PRACTICAL APPLICATION OF THE MICHIGAN STATE PLANE COORDINATE SYSTEM

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Biographical Sketch

Earl F. Burkholder is a Project Manager for Commonwealth Associates Inc. and is currently responsible for computer applications and computational procedures for Commonwealth's surveying projects. He was responsible for designing the Control Traverses and computing the Michigan State Plane Coordinates and section breakdowns for surveys used in the fee title acquisition of 93 miles of 765 Kv transmission line corridor in St. Clair, Lapeer, Sanilac, and Tuscola Counties in Michigan. He is also responsible for the computation of state plane coordinates for ground control of aerial photography of more than 500 miles of transmission line in Minnesota and North Dakota. He graduated "cum laude" from the University of Michigan in 1973 with a Bachelor of Science in Civil Engineering (Geodetic). He is a member of M.S.R.L.S., A.S.C.E. and A.C.S.M. and is a Registered Land Surveyor in the State of Michigan.

Abstract

The Michigan Coordinate System Law was enacted by the Michigan Legislature in 1964. Implementation of the system has progressed quite slowly in the past ten years as the state legislature has yet to appropriate funds for additional monumentation of the system. However, some surveyors have profitably used the system as a tool for large-scale mapping projects and others have used it for control of small and local surveys. The system provides a unified data base standard to all users and is permanent monumentation to any point defined by it. Use of the system is facilitated by modern equipment which is readily available and easy to use. As more people become convinced of the merits of the system, the "powers that be" will be able to see that investments in the system can yield handsome returns.

The Michigan State Plane Coordinate System (M.S.P.C.S.) is a combination of three Lambert Conformal Projections, a North Zone, Central Zone and South Zone. The system was designed by Professor Ralph M. Berry (formerly Professor of Geodetic Engineering at the University of Michigan, now Assistant to the Chief of the Leveling Division of National Geodetic Survey, N.O.S., N.O.A.A.) and enacted into law by the Michigan Legislature in the regular session of 1964.[1] The M.S.P.C.S. is unique in that it is designed to a reference elevation of 800 feet above the Clarke spheroid of 1866, the mathematical model of other state plane coordinate systems.[2] As the elevation of most of Michigan is within several hundred feet of the 800-foot elevation, the need to reduce horizontal distances to "sea level" is eliminated for all but the most precise work and in areas where the elevation is significantly higher than 800 feet. The mathematical basis of the system and the detailed computational considerations required to use the system were both treated by Professor Berry in his paper, "Use of the Michigan

Coordinate System", delivered to the 24th Annual Conference of M.S.R.L.S. at Grand Rapids in 1965.

With the M.S.P.C.S. thus defined and adopted by the State of Michigan, the National Geodetic Survey (formerly the Coast and Geodetic Survey) has computed and published the Michigan State Plane Coordinate values for the geographic positions (latitude and longitude) of the triangulation stations of that part of the national network located in Michigan. Thus the system is monumented and available for use in those areas covered by the national network. Admittedly, the triangulation arcs are spaced at intervals of 30 to 50 miles, in some cases even farther. The stations in the arcs are often spaced up to 10 to 15 miles apart and some of these have been destroyed since they were established. However, the basis of the system is there and we can use it. It is encouraging to note that in some of the more populated areas the national network has been extended by the National Geodetic Survey to cover the spaces between the triangulation arcs with second order stations to be used for local control. At this point, a lot could be said about implementation on the national level, but I refer you to Appendix A which is a list of papers published in the A.C.S.M. Proceedings; particularly the one given by Mr. Joseph F. Dracup in the fall of 1974, "A Small Beginning Directed at a Big Need: Multipurpose Integrated Survey Systems". Don't let the title scare you, it is very readable and contains a lot of information.

Through little or no effort on the part of the practicing surveyor a universal data base has been defined, adopted, and monumented. The next step is to acquaint potential users (surveyors, attorneys, engineers, planners, abstractors, realtors, assessors, etc.) with the features of this tool and to show how it can be practical and economical. The paper Professor Berry gave to M.S.R.L.S. in 1965 (ten years ago) contains information on how to use the M.S.P.C.S. Additional information published since then further facilitates use of the system. In December, 1971, Professor Berry and his assistant, Herbert W. Stoughton, gave a computational seminar for the M.S.R.L.S. on using the system. They covered the same material of the 1965 paper and presented some additional information. With Professor Berry's permission, the M.S.R.L.S. has agreed to make a reprint of his paper available for the cost of printing it. If you still have the 1965 paper or the material from the 1971 seminar, you should not need the reprint; but if you want the reprint, you can use the form in Appendix C and send it to the State Office with payment by March 15, 1975. Also in Appendix C is given ordering information for two pamphlets, "State Plane Coordinates by Automatic Data Processing" and "Plane Coordinate Projection Tables, Michigan (Lambert)". These were part of the 1971 seminar material and are very helpful when working with the M.S.P.C.S. In addition to these sources of information, the N.G.S. and A.C.S.M. in cooperation with local sections and affiliates gives a "Surveying Instrumentation and Coordinate Computation Workshop" at various locations throughout the country. The Education Committee of the M.S.R.L.S. is currently investigating the possibility of having them conduct a workshop here in Michigan this fall. I urge you to attend if at all possible. I have not attended one of the workshops, but I have studied the workshop notes and I look forward to attending when it does come to Michigan.

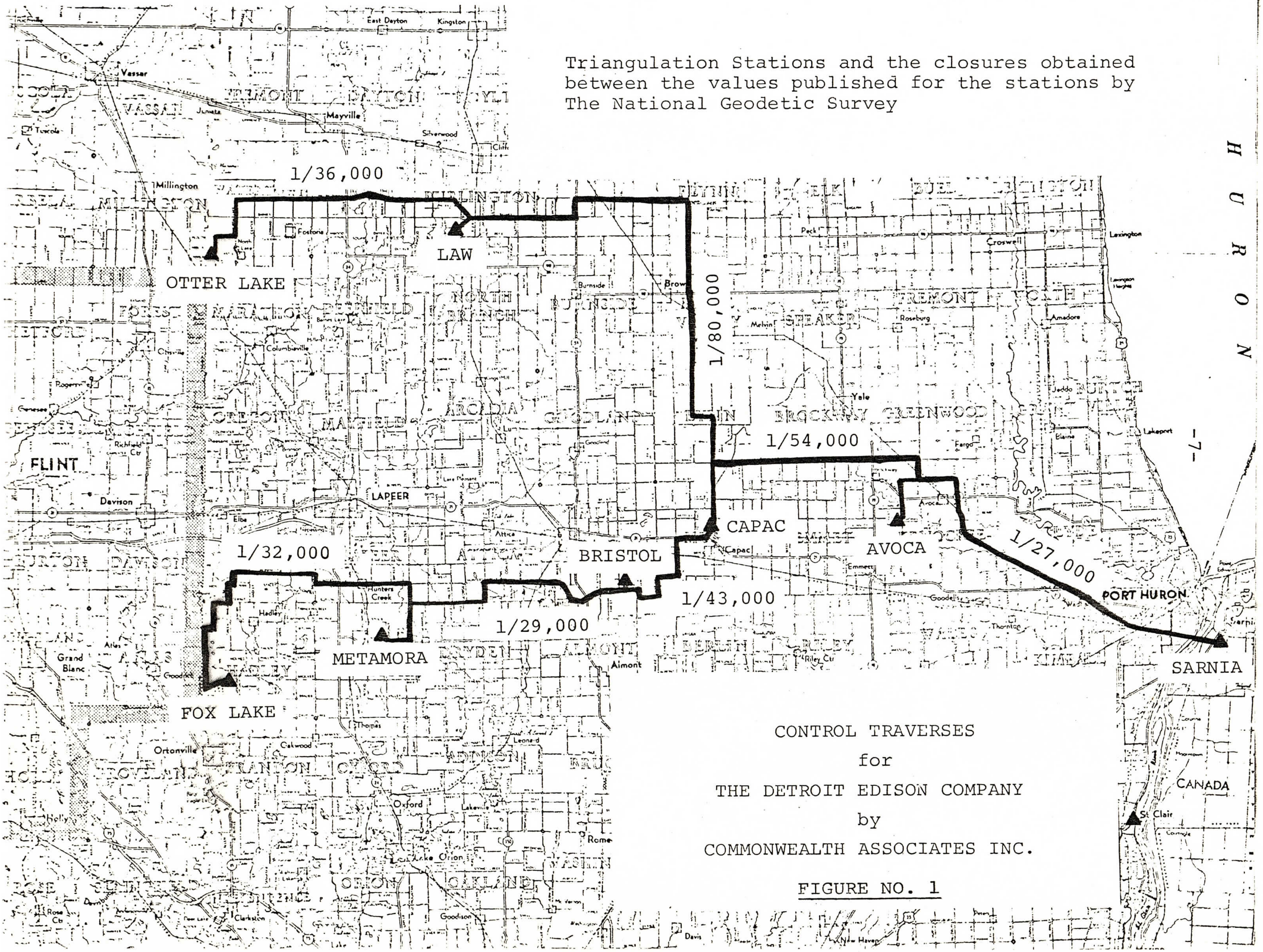
Turning now to the questionnaires which were sent out to all M.S.R.L.S. members with the minutes of the January 4th Board of Directors meeting. I'm sorry that the return date of January 20th turned out to be unrealistic for those of you who received your questionnaire after that date. I did, however, tabulate the results of those questionnaires received up through the 28th of January, see Appendix B.

I recognize that my questionnaire method violates proper random sampling techniques and that any inferences drawn from the tabulated percentages are biased at best, but I was truly heartened by the comments and questions on the replys that I received. Some surveyors have used the Michigan State Plane Coordinate System and many more are interested in seeing the system implemented. However, the most prevalent question was, "Who is going to pay for monumenting the system to the extent it becomes practical for the practicing surveyor?" and, "Who or what State agency is going to be responsible for administrating the effort?" A good many others said that they would rather see any state monies spent on surveying used to remonument and to perpetuate the U.S. Public Land System while others questioned any application of M.S.P.C.S. to boundary surveying as practically all Michigan land title is referenced to the U.S. Public Land System. I will hasten to confess that I don't have the answers to these questions--only some ideas. Surveyors in other states have wrestled with the same problems and many have discussed them at the A.C.S.M. Conventions and have published papers in the A.C.S.M. Proceedings. I have searched through the Proceedings of 1971 through 1974 and have listed in Appendix A some of the articles that I thought might be of interest for further reading.

Several states, North Carolina,[3] Alabama,[4] and Missouri,[5] have adopted legislation creating a Division of Geodetic Survey within their state. Typically, the Division is charged with responsibility for surveying data within the state, for remonumenting and perpetuating the U.S. Public Land System, and for extending control for the state plane coordinate system. Counties in other states, Oregon,[6] Minnesota,[7] Florida,[8] and Wisconsin,[9] to name a few, have gone about remonumentation on a county basis and some cities and metropolitan areas have embarked on a control program of their own or in cooperation with the N.G.S.[10] The important thing is that people are attacking the monumentation problem and are making progress. Not surprisingly, Michigan as contributed with its Corner Recordation Act, Act 132 for recording surveys, its Plat Act, and in 1964 the City of Detroit[11] was one of the first cities to take advantage of N.G.S. cooperative venture for metropolitan surveys. More recently there has been some interest in the creation of a "State Land Survey Authority" in Michigan. I urge each of you to make a contribution as to the activities you feel such an Authority should engage in as it would be through you, the Michigan Surveyor, that such an Authority could best serve the interests of the people of Michigan.

To those of you who asked why the M.S.P.C.S. is necessary, let me relate to you some of the reasons why we at Commonwealth have used it. Maybe then you could come up with your own reasons for taking advantage of the system. One of the most obvious advantages of using a state plane coordinate system is that it provides a unified data base that is standard to all users. After appropriate corrections are made for scale, all computations are performed according to the principles of Euclidian Plane Geometry. Hence, problems of rotating and translating local coordinate systems are eliminated as all work can be performed on one coordinate system without undue warping, discrepancies, or station equations. In the surveying that Commonwealth did for The Detroit Edison Company (see Figure Number 1, Page 7) we have the same bearing and coordinate system from Port Huron to Greenwood Township to Capac, across Lapeer County to Genesee County and all the way up to Millington in Tuscola County.

Another advantage is that of the one way traverse. We were able to start at a triangulation station, traverse along the general route of the transmission line corridor and close in to another triangulation with azimuth and position. This gave us a check on our work and eliminated the need for double runs or loops to insure against blunders. We could then go off this control traverse, tie in the section corners that we needed and close back to any other point on the control traverse. We confidently developed the entire network from the segments of



CONTROL TRAVERSES
for
THE DETROIT EDISON COMPANY
by
COMMONWEALTH ASSOCIATES INC.

FIGURE NO. 1

control traverse between triangulation stations. From this network we were able to provide the photogrammetrist who was compiling the planimetric map of the corridor accurate horizontal ground control. He had contracted to provide the ground control, but we were able to provide it for 20 percent of his contract price, saving the client 80 percent. He selected the photo identifiable points for which he wanted coordinates, and it was a simple task for our crew to occupy one of the corners nearby, backsight another point, turn an angle and measure the distance to the object. Duplicate effort was eliminated resulting in cost savings to the client.

However, my personal belief is that the biggest advantage of the Michigan State Plane Coordinate System is the monumentation it provides to any point previously defined by the system. I'm sure that there is not a surveyor here who does not appreciate the efforts of his predecessors who properly monumented the surveys that they made. According to the records in many courthouses, many County Surveyors in the second half of the nineteenth century who had a better chance of finding the original wood stake would, with no small effort, bury an angular stone or one with a hole or an "X" chiseled in it to monument the section corners. Better yet, to make sure that no one would mistake the evidence, he often buried some charcoal, broken glass, or pottery around the base of his monument. Now, I have nothing against stones for monuments except that they require an inordinate amount of time and money to recover when the witnesses are not readily available. In fact, many surveyors have been guilty of placing a monument according to highly visible evidence when a subsurface search would have revealed a stone, previously honored as the corner, in a different location. Using various locators, we have somewhat better success today in recovering more recent monuments, "T" irons and other metallic objects. Now the problem also is choosing which of several objects to honor as monument to the corner. On the other hand, road graders on gravel roads are sure death to many monuments placed with all good intentions to mark a corner. So, it still is difficult to properly monument a corner such that it is readily recoverable. However, the problem of the roving section corner can be solved and the location of the corner permanently monumented when it is defined by the Michigan State Plane Coordinates. Recovering the evidence is a matter of traversing between known points rather than digging with a pick and shovel or a backhoe for a stone or other evidence which might be there. I recognize that, using the traverse method, no two surveyors would replace a corner in exactly the same location, but coming off of a control point up to three miles away and closing on another control point with a traverse closing 1/25,000 or better and with proper adjustment, the points should be within a half a foot of each other. In densely populated areas where land values are high, the control stations should be closer than that and the circle of probability would be smaller. I'm sure that by now many of you have formulated reasons of your own for using or not using the system. What I want to do is point out how it can be of benefit in many cases, to stimulate discussion on it, and to provide channels for acquiring information on how to use it properly.

I'd like to go on now to our actual experience with using the M.S.P.C.S. At the beginning of the project, the first thing we did was to obtain the Geodetic Control Data from the National Geodetic Survey in Rockville, Maryland. Geodetic Control Diagrams showing the extent of N.G.S. horizontal and vertical control are available for 50 cents per sheet. Each sheet covers a $1^{o} \times 2^{o}$ area at a scale of 1/250,000 and gives explanatory notes on ordering information from the sheet. The data is distributed in 30 minute blocks and, as of February 1, 1975, costs $2.00 per block each for the horizontal and the vertical data. A sample horizontal data sheet (see Figure 2, Page 10) shows the published data for the triangulation station, a description

FIGURE NO. 2

JUNE 1960
PUBLISHED AND PRINTED BY:
U.S. DEPARTMENT OF COMMERCE
COAST AND GEODETIC SURVEY
WASHINGTON D.C.
REVISED FEB 1967

HORIZONTAL CONTROL DATA

by the
Coast and Geodetic Survey
NORTH AMERICAN 1927 DATUM

QUAD 430833 STATION 1009
MICH
LATITUDE 43°00' TO 43°30'
LONGITUDE 83°30' TO 84°00'
DIAGRAM NK 17-1 FLINT

Kaul (Saginaw County, H. C. Warwick, 1932).—About 8½ miles east of Saginaw, in NW¼ sec. 21, T. 12 N., R. 6 E., at southwest corner of land owned by Mike Reinbold, about 200 yards west of his barn, 29 feet north of center line of gravel county road, 1 foot north of right-of-way fence, and 2 feet east of property line between Reinbold's and John Kaul's property. To reach from intersection of James and Genese Streets in Saginaw, go east 4.5 miles on James Street and paved road to crossroads, and continue straight east 3.2 miles on gravel county road to station site. Surface and underground marks are standard disk station marks in concrete, notes 1a and 7a. Upper mark projects 3 inches. Reference and azimuth marks are standard reference disks in concrete, note 11a. No. 1 projects 3 inches, is on land owned by Joe Kaul, 28 feet south of center line of road, 1 foot south of right-of-way fence, 106 feet east of property line between Joe Kaul's and John Kaul's property, and 117.90 feet from station in azimuth 298°22′. No. 2 projects 3 inches, is on land owned by John Kaul, 30 feet south of center line of road, 1 foot south of right-of-way fence, 1 foot east of fence between cultivated field on east and apple orchard on west, and 141.00 feet from station in azimuth 66°16′. Azimuth mark projects 6 inches, is on right-of-way of county road, 27 feet south of center line of road, 0.5 foot north of right-of-way fence line, 28 feet west of fence corner, and approximately 0.35 mile from station in azimuth 271°40′44″. Finial of school belfry is about ¾ mile from station in azimuth 220°38′12″.

Form 526
(11-8-55)

RECOVERY NOTE, TRIANGULATION STATION

R

NAME OF STATION: KAUL
ESTABLISHED BY: H.C.W. YEAR: 1932 STATE: Michigan
RECOVERED BY:* U.S.G.S. YEAR: 1958 COUNTY: Saginaw

Detailed statement as to the fitness of the original description; including marks found, stampings, changes made, and other pertinent facts:

Station recovered in good condition.
The station is located 7.0 miles north and 1.2 miles west of Frankenmuth, T 12 N, R 6 E, 0.1 mile west center sec. 21; 27 feet north and 0.7 foot below center line of road; 3 feet east of fence row between Reinbold's and Kaul's property; in concrete post, a standard tablet stamped U.S.C.&G.S. KAUL 1932.
Reference mark 1 is 56 feet south and 103 feet east of triangulation station, 29 feet south of center line road; in concrete post a standard tablet stamped U.S.C.&G.S. KAUL NO 1.
Reference mark 2 is 128 feet west and 57 feet south of station; 30 feet south of center line road; in concrete post a standard tablet stamped U.S.C.&G.S. KAUL NO 2.

*Name of chief of party should be inserted here. The officer who actually visited the station should sign his name at the end of the recovery note.
NOTE.—One of these forms must be used for every station recovered.

ADJUSTED HORIZONTAL CONTROL DATA

NAME OF STATION: KAUL YEAR: 1932
STATE: Michigan LOCALITY: Lake Huron - Big Rapids
First -ORDER Triangulation SOURCE: G-2422 FIELD SKETCH: MICH 4-III

GRID DATA	COORDINATES (Feet)	PLANE AZIMUTH θ (OR Δα) ANGLE	MARK
STATE: Mich ZONE: E CODE: 2101	x 472,460.59 y 702,952.89	271°45'01"	AZIMUTH MARK
STATE: Mich ZONE: S CODE: 2113	x 2,149,564.09 y 703,489.06	271 17 45 +0 22 59	AZIMUTH MARK

GEODETIC DATA	POSITION		SECONDS IN METERS	ELEVATION
	LATITUDE: 43°25'44".156	NORTH		METERS
	LONGITUDE: 83 46 13.210	WEST		FEET

TO STATION	GEODETIC AZIMUTH (From south)	DISTANCE LOGARITHM (Meters)	DISTANCE METERS
	FIRST-ORDER		
SAGINAW	90°51'32".53	4.138 6987	13,762.54
APPOLD	133 01 09.91	4.331 1125	21,434.46
JONAS	168 10 54.97	4.169 3786	14,769.94
GREW	207 37 31.30	4.185 4829	15,327.91
BERNTHAL	262 42 55.82	3.955 7188	9,901.91
	THIRD-ORDER		
SAGINAW CITY HALL FOOT OF FLAGPOLE	85 50 41.8	4.157 678	14,377.3
SAGINAW CONSUMERS HEATING CO STACK	90 42 34.5	4.132 244	13,559.5
SAGINAW CONSUMERS POWER CO S STACK	118 12 27.5	4.123 975	13,303.8
SAGINAW CONSUMERS POWER CO N STACK	118 46 48.3	4.123 992	13,304.3
BAY CITY CLEMENTS AIRPORT BEACON	143 24 12.4	4.213 301	16,341.8
BAY CITY ST STANISLAUS CH S STEEPLE	151 58 13.7	4.279 991	19,054.2
MUNGER MERRITT LUTHERAN CHURCH	174 18 59	4.017 552	10,412.4
AZIMUTH MARK	271 40 44		
PTS NO 13 USGS	350 20 52.5	3.746 380	5,576.7

USCOMM—ESSA—ASHEVILLE

of how to find the station, and a recovery note updating the former description. Several comments about the data itself: Note that coordinates are given for two separate projections, a Lambert system and a Transverse Mercator system. As I pointed out earlier, the M.S.P.C.S. is a Lambert system, and a handy way to distinguish the difference is that the "x" value for the Lambert system is always over 2 million while it never exceeds one million in the Transverse Mercator system. Also note that the geodetic azimuths are referenced from south and that the geodetic azimuth differs from the plane azimuth by the convergence or the delta alpha angle. When you recover a triangulation station, be sure to send N.G.S. a recovery note indicating the conditions as you found them. It provides them with user information and alerts them of the marks which have been destroyed.

After we obtained the requisite data, we made reconnaisance trips to recover the stations and to plan the control traverse route. We tried to maximize corridor coverage while minimizing the traverse distance between triangulation stations. In many cases we were able to use section corners for traverse points and we were careful to witness all of our traverse points to facilitate future use. This extra effort paid off handsomely as we had to return to the traverse repeatedly, often months apart. The best control is useless if you can't find it.

For measuring the angles we used T-2 theodolites, measuring each angle three times direct and reverse on the control traverse and two times direct and reverse on section loops. Care in turning the angles paid off as the angles from "Avoca" to "Capac" closed 22 seconds in 43 stations and the segment from "Capac" to "Law" closed in one second. Hardly typical, but one of our better efforts.

We measured the distances with a Wild DI-10 Distomat. It mounts directly on the theodolite and we have been pleased with the results and dependability of our units. Like one who surveys using a short chain, we can get fantastic loop closures, but we were really gratified when we were able to get such decent closures between triangulation stations. We are confident that by monitoring our equipment and procedures more closely, we could consistently run traverses with closures better than 1/50,000.

The Michigan Coordinate System Law stipulates in Section 6 that "No coordinates based on the Michigan Coordinate system purporting to define the position of a point or a land boundary, shall be presented to be recorded in any public land records or deed records unless such point is within one-half mile of a triangulation or traverse station established in conformity with the standards prescribed in Section 5 of this act." Section 5 specifies the standards as being those conforming to those adopted by the U.S. Coast and Geodetic Survey for first and second order geodetic surveys. In February, 1974, the Federal Geodetic Control Committee published, "Classification, Standards of Accuracy and General Specifications of Geodetic Control Surveys". Figure 3, Page 13, shows a copy of the specifications pertaining to traverses.

In computing control traverses on a state plane system, one must multiply the measured distances by an appropriate scale factor to reduce the distance measured on the curved surface to its equivalent length on the plane projection. We used the scale factor on a section by section basis. This allowed us to systemize its use and yet keep the correction several times more accurate than our closures. We scaled the latitude of the center of each section we crossed on the Geodetic Control Diagram to the nearest one-half minute. We then got the corresponding scale factor from the "Plane Coordinate Projection Tables". It worked very well for the computations and our field personnel adapted very quickly to using it in the field.

FIGURE 3

TRAVERSE

Classification	*First-Order*	*Second-Order* Class I	*Second-Order* Class II	*Third-Order* Class I	*Third-Order* Class II
Recommended spacing of principal stations	Network stations 10-15 km Other surveys seldom less than 3 km.	Principal stations seldom less than 4 km except in metropolitan area surveys where the limitation is 0.3 km.	Principal stations seldom less than 2 km except in metropolitan area surveys where the limitation is 0.2 km.	Seldom less than 0.1 km in tertiary surveys in metropolitan area surveys. As required for other surveys.	
Horizontal directions or angles (2)					
Instrument	0".2	0".2 or 1".0	0".2 or 1".0	1".0	1".0
Number of observations	16	8 or 12*	6 or 8*	4	2
Rejection limit from mean	4"	4" or 5"	4" or 5"	5"	5"
Length measurements		* May be reduced to 8 and 4, respectively, in metropolitan areas.			
Standard error (1)	1 part in 600,000	1 part in 300,000	1 part in 120,000	1 part in 60,000	1 part in 30,000
Reciprocal vertical angle observations (4)					
Number of and spread between observations	3 D/R—10"	3 D/R—10"	2 D/R—10"	2 D/R—10"	2 D/R—20"
Number of stations between known elevations	4-6	6-8	8-10	10-15	15-20
Astro azimuths					
Number of courses between azimuth checks (7)	5-6	10-12	15-20	20-25	30-40
No. of obs night	16	16	12	8	4
No. of nights	2	2	1	1	1
Standard error	0".45	0".45	1".5	3".0	8".0
Azimuth closure at azimuth check point not to exceed (8)	1".0 per station or 2" $\sqrt{N}$	1".5 per station or 3" $\sqrt{N}$. Metropolitan area surveys seldom to exceed 2".0 per station or 3" $\sqrt{N}$	2".0 per station or 6" $\sqrt{N}$. Metropolitan area surveys seldom to exceed 4".0 per station or 8"$\sqrt{N}$	3".0 per station or 10" $\sqrt{N}$. Metropolitan area surveys seldom to exceed 6" per station or 15" $\sqrt{N}$	8" per station or 30" $\sqrt{N}$
Position closure (5)(8) after azimuth adjustment	0.04m $\sqrt{K}$ or 1:100,000	0.08 $\sqrt{K}$ or 1:50,000	0.2m$\sqrt{K}$ or 1:20,000	0.4m $\sqrt{K}$ or 1:10,000	0.8m $\sqrt{K}$ or 1:5,000

Conclusions

I have welcomed this opportunity to speak to the M.S.R.L.S. about a tool which I feel has been underutilized by surveyors, engineers, planners, assessors, etc. I hope this exposure to the M.S.P.C.S. will foster continued discussions on its merits and applications. In areas where it is monumented, I would hope that more surveyors avail themselves of the benefits of using the M.S.P.C.S.

Lastly, I feel that we should request the State Legislature to appropriate funds for monumenting and maintaining the M.S.P.C.S. statewide.

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6. Merkel, Donald E., "A Program in Corner Recovery", Proceedings of A.C.S.M. Spring 1974 Convention

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9. Kiedrowski, Anthony B., "The County Surveyor Office - A Rebirth", Proceedings of A.C.S.M. Spring 1974 Convention

10. Dracup, Joseph F., "A Small Beginning Directed a Big Need: Multipurpose Integrated Survey Systems", Proceedings of A.C.S.M. Fall 1974 Convention

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APPENDIX A

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Roy O. Williamson, pp 88-109

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Fall 1971

"Practical Uses of Coordinates - or Control Surveys in Operation"
Pliney Gale, pp 45-59

Spring 1972

"Benefits to Planners from State Geodetic Surveys"
Wilber C. Fuller, pp 227-229

"Mark Maintenance and State Cooperation"
Alton K. Hansen, pp 344-350

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John E. McIntosh, pp 311-315

"The Role of the Surveyor Confronted with the Problems of Megalopolis"
Albert A. Miland, pp 428-436

"Perpetuation of Public Land Surveys in Alabama"
Clurin Battle Reed, Jr., pp 36-42

"Remonumentation - Needed an Approach"
Walter G. Robillard, pp 61-64

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"Better Land Records Through Uses of Graphic Data Banks"
Arun P. Bhagwat, pp 57-65

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"Control Surveys ITT - Community Development Corporation"
Melvin Kleeger, pp 188-196

"Subdivision Lay-out by Geodetic Control and Plane Coordinates"
Calvin W. Rice, pp 154-159

"Control Surveying - An Engineering and Data Base for Utilities"
Edwin H. Schmidt, pp 164-175

Spring 1974

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Anthony B. Kiedrowski, pp 326-328

"Second Order Horizontal Control for New Mexico Land Grants"
Harold Welch and Richard L. Koogle, pp 334-360

"A unitized Land Survey Information System for the State of Missouri"
Robert E. Myers, pp 490-509

"How Electronic Distance Measuring Revolutionized Surveying Methods of San Diego County"
Phillip S. Barker, pp 597-601

Fall 1974

"A Small Beginning directed at a Big Need: Multipurpose Integrated Survey Systems"
Joseph F. Dracup, pp 202-220

APPENDIX B

Tabulation of Questionaire Replys

Are you a Registered Land Surveyor in Michigan? 100%
Other states? 20%

Are you employed in private practice? 84%
Government? 8% Other? 10%

Are you a member of MSRLS? 100% ACSM 39% Other 25%

How often do you use the Michigan Coordinate System?
Always 1% Generally 1% Sometimes 21% Never 77%

Would you use the Michigan Coordinate System if it were readily accessible in your area of practice? Yes 74%

How far would you be willing to go to tie your surveys to the Michigan State Plane Coordinate System?
2-4 miles 8% 1-2 miles 38% ½-1 miles 34% 0-½ miles 13%

Do you have and/or know where to get information on using the Michigan State Plane Coordinate System? Yes 45%

Total M.S.R.L.S. members responding by Jan. 28,1975 20%

APPENDIX C

Ordering Information

"State Plane Coordinates by Automatic Data Processing"
ESSA, Coast & Geodetic Survey, Publication 62-4 45¢ ea.

"Plane Coordinate Projection Tables, Michigan (Lambert)
Coast & Geodetic Survey, Publication 65-3 25¢ ea.

Order the above from: Superintendent of Documents
U.S. Government Printing Office
Washington, D.C. 20402

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