148.8869	332.2535	731.3917	3491.3710
2	24.2901	58.2379	128.5811	274.3387	576.3618	2498.9389
3	22.7698	52.5926	111.4460	227.5897	456.7923	1801.7319
4	21.3731	47.6096	96.9439	189.7108	364.1467	1308.9200
5	20.0883	43.2023	84.6346	158.9026	292.0294	958.4141
6	18.9050	39.2962	74.1559	133.7501	235.6292	707.5423
7	17.8139	35.8273	65.2098	113.1367	191.3122	526.8223
8	16.8065	32.7406	57.5501	96.1787	156.3239	395.7792
9	15.8753	29.9884	50.9729	82.1745	128.5677	300.1164
10	15.0136	27.5297	45.3091	70.5649	106.4414	229.7985
11	14.2152	25.3290	40.4178	60.9035	88.7163	177.7439
12	13.4747	23.3553	36.1817	52.8321	74.4465	138.9286
13	12.7871	21.5820	32.5026	46.0628	62.9006	109.7689
14	12.1479	19.9857	29.2983	40.3636	53.5112	87.6948
15	11.5531	18.5460	26.4997	35.5465	45.8365	70.8529
16	10.9991	17.2452	24.0486	31.4591	39.5309	57.8995
17	10.4823	16.0677	21.8959	27.9774	34.3233	47.8547
18	10.0000	15.0000	20.0000	25.0000	30.0000	40.0000
19	9.5493	14.0301	18.3258	22.4440	26.3920	33.8055
20	9.1277	13.1475	16.8432	20.2411	23.3652	28.8781
21	8.7329	12.3429	15.5269	18.3354	20.8125	24.9246
22	8.3630	11.6082	14.3551	16.6803	18.6486	21.7248
23	8.0159	10.9362	13.3092	15.2375	16.8045	19.1127
24	7.6901	10.3205	12.3731	13.9750	15.2251	16.9618
25	7.3838	9.7554	11.5333	12.8661	13.8653	15.1758
26	7.0957	9.2360	10.7779	11.8886	12.6887	13.6803
27	6.8244	8.7579	10.0967	11.0238	11.6657	12.4180
28	6.5688	8.3169	9.4809	10.2559	10.7719	11.3442
29	6.3277	7.9097	8.9229	9.5717	9.9872	10.4238
30	6.1001	7.5331	8.4160	8.9600	9.2952	9.6290

Present Value of One Dollar Growing at 19%

1	27.4713	70.7742	169.0948	392.3350	899.2094	4663.1868
2	25.7014	63.6805	145.7685	323.1929	706.6771	3327.0310
3	24.0780	57.4369	126.1057	267.4598	558.4358	2390.3828
4	22.5872	51.9299	109.4829	222.3679	443.7815	1729.8699
5	21.2164	47.0628	95.3896	185.7497	354.7024	1261.2709
6	19.9543	42.7525	83.4066	155.9021	285.1776	926.7853
7	18.7910	38.9276	73.1888	131.4820	230.6643	686.5384
8	17.7174	35.5268	64.4512	111.4277	187.7229	512.8817
9	16.7254	32.4970	56.9583	94.8969	153.7384	386.5424
10	15.8078	29.7926	50.5145	81.2189	126.7148	294.0162
11	14.9560	27.3740	44.9574	69.8588	105.1237	225.7918
12	14.1701	25.2069	40.1515	60.3878	87.7893	175.1350
13	13.4388	23.2613	35.9836	52.4617	73.8045	137.2523
14	12.7593	21.5115	32.3590	45.8033	62.4661	108.7139
15	12.1273	19.9348	29.1980	40.1883	53.2275	87.0524
16	11.5387	18.5115	26.4339	35.4351	45.6620	70.4834
17	10.9901	17.2244	24.0101	31.3959	39.4350	57.7090
18	10.4782	16.0583	21.8789	27.9504	34.2836	47.7804
19	10.0000	15.0000	20.0000	25.0000	30.0000	40.0000
20	9.5529	14.0379	18.3390	22.4639	26.4197	33.8518
21	9.1345	13.1616	16.8667	20.2756	23.4118	28.9522
22	8.7426	12.3623	15.5583	18.3802	20.8718	25.0142
23	8.3750	11.6318	14.3924	16.7323	18.7158	21.8220
24	8.0301	10.9632	13.3508	15.2943	16.8763	19.2124
25	7.7060	10.3502	12.4179	14.0348	15.2991	17.0608
26	7.4013	9.7873	11.5803	12.9275	13.9399	15.2722
27	7.1145	9.2696	10.8262	11.9506	12.7627	13.7730
28	6.8444	8.7927	10.1458	11.0856	11.7383	12.5064
29	6.5897	8.3526	9.5303	10.3170	10.8425	11.4281
30	6.3494	7.9460	8.9722	9.6317	10.0556	10.5032

Present Value of One Dollar Growing at 20%

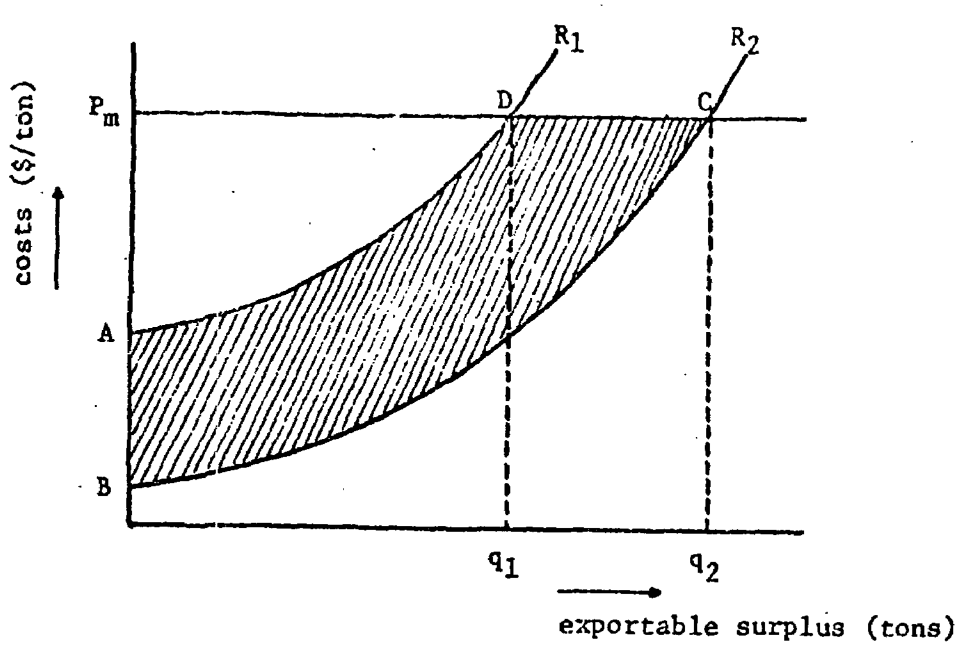
ER \ N =	10 YRS	15 YRS	20 YRS	25 YRS	30 YRS	40 YRS
1	29.0861	77.5000	192.1223	463.4966	1105.9892	6228.4854
2	27.1959	69.6510	165.3340	380.9796	866.9903	4430.9692
3	25.4628	62.7472	142.7760	314.5537	683.2653	3173.4259
4	23.8719	56.6623	123.7258	260.8854	541.4066	2288.5296
5	22.4095	51.2883	107.5923	217.3661	431.3881	1662.1972
6	21.0637	46.5327	93.8901	181.9473	345.6825	1216.2381
7	19.8237	42.3158	82.2200	153.0155	278.6164	896.7868
8	18.6797	38.5694	72.2526	129.2955	225.8982	666.5495
9	17.6232	35.2343	63.7158	109.7770	184.2690	499.5707
10	16.6462	32.2598	56.3837	93.6563	151.2443	377.6939
11	15.7418	29.6018	50.0688	80.2924	124.9235	288.1542
12	14.9036	27.2221	44.6150	69.1728	103.8469	221.9301
13	14.1259	25.0875	39.8919	59.8860	86.8892	172.6130
14	13.4037	23.1694	35.7902	52.1008	73.1798	135.6273
15	12.7321	21.4425	32.2185	45.5499	62.0426	107.6884
16	12.1070	19.8850	29.0998	40.0169	52.9505	86.4264
17	11.5245	18.4778	26.3694	35.3259	45.4912	70.1223
18	10.9812	17.2040	23.9723	31.3339	39.3410	57.5224
19	10.4740	16.0490	21.8623	27.9239	34.2445	47.7076
20	10.0000	15.0000	20.0000	25.0000	30.0000	40.0000
21	9.5565	14.0455	18.3520	22.4835	26.4470	33.8974
22	9.1413	13.1756	16.8898	20.3095	23.4579	29.0252
23	8.7521	12.3814	15.5892	18.4244	20.9303	25.1028
24	8.3869	11.6551	14.4291	16.7837	18.7822	21.9183
25	8.0440	10.9899	13.3919	15.3505	16.9474	19.3112
26	7.7217	10.3797	12.4622	14.0939	15.3725	17.1591
27	7.4186	9.8189	11.6267	12.9883	14.0138	15.3679
28	7.1331	9.3028	10.8741	12.0120	12.8361	13.8651
29	6.8641	8.8271	10.1945	11.1469	11.8104	12.5944
30	6.6104	8.3880	9.5793	10.3777	10.9128	11.5117

ECONOMIC ANALYSIS OF ROAD AND AGRICULTURAL INVESTMENTS 12/

1. The following presentation pertains to the economic evaluation of an investment package consisting of a rural road (RR) improvement (construction) and complementary agricultural investments in its zone of influence. The prices on the local market of agricultural products produced in the RR's zone of influence and transported to the local market, which are called the "local market prices", are assumed constant. In other words, the local market is the importing area and the road's zone of influence is the producing area. In addition, to simplify the presentation, non-agricultural traffic is ignored. Thus, all benefits to be had from the investment package accrue to farmers in the zone of influence and/or transporters of agricultural products over the rural road under consideration.

2. No Home Consumption. The benefits (B) accruing to farmers and transporters during a specific year of the situation where only one agricultural crop in the zone of influence is cultivated are graphically portrayed in Figure 7. This presentation as well as expression (1) for these benefits ignore home consumption in the with- and without-project situations.

Figure 7: Exportable Surplus



12/ This form of presentation was suggested by Anandarup Ray. For extensive analysis along similar lines, see H. G. van der Tak and A. Ray, The Economic Benefits of Road Transport Projects, World Bank Occasional Paper No. 13.

$$B = (P_m q_2 - R_2) - (P_m q_1 - R_1) \quad \ldots\ldots\ldots\ldots (1)$$

where

P_m = local market price of a specific agricultural product (\$/ton)

q_1, q_2 = exports of this product from the road's zone of influence in the without- and with-project situation, respectively (tons)

R_1, R_2 = economic cost of producing and transporting to the local market (over the rural road under consideration) q_1 and q_2 tons, respectively (\$)

Note that P_m is assumed to be constant in the without- and with-project situations (para. 1).

3. The costs R_1 and R_2 can be divided into costs of production and cost of transportation:

C_1, C_2 = economic cost of producing q_1 and q_2, respectively (\$)

K_1, K_2 = economic cost of transporting over the rural road the exports q_1 and q_2, respectively (\$)

Thus, expression (1) becomes

$$B = (P_m q_2 - C_2 - K_2) - (P_m q_1 - C_1 - K_1) \quad \ldots\ldots (2)$$

4. The following terms are introduced in order to divide B into B_1, or benefits accruing to farmers and B_2, or benefits accruing to transporters.

k_1, k_2 = economic costs of transporting over the rural road one ton of q_1 and one ton of q_2, respectively (\$/ton)

F_1, F_2 = fare of transporting over the rural road one ton of q_1 and one ton q_2, respectively (\$/ton)

Thus, $K_1 \equiv k_1 q_1$, $K_2 \equiv k_2 q_2$, and

$$K_1 - K_2 = k_1 q_1 - k_2 q_2 = [F_1 q_1 - F_2 q_2] + [(F_2 q_2 - F_1 q_1) - (k_2 q_2 - k_1 q_1)]$$

The term $[F_1 q_1 - F_2 q_2]$ represents the difference between the farmer's transport bill in the without-project situation and his bill in the with-project situation, while $[(F_2 q_2 - F_1 q_1) - (k_2 q_2 - k_1 q_1)]$ represents the portion of transport savings accruing to transporters in the form of a higher profit. Calling $(F_2 q_2 - F_1 q_1)$

the Δ transport revenues and $(k_2q_2 - k_1q_1)$ the Δ transport costs, we may also write:

$$K_1 - K_2 = -[\Delta \text{ transport revenues}] + [\Delta \text{ transport revenues} - \Delta \text{ transport costs}]$$

Defining

P_1, P_2 = farm-gate price of a specific agricultural product in the without- and with-project situation, respectively (\$/ton)

results in $P_m = P_2 + F_2 = P_1 + F_1$

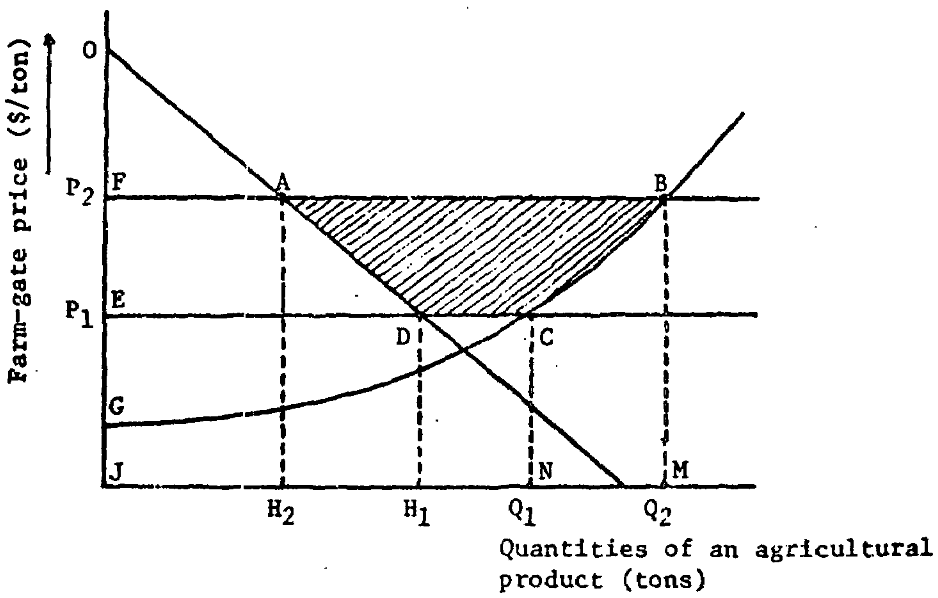
Thus, the farmgate price increases in the with-project situation by $(F_1 - F_2)$

5. Expression (2) can now be rewritten as

$$\begin{aligned} B &= \{B_1\} + \{B_2\} = \{[(P_2 + F_2)q_2 - C_2] - [(P_1 + F_1)q_1 - C_1] + \\ &+ [F_1 q_1 - F_2 q_2]\} + \{[F_2 q_2 - F_1 q_1] - [k_2 q_2 - k_1 q_1]\} = \\ &= \{[P_2 q_2 - C_2] - [P_1 q_1 - C_1]\} + \{[F_2 q_2 - F_1 q_1] - \\ &- [k_2 q_2 - k_1 q_1]\} \qquad \text{.......... (3)} \end{aligned}$$

6. Home Consumption. Expressions (1, (2) and (3) ignore the home consumption in the without- and with-project situations (para. 2). Reference is made to Figure 8 in order to examine the effect of home consumption on B_1.

Figure 8: Demand and Supply Curves



The symbols H_1, H_2, Q_1, Q_2, P_1 and P_2 in Figure 2 denote:

H_1, H_2 = on-farm (home) consumption of the agricultural product with farm-gate price P_1 and P_2, respectively (tons)

Q_1, Q_2 = production of the agricultural product with farm-gate price P_1 and P_2, respectively (tons)

P_1, P_2 = as defined in para. 4

Note that $q_1 \equiv Q_1 - H_1$ and $q_2 \equiv Q_2 - H_2$.

The benefits accruing to farmers (B_1) during a specific year of the situation where one agricultural crop in the zone of influence is cultivated are represented by area ABCD of Figure 8. Assuming that AD and BC of the demand and supply curves of Figure 8 can be approximated by straight lines, gives:

$$\text{area ABCD} = (P_2 - P_1)Q_1 + \frac{1}{2}(P_2 - P_1)(Q_2 - Q_1) - [H_1(P_2 - P_1) - \frac{1}{2}(H_1 - H_2)(P_2 - P_1)] =$$

$$= (P_2 - P_1)(Q_1 - H_1) + \frac{1}{2}(P_2 - P_1)[(Q_2 - Q_1) + (H_1 - H_2)]$$

or, since $q_1 = (Q_1 - H_1)$ and $q_2 = (Q_2 - H_2)$,

$$\text{area ABCD} = (P_2 - P_1)q_1 + \frac{1}{2}(P_2 - P_1)[(q_2 - q_1) + (H_1 - H_2)] =$$

$$= \frac{1}{2}(P_2 - P_1)(q_2 - q_1) + (P_2 - P_1)q_1 = \frac{1}{2}(P_2 - P_1)(q_2 + q_1)$$

Defining $\Delta P = (P_2 - P_1)$ and $\Delta q = (q_2 - q_1)$ results in

$$B_1 = \Delta P q_1 + \frac{1}{2}\Delta P \Delta q \qquad \text{............... (4)}$$

Another way of expressing B_1 is

$$B_1 = \frac{1}{2}(F_1 - F_2)(q_2 + q_1) \qquad \text{............. (5)}$$

since $P_2 = (P_m - F_2)$ and $P_1 = (P_m - F_1)$.

Expressions (4) and (5) are graphically represented by areas ABCD of Figure 9 and Figure 10, respectively. Note that areas ABED and BEC of Figure 9 correspond to ΔPq_1 and $\frac{1}{2}\Delta P\Delta q$ respectively; areas AECD and ECB of Figure 10 also correspond to ΔPq_1 and $\frac{1}{2}\Delta P \Delta q$ respectively.

Figure 9: Surplus versus Farmgate Price

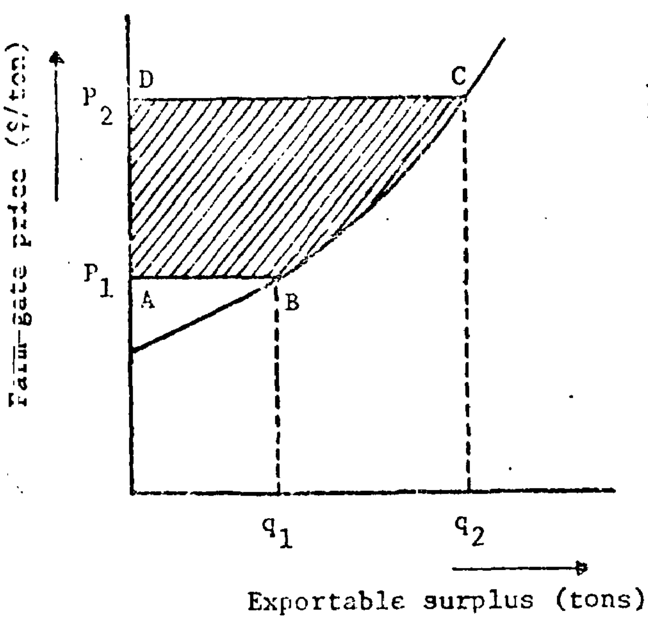
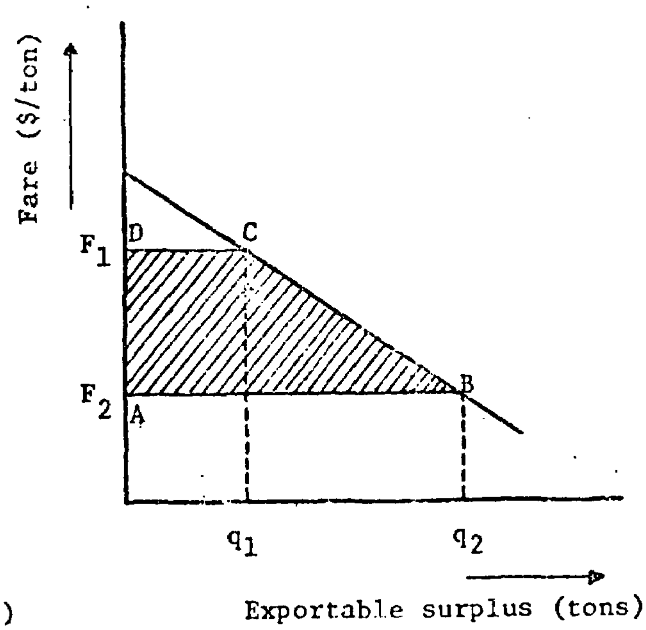


Figure 10: Surplus versus Fare



7. **Another way of taking into consideration the effect of home consumption on B_1 is as follows:**

$$B_1 = (P_2 Q_2 - C_2) - (P_1 Q_1 - C_1) + (S_2 - S_1) \quad \ldots\ldots (6)$$

where P_1, P_2, Q_1, Q_2, C_1 and C_2 are as defined previously, and

S_1, S_2 = consumer surplus on home consumption in the without- and with-project situation, respectively ($)

Note that in Figure 8:

area FBMJ = $P_2 Q_2$ = total income in the with-project situation

area ECNJ = $P_1 Q_1$ = total income in the without-project situation

area GBMJ = agricultural production costs in the with-project situation

area GCNJ = agricultural production costs in the without-project situation

area OFA = S_2 = consumer surplus in the with-project situation

area OED = S_1 = consumer surplus in the without-project situation

area ADEF = $-(S_2 - S_1)$ = loss in consumer surplus

The term $-(S_2 - S_1)$ is determined as follows:

$$(S_2 - S_1) = - \text{ (area ADEF of Figure 8)} = -\Delta PH_2 + \frac{1}{2}\Delta P\Delta H =$$

$$= -[(P_2 - P_1)H_2 + \frac{1}{2}(P_2 - P_1)(H_1 - H_2)] =$$

$$= -[P_2 H_2 - P_1 H_2 - P_1 H_1 + P_1 H_1 + \frac{1}{2}(P_2 - P_1)(H_1 - H_2)] =$$

$$= -[P_2 H_2 - P_1 H_1 + P_1 H_1 - P_1 H_2 + \frac{1}{2}(P_2 - P_1)(H_1 - H_2)] =$$

$$= -(P_2 H_2 - P_1 H_1) - (P_1 H_1 - P_1 H_2) - \frac{1}{2}(P_2 - P_1)(H_1 - H_2) =$$

$$= -(P_2 H_2 - P_1 H_1) - P_1(H_1 - H_2) - \frac{1}{2}(P_2 - P_1)(H_1 - H_2) \quad \text{.................} \quad (7)$$

Substituting expression (7) for $(S_2 - S_1)$ of expression (6) gives:

$$B_1 = (P_2 Q_2 - C_2) - (P_1 Q_1 - C_1) - (P_2 H_2 - P_1 H_1) -$$

$$- P_1(H_1 - H_2) - \frac{1}{2}(P_2 - P_1)(H_1 - H_2) =$$

$$= P_2 q_2 - P_1 q_1 - P_1(H_1 - H_2) - \frac{1}{2}(H_1 - H_2)(P_2 - P_1) -$$

$$- (C_2 - C_1) \quad \text{................} \quad (8)$$

8. Expressions (4), (5) and (8) are different ways of evaluating B_1. Expression (8) is preferred if one wishes to examine the influence of changes in C_1 and C_2. In addition, a comparison between the first two terms of expression (3), which represent B_1, and expression (8) clearly shows the impact of home consumption in the without- and with-project situations on B_1. This impact is represented by $-P_1(H_1 - H_2) - \frac{1}{2}(H_1 - H_2)(P_2 - P_1)$. Thus, these terms should be added to expression (1) if the aforementioned impact is to be taken into consideration in this expression:

$$B = [(P_m q_2 - R_2) - (P_m q_1 - R_1)] + [-P_1(H_1 - H_2) -$$

$$- \frac{1}{2}(H_1 - H_2)(P_2 - P_1)] \quad \text{...........} \quad (9)$$

Note that expression (9) may also be derived as follows:

$$B = B_1 + B_2 = (P_2 Q_2 - C_2) - (P_1 Q_1 - C_1) + (S_2 - S_1) + + (F_2 q_2 - K_2) - (F_1 q_1 - K_1) =$$

$$= (P_2 q_2 + P_2 H_2 - C_2) - (P_1 q_1 + P_1 H_1 - C_1) + + (S_2 - S_1) + (F_2 q_2 - K_2) - (F_1 q_1 - K_1) =$$

$$= (P_2 q_2 + F_2 q_2 + P_2 H_2 - C_2 - K_2) - - (P_1 q_1 + F_1 q_1 + P_1 H_1 - C_1 - K_1) + (S_2 - S_1)$$

or, since $R_2 = C_2 + K_2$, $R_1 = C_1 + K_1$, and $P_m = P_1 + F_1 = P_2 + F_2$,

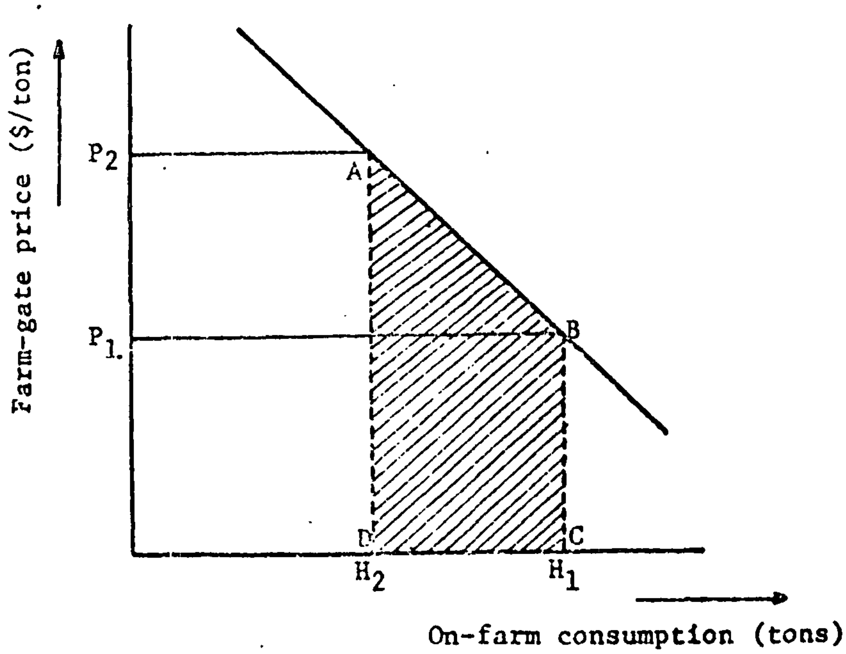
$$B_1 + B_2 = (P_m q_2 + P_2 H_2 - R_2) - (P_m q_1 + P_1 H_1 - R_1) + (S_2 - S_1) =$$

$$= P_m(q_2 - q_1) - (R_2 - R_1) + (P_2 H_2 - P_1 H_1) + (S_2 - S_1) =$$

$$= P_m(q_2 - q_1) - (R_2 - R_1) - P_1(H_1 - H_2) - \frac{1}{2}(H_1 - H_2)(P_2 - P_1)$$

9. Area ABCD of Figure 7 and area ABCD of Figure 11 represent the first two and last two terms of expression (9), respectively.

Figure 11: Home Consumption versus Farmgate Price

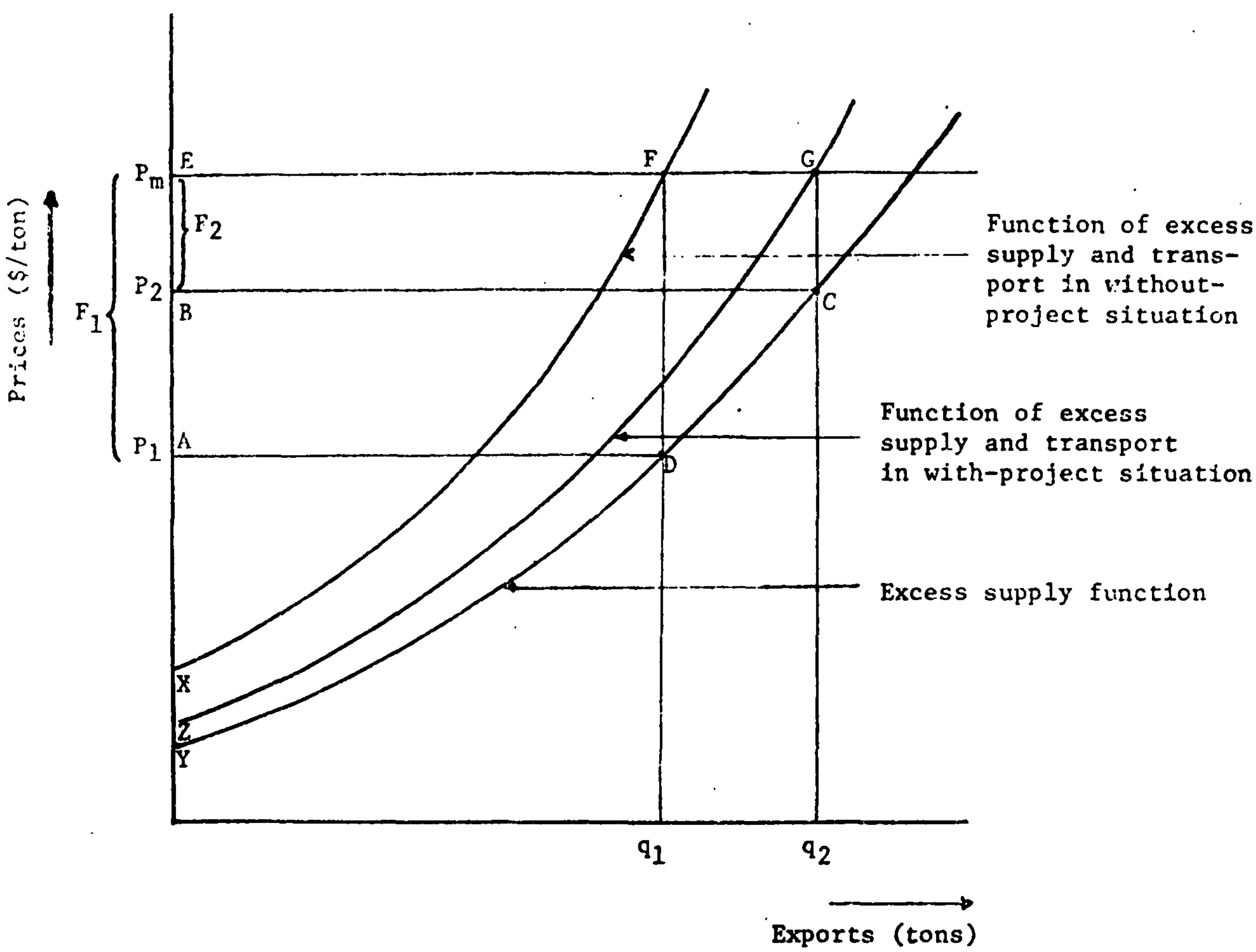


10. Naturally, an expression for B in terms of farmgate prices is simply obtained by adding expression (8) to the last two terms of expression (3):

$$B = B_1 + B_2 = P_2 q_2 - P_1 q_1 - P_1(H_1 - H_2) - \frac{1}{2}(H_1 - H_2)(P_2 - P_1) -$$
$$- (C_2 - C_1) + (F_2 q_2 - F_1 q_1) - (k_2 q_2 - k_1 q_1) \quad \ldots \quad (10)$$

Figure 12 is a graphical presentation of expression (10).

Figure 12: Exports versus Prices



Note that in Figure 12:

Area ABCD represents the benefits accruing to farmers.

(Area AEFD - area ZXFD) represents the profit of transporters in the without-project situation.

(Area BEGC - area YZGC) represents the profit of transporters in the with-project situation.

(Area BEGC - area AEFD - area YZGC + area ZXFD) represents the benefits accruing to transporters.

Line YC is the same as line BC of Figure 9.

11. Assuming that the prices used in the illustration are efficiency prices and that salvage values are negligible, successive application of expression (9) or (10) to each crop of a zone of influence and the summation of the results give the total benefits of any year during the expected life of the investment project, if more than one crop is cultivated in a rural road's zone of influence.

12. The aforementioned discussion considers the one-to-one relationship between farm production and agricultural transport over the improved (constructed) rural road. Specifically, substitution along the compensated (i.e., excluding income effects) demand curve OD of Figure 8 will occur as the price of the agricultural product considered rises; less of this product will be consumed at home. Income affects can, of course,also be relevant. For instance, if the agricultural product is an important one in farm production, a price rise will increase farmers' income, which may result in increased "home" demand. In this case, the aforementioned demand curve OD will slope more steeply and the benefits evaluated by expression (9) or (10) will be underestimated.

13. Naturally, the demand curve OD may be more flat for an inferior product of the farm production and in this case expression (9) or (10) would overestimate the benefits B. The analysis of slopes of the compensated demand curve OD of figure 8 is complex and time-consuming. Generally, the costs of investments of a rural road improvement (construction) and complementary agricultural components do not warrant such an analysis.

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World Bank Staff Working Paper No. 241. August 1976. 92 pages (including annexes, tables). English and French.

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Headquarters
1818 H Street, N.W.
Washington, D.C. 20433, U.S.A.
Telephone: (202) 477-1234
Telex: WUI 64145 WORLDBANK
RCA 248423 WORLDBK
Cable Address: INTBAFRAD
WASHINGTONDC

European Office
66, avenue d'Iéna
75116 Paris, France
Telephone: (1) 723-54.21
Telex: 842-620628

Tokyo Office
Kokusai Building
1-1 Marunouchi 3-chome
Chiyoda-ku, Tokyo 100, Japan
Telephone: (03) 214-5001
Telex: 781-26838

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