

MICHIGAN
STATE HIGHWAY DEPARTMENT
JOHN C. MACKIE, COMMISSIONER

HIGHWAY RESEARCH LABORATORY
ITS OPERATION IN RELATION TO
MICHIGAN STATE UNIVERSITY

Research Laboratory
Office of Testing and Research
November 5, 1957

November 8, 1957

TO: W. W. McLaughlin
Testing and Research Engineer

FROM: E. A. Finney

SUBJECT: Report on Research Laboratory - Its Operation in Relation
to Michigan State University

Transmitted herewith is the second of a series of two reports concerned with the facilities and operation of the Research Laboratory of the Office of Testing and Research, located at Michigan State University.

This second report describes the cooperative relationship which exists between the Research Laboratory and the University, and suggests ways in which this relationship could be improved in the future to the mutual benefit of both State agencies.

It is intended that this report serve to supplement the first report, dated October 25, 1957, and concerned with the facilities of the Research Laboratory at the University.

E. A. Finney, Director
Research Laboratory

EAF:shl

PREFACE

This is a summary of information concerning the operation of the Research Laboratory at Michigan State University, under a Memorandum of Agreement executed in September, 1939, between the State Board of Agriculture, the State Administrative Board, and the State Highway Commissioner.

After outlining the Research Laboratory's objectives, the report describes the facilities made available to the Laboratory by the University under this Memorandum and, in turn, mentions the services rendered to the University for the use of those facilities. In addition, the report lists benefits being derived by both agencies from pursuance of cooperative effort, and suggests means of further enhancing the Department's services to the University.

This report was prepared at the request of Mr. Sidney Woolner, Chief Deputy Commissioner, to supplement a previous Research Laboratory report, entitled "Highway Research Laboratory: Current Facilities and Proposed Requirements in the New Engineering Center at Michigan State University," dated October 25, 1957.

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MICHIGAN STATE COLLEGE
OF AGRICULTURE AND APPLIED SCIENCE
OFFICE OF THE SECRETARY
EAST LANSING, MICH.

JOHN A. HANNAH

September 16, 1939

Mr. Murray D. VanWagonner
State Highway Commissioner
Lansing, Michigan

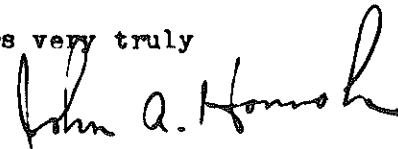
Dear Mr. VanWagonner:

The State Board of Agriculture at its meeting on September 15 approved the memorandum of agreement between Michigan State College and the State Highway Department providing for the establishment and maintenance on the campus of Michigan State College of a research laboratory to be financed and supervised by the State Highway Department.

We are returning the signed memoranda of agreement with the request that you return one for our files after it has been approved by the State Administrative Board.

The State Board of Agriculture is pleased to cooperate in this manner to make available the facilities of the College to your department for the benefit of the people of the State.

Yours very truly



Secretary

*Agreement
attached*

October 5, 1939

Mr. John A. Hannah, Secretary
Michigan State College
of Agriculture & Applied Science
East Lansing, Michigan

Dear Mr. Hannah:

The State Administrative Board has authorized the acceptance of the facilities offered by the State Board of Agriculture, for a research laboratory on the campus of Michigan State College.

I enclose herewith certified copy of such authorization.

Very truly yours,

STATE HIGHWAY COMMISSIONER

MDV:GRD

cc: J. W. Kushing

LGS

MEMORANDUM OF AGREEMENT
BETWEEN
MICHIGAN STATE HIGHWAY DEPARTMENT
AND
MICHIGAN STATE COLLEGE

It is recognized that the Michigan State College is an educational institution the object of which is to provide facilities for higher education, research and cooperative scientific enterprises.

It is recognized also that the Michigan State Highway Department is a governmental service organization the function of which is to provide for the construction, maintenance and safety of the public highways. To insure efficient administration and progress in highway engineering it is necessary that the Highway Department provide certain facilities for the scientific investigation of its problems and other instructional service facilities for the benefit of the general public. The two missions being in no sense antagonistic, but supplementary, it would seem the part of wise economy that these two agencies should avail themselves, of certain facilities of each other which would enhance the working out of their respective missions in serving the public interest.

Accepting the foregoing principles as fundamentally sound, the Michigan State College offers to the Michigan State Highway Department those facilities of plant and equipment which will enable the latter to carry on an active research program. The Michigan State College further offers such other facilities which will allow the Michigan State Highway Department to instruct the general public in its problems and further assist in the promotion of the general welfare. The Michigan State Highway Department in accepting the use of these facilities will endeavor to employ the same without interfering with student activities. And,

in acceptance of this offer the Michigan State Highway Department will strive to encourage and develop the importance of highway engineering research; to assist the Michigan State College in a cooperative manner in the promotion and carrying on of scientific investigation; to bring about through mutual confidence the coordination of data and new knowledge and the correlation of effort, to the end that highway engineering and the pursuance of its study shall be more effective and conclusive.

The detailed manner in which the coordination of facilities and efforts may be affected shall be determined by the respective administrators and officials of the two organizations.

It is understood that this agreement shall be effective for a period of one year and may be continued for an indefinite period by mutual agreement.

Murray D. Van Wagenen
State Highway Commissioner

Robert B. Shaw
President, Michigan State College

Date September 10, 1939

Date September 16, 1939

Approved _____

Approved State Bd of Agriculture
John A. Houchens, Sec.

Date _____

Date Sept 15 - 1939

OBJECTIVES

Organization of research under the Research Laboratory, Office of Testing and Research of the Michigan State Highway Department, is directed toward the accomplishment of the following objectives:

1. Achieving a sound research organization in terms of administration, staff and facilities for the execution of a research program commensurate with the growth and responsibilities of the Department.
2. Encouraging those now actively engaged in research, and providing opportunities in research work for interested and capable employees of the Department not now doing research.
3. Promoting cooperation in research within the Department, and between the Department and educational institutions, agencies of the federal government and of industry, in order to secure concentrated effort, to minimize duplication, and to stimulate progress.
4. Formulating comprehensive projects of research, and the developing of effective means of utilizing the scientific and technical resources of both the State and the Nation to deal with these projects.

COOPERATION WITH MICHIGAN STATE UNIVERSITY

Since the establishment of the Highway Research Laboratory in 1939, a very satisfactory and effective research arrangement has existed between departments of the various colleges of the University and the Highway Research Laboratory. The Memorandum of Agreement between the University and the Highway Department has simply and effectively provided a healthy environment for the Department to pursue its research activities on the campus in East Lansing.

The Memorandum of Agreement provides no details as to how the coordination of facilities and efforts may be effected. This has been left to the discretion of the respective administrations and officials of the two State agencies. In the past, matters concerned primarily with normal research activities between the Research Laboratory and various departments of the University have been handled directly with department heads or with their designated representatives. Matters concerned with laboratory facilities or operating policies requiring University Administration attention have been handled through the Dean of Engineering.

Under the Agreement, the University has provided the Research Laboratory with certain office and laboratory space in Olds Hall and Wells Hall, including such utilities as light, heat, water and gas, without monetary compensation.

Other important and necessary facilities available to the Research Laboratory include:

1. The use, with faculty privileges, of the main library and several specialized departmental libraries.
2. The availability of the academic staff for consultation on research matters of mutual interest, and use of University laboratory equipment with special permission.
3. The University maintenance shops are available for repair work and for constructing scientific equipment. The University is reimbursed by the Department for this work on the same basis as University departments.
4. It is possible to purchase laboratory supplies and sundry materials through University stores at savings offered by the overall purchasing advantage of the University.

5. The University campus and adjacent farm land are available for special field studies.
6. Parking facilities are available for storage of mobile test equipment and personnel transportation equipment.

In accepting the use of these facilities, the Department has agreed to encourage and develop the importance of highway research, to assist the University in promoting and carrying on scientific investigations, and through the mutual coordination of data and new knowledge, to make the study of highway engineering more effective and conclusive.

In fulfillment of the Department's responsibilities under the Agreement, over the years, the Research Laboratory has developed an outstanding, progressive, and nationally recognized highway research program. In pursuance of this program of research, the Research Laboratory has cooperated with the University in the following categories: (1) The Engineering Experiment Station; (2) Departments of the University; (3) Employment of undergraduate and graduate students; (4) Employment of faculty members; and (5) Special services to departments of the University. These five categories of cooperation are described in brief detail below.

Cooperation with Engineering Experiment Station

The Research Laboratory has cooperated with the Engineering Experiment Station in three areas of highway research as follows:

1. In providing technical information from Laboratory research for publication as bulletins of the Engineering Experiment Station. Three such bulletins have been published.
2. In encouraging industry to establish fellowships at the Engineering Experiment Station for the purpose of carrying on highway research of mutual interest, and employing graduate students or members of the teaching staff. Complete supervision and responsibility for this work rest with the Research Laboratory. Two such projects have been completed.
3. In serving as a consulting agency or acting in a supervisory capacity to a certain extent on research work of mutual interest, performed under Industrial Fellowships established at the Engineering Experiment Station. Work conducted by staff members or graduate students of the Engineering School. The Laboratory has been active on two such projects.

Cooperation with University Departments

The Agreement between the two State agencies is not restrictive with respect to the manner in which the research activities of the Research Laboratory are conducted in cooperation with the various departments of the University. This has permitted considerable latitude in joint operation, to the benefit of both agencies. These various cooperative activities are discussed below under the following headings: (1) Jointly sponsored research projects; (2) Collaboration on research projects of mutual interest; (3) Employment of graduate and undergraduate students; (4) Employment of University staff members; and (5) Special services to the University.

Jointly Sponsored Research Projects: In the past, one jointly sponsored research project has been completed. In this case, the staff members of the Soil Science Department and the Research Laboratory participated jointly on the study of Turf Growth on Highway Shoulders. This is recognized as a beneficial and productive way of carrying on certain types of highway research projects where prevailing deficiencies in staff and equipment can be overcome by joint effort.

Collaboration with University Departments: In many instances there has been a mutual exchange of scientific advice and assistance between the Research Laboratory and various University departments in connection with currently active research projects of mutual interest. This cooperative relationship has furnished the Laboratory with a wealth of excellent scientific assistance on many projects. In this connection, the University departments have been very generous with their time and the loan of special scientific equipment. In return, the Research Laboratory has reciprocated to the best of its ability in a similar manner. University departments with which the activities have taken place include Bacteriology, Geology, Mathematics, Chemistry, Chemical Engineering, Physics, Applied Mechanics, Civil Engineering, Mechanical Engineering, Soil Science, Agricultural Engineering, Audio-Visual Aids, and Statistics.

Employment of Graduate and Undergraduate Students

In pursuance of its research program, the Research Laboratory has found it necessary to obtain student help on a part-time basis to act as laboratory assistants to permanent staff members. The students are assigned to various tasks commensurate with their academic background, native ability, and length of service with the Department. This policy of hiring students has certain desirable features: (1) It has been possible for the Laboratory to carry on an extensive research program in the face of a shortage of qualified full-time personnel. (2) It serves to enlighten young engineers to future possibilities in highway engineering and thereby encourage them to stay with the Department after graduation. Areas of student help are briefly defined below.

Graduate Student Research: Through a working arrangement with the University authorities, it is possible for students working toward advanced degrees to do research work for thesis credit in the Research Laboratory, under joint supervision of their major professors and experienced staff members of the Research Laboratory. This is considered a desirable method for expanding the effectiveness of the Research Laboratory while at the same time enhancing the research prestige of the University. The program as it now stands is not as effective as it should be, because the present policy of using Civil Service positions for graduate students does not permit competition with the various University departments for qualified candidates. Methods are now being considered by the Personnel Division to correct this situation. At present, no graduate students are working in the Laboratory under this arrangement, although in the past there have been several.

Undergraduate Student Research: This concerns undergraduate students who are available to do independent research as partial fulfillment of the requirements for a B.S. degree. The student is required to work on a project selected by the Research Laboratory. His work is usually performed in the Laboratory under the guidance of a staff member. In the past, several students have availed themselves of this opportunity to the benefit of the Department. No students are working in this category at the present time.

Student Laboratory Aides: This category includes all students, graduate or undergraduate, who are employed on a part-time basis for the express purpose of assisting full-time staff members on various phases of the overall Laboratory research program. The present student complement includes fourteen Highway Laboratory Aides B, five Highway Laboratory Aides A, one Electronic Technician I, and one Physical Testing Engineer I, totaling 21.

Another class of student help in this group includes one Engineer Trainee I and six Student Engineering Aides B, making a grand total of 28 employees, two of whom are now taking graduate work at Michigan State University.

Employment of Faculty Members

In the past, and under certain circumstances, it has been possible to hire University staff members on a part-time basis to assist the Laboratory staff on various research projects. Usually, because of heavy teaching loads, it has been possible to hire such persons only during the summer months. However, there have been occasions when we have been fortunate in hiring University

staff members on a part-time basis throughout the year. Under this program, we have acquired the services of a petrologist from the Geology Department, two electronic engineers from the Electrical Engineering Department, and two Civil engineers from the Civil Engineering Department.

Special Services to the University

Other areas of collaboration in which the Research Laboratory has given many special services to the University in recent years include:

1. Specialized consulting service to the Buildings and Utilities Department on such subjects as reinforced concrete design and concrete mix proportioning; and to the Landscape Department on concrete curing, aggregate stabilization, mechanical analysis of materials, bituminous resurfacing, and traffic signs.
2. Participation in lectures and demonstrations on recording oscillographs for classes in Experimental Stress Analysis for the Department of Applied Mechanics.

BENEFITS RECEIVED FROM THIS COOPERATIVE EFFORT

The location of the Highway Research Laboratory on the Campus of Michigan State University has the advantage of bringing certain benefits to both State agencies. These benefits are briefly described below.

To the Highway Department

1. The University environment is ideal for the promotion and pursuance of scientific investigation.
2. The Department's research activities are conducted far enough from Lansing to escape the many interruptions normally associated with the daily operation of the Department, yet close enough to be readily accessible at all times to the Department's staff and other highway personnel.
3. The many facilities which the University provides are available to the Department for carrying on a progressive highway research program and could not be placed in another location without costly duplication of equipment and facilities.
4. Considerable benefits are derived by the mutual exchange of ideas, equipment and facilities.
5. The proximity of the University schools makes it possible for the Research Laboratory staff members to participate in advanced study for self-betterment to the ultimate benefit of the Department.
6. The Laboratory provides a contact between the Department and students who might be interested in making a career in Highway Engineering.
7. Specialists on the academic staff are available at all times for consultation and assistance on problems of mutual interest.
8. Cooperative research work is possible to supplement and thereby increase the effectiveness of the Laboratory's research program.

To Michigan State University

1. Faculty members and students are exposed to the latest developments in highway engineering and highway research.

2. The Laboratory creates worldwide publicity for the University through its mail contacts with other highway research organizations, with technical societies and industry, also by Laboratory visitors and by on-campus conferences sponsored by the Research Laboratory.
3. The presence of the Research Laboratory on the campus enhances the research prestige of the University in the field of highway engineering.
4. The Laboratory is in a position to furnish special technical services to the University on matters dealing with operation and maintenance.
5. The Laboratory, in providing employment for students and faculty members on research projects, creates certain benefits to both the individual and the University.
6. Research Laboratory staff members are available for teaching or lecturing on subjects related to highway engineering and highway research.

METHODS OF INCREASING SERVICE TO THE UNIVERSITY

There are five methods by which the Department can render greater service to the University in the future with a minimum of capital outlay. These methods include: (1) Establishing of a number of graduate research assistantships; (2) Providing grants for highway research; (3) Employing of faculty members as consultants; (4) Employing of faculty members on a part-time basis; and (5) Joint participation in planned research. All of these methods would be highly acceptable to the University authorities because such a program would not only increase the prestige of the University in the field of highway research, but would tend to attract to the campus desirable staff members and outstanding graduate students with a special interest in highway engineering. A detailed description of each of the five methods of service follows.

Establishment of Graduate Research Program

At the present time, the Research Laboratory relies to a large extent on student help on a part-time basis to assist permanent Laboratory staff members. This type of help is provided for the most part through Highway Laboratory Aide B, A, and A1 positions, and is supplemented at times by a limited number of Student Engineering Aides B and Engineer Trainees who are furnished on a temporary basis through the Personnel Division.

It is proposed that all of the Highway Laboratory Aide positions now under the jurisdiction of the Research Laboratory be reallocated to a new class, possibly called "Student Highway Research Aides" on the B, A, I, and II levels. A certain number of B and A positions could be reserved for qualified undergraduates, the I positions for graduate students on the Master's level, and the II positions for graduate students on the Doctorate level.

The graduate students would be recruited by the University through normal procedures, in cooperation with the Research Laboratory. They would be assigned to independent research problems in the Research Laboratory or to certain phases of highway research under joint participation with the University. All laboratory positions assigned to this program would be filled with graduate students as the positions became vacant due to resignation of present undergraduate incumbents. Undergraduates, when needed, would be selected on the basis of educational background, experience and personal aptitudes.

Grants for Highway Research

This plan would consist of establishing research teams in certain University departments, consisting of one faculty member on a part-time basis and one or more graduate research assistants. The graduate student

or students would work on a research project assigned by the Research Laboratory under the guidance and assistance of a major professor who would receive a part of the grant for his services. There are instances where certain types of research projects could be carried out successfully under such a plan.

Employment of Faculty Members as Consultants

It is possible to employ faculty members for consulting purposes on what is known as a University overtime permit, which limits faculty members to engage in overtime work not to exceed two full days per month. Help of this type is badly needed at times by the Research Laboratory.

Part-Time Employment

A faculty member in this capacity would be hired with the definite understanding that he would operate continuously on a one-half time basis for both agencies. This type of help would supplement the Research Laboratory staff and provide expert help in academic fields which otherwise could not be obtained under present employment conditions.

Joint Participation in Research Projects

It is possible to carry on research projects, jointly sponsored and executed by the Research Laboratory and a department of the University. The work would be done by staff members of the two agencies with funds and equipment jointly provided.

There is the possibility that certain research under this program might be eligible for the use of the 1-1/2 percent Federal Highway Research money, or money from the Bureau of Public Roads' Highway Survey Fund.

The administrations of the Engineering Experiment Station and the Highway Traffic Safety Center have expressed their desire to cooperate with the Research Laboratory on research projects of mutual interest. Both could well be considered in connection with any of the plans mentioned above.

It should be understood that in considering any of the above plans, it would be the intent of the Research Laboratory to seek help from the University only in those fields of research endeavor which cannot be accomplished or handled effectively with its present complement of staff or equipment. The University is also limited in the types of research that it can do effectively for the Highway Department.

PROJECTS FOR IMMEDIATE CONSIDERATION

The following is a summary of research work under consideration by the Research Laboratory which could be given immediate consideration in the proposed expanded service plan with the University. The projects are listed under the department of the University which would be affected, together with their scope and the assistance that would be required.

Statistics Department

Consultation and assistance is needed from this department in setting up the proper statistical approach for handling and interpretation of raw data from several major Laboratory projects which are now either completed or in progress, such as the Michigan Test Road, Performance of Postwar Pavements, Skid Resistance of Pavement Surfaces, Dynamic Load Aspects of Truck Size and Weight, and others.

In this case, there are two possible courses of action: (1) to hire a staff member on overtime consulting basis, or (2) to establish a graduate research assistantship in the Statistics Department. The graduate research assistant would work part-time in the Research Laboratory for thesis credit under the guidance of a major professor in the Statistics Department. Both methods are recommended in order to get things going; then possibly after a year or so, the graduate student could be retained in the Laboratory on a full-time basis.

Physics Department

The Physics Department would be the best place to find assistance to supplement the work of the Isotopes Section of the Research Laboratory. It is necessary to determine the optimum energies and sources of gamma rays and neutrons for use in moisture and density gages. This would involve a study of the scattering of neutrons and gamma rays by typical soils and aggregates used in highway construction, with emphasis on the energies of the scattered particles and/or protons. The above work would supplement current projects on the development of density and moisture gages. The nature of this problem possibly could be handled best under the grant plan or a jointly sponsored research project.

Electrical Engineering Department

In connection with current research work for the Department's Traffic Division, it will be necessary for the Research Laboratory to start a study of instrumentation for electronic radar-actuated equipment for automatic control of traffic signals, for the purpose of improving traffic flow patterns in certain complicated high-traffic areas. This equipment might take the form of radar monitoring circuits throughout the network, which would feed data

into an electronic computer and the computer would determine the best solution for the traffic flow pattern, automatically handling the traffic control devices accordingly. This is part of one phase of a current investigation concerned with the writing of manufacturing and installation specifications for all traffic control devices and related appurtenances.

This work may warrant hiring a faculty member on a part-time basis indefinitely, because he could also be profitably employed on certain other phases of electrical work. Further, the Electrical Engineering Department is better equipped to handle this work than the Research Laboratory.

Applied Mechanics Department

Early work established maximum stress levels for unlimited repetitions of load on non-air-entrained concrete. The same relationship between stress load and load repetition should be established for air-entrained concrete. This information is necessary for modern pavement design considerations.

The Applied Mechanics Department has the personnel and equipment to carry on studies in this field in an accelerated manner. The Laboratory suggests that a research project be set up in that department, either by a research grant or a jointly sponsored research project between the Laboratory and the Applied Mechanics Department. Graduate assistants would be supplied to do the work under the graduate assistant program.

Soil Science Department

At present, the Laboratory is carrying on research concerning the effect of the 200-mesh material in soils on the ultimate performance of the highway. In this connection, it is highly desirable that the work be supplemented by a study including the identification and estimation of clay minerals such as illite, montmorillonite, kaolinite, chlorite, etc., in typical highway soils, and correlation of types and percentages of clay minerals with behavior as highway engineering materials. This would involve x-ray diffraction studies. The work could no doubt be handled effectively by the use of graduate research assistants for thesis credit.

University Personnel Required

In order to put the above cooperative research program into effect, it would be necessary for the Highway Department to provide means for securing the following personnel:

- 4 Graduate Research Assistants
- 2 Faculty Members on a consulting or part-time basis
- 1 Grant for joint research, to include a faculty member and
- 1 graduate research assistant

METHOD FOR FINANCING EXPANDED SERVICE PROGRAM

The following is a summary showing status of certain positions in the Research Laboratory which might be considered in connection with the expanded service program.

		Starting Salary, per year
1 Electronics Engineer IV	New Position	\$8,372.
1 Statistician III	" "	5,324.
1 Physical Research Engr. III	Vacant	\$7,099.
1 Physical Research Engr. II	"	5,992.
1 Chemist III	"	5,971.
1 Chemist II	"	5,011.
2 Hwy. Lab. Technician I	"	4,635.
1 Hwy. Lab. Aide B	"	<u>3,695.</u>
		\$46,099.

Table I gives more information on the salary range for the above named positions. In addition to the above situation, we have a certain sum of money available from the residue of the student part-time position salaries as shown below.

TABLE I
Summary of Salary Range for
Certain Laboratory Positions

	Starting		Top		Years
	per hr.	per yr.	per hr.	per yr.	
Electronics Engineer IV	\$4.01	\$8,372.	\$5.00	\$10,440.	4
Phys. Research Engr. III	3.40	7,099.	4.18	8,727.	4
Phys. Research Engr. II	2.87	5,992.	3.46	7,224.	4
Chemist III	2.86	5,971.	3.65	7,621.	4
Statistician III	2.86	5,971.	3.65	7,621.	4
Chemist II	2.40	5,011.	3.02	6,305.	4
Hwy. Lab. Technician II	2.55	5,324.	3.11	6,493.	4
Hwy. Lab. Technician I	2.22	4,635.	2.71	5,658.	4
Hwy. Lab. Aide A	1.91	3,988.	2.21	4,618.	3
Hwy. Lab. Aide B	1.77	3,695.	2.06	4,301.	2

The above figures are based on Civil Service rate schedule as of July 7, 1957.

Highway Laboratory Aide Positions:

	<u>Part-time</u>	<u>Full-time</u>	<u>Difference</u>
Lab. Aides A	\$13,325.	\$21,320.	\$7,995.
Lab. Aides B	<u>20,174.</u>	<u>39,312.</u>	<u>19,165.</u>
	\$33,472.	\$60,632.	\$27,160.

The sum of \$27,160. would be available for graduate research assistants on direct grant without unbalancing the salary budget.

Current rate of pay by the University for graduate students on a half-time basis is as follows:

	<u>9 months</u>	<u>12 month basis (1 month vacation)</u>
Master's degree	\$1,700.	\$2,270. (approx.)
Doctor's degree	1,900.	2,533. "

For Master's degree candidates, the salary of \$2,270. would be approximately equivalent to that of a Highway Laboratory Technician I working part-time for a full year, or $\$4,635 \div 2 = \$2,317.$

In the case of a Doctorate candidate, the salary of \$2,533. would be approximately equal to that of a half-time Highway Laboratory Technician II, or $\$5,324 \div 2 = \$2,612.$