Control and Adjustments of Construction Schedule

M. J. WALKER

Commissioner John C. Mackie, soon after taking office in 1957, outlined a dynamic and progressive five-year construction program, which would give Michigan 2,900 miles of new or reconstructed highways, and included 905 miles of new expressways connecting all major cities of 50,000 population or over. This 905 miles, in turn, included construction of 580 miles on the Interstate System, and 325 miles of other arterial 4-lane, divided routes, and provides for the surfacing of all remaining 800 miles of gravel roads existing on Michigan trunklines. Since July 1957, 296 miles of divided highways have been awarded and opened to traffic, and 251 miles of divided highways are now under construction. There have been 634 miles of gravel trunklines hard surfaced.

The estimated cost of this five year program is 1 billion 250 million dollars, to be financed by $505 million in Federal aid, $330 million in State funds, and $415 million in bonds.

This complete program was made public, with letting dates on each project, in advance, and schedules with target dates were set up for each division to meet in order that the entire schedules for the divisions could meet the predetermined letting dates.

It was evident, with such an enormous program in view, that the divisions and district engineers would have to be aware of target dates they would have to meet in their respective areas of work, in order to meet the letting dates made public on each project.

It also seemed desirable that some central system of reporting to top management, in view of the tremendous responsibility involved in a program of this size, was desirable. It was felt that a central reporting procedure would eliminate many engineering manhours at top levels in the searching out and putting together information from the various divisions. It also was felt that such a system could stop many delays before they materialized. The section that seemed most desirable to initiate this procedure was "records and reports," as all of the basic information on the trunkline system was already there; and much of the information that would be needed was already available. The section was expanded, and the new area of work incorporated was called "program performance."

The first step was preparing simple bar charts, by districts, on every project; showing the work schedules and target dates necessary for each division and section to meet, in order to award the project on the date already made public. These charts were distributed to the district engineers, division heads and top management. (A sample of this bar chart is shown in Figure 1.) By acquainting the various divisions of the target dates necessary for them to complete their phase of the work, it indicated to them where their work pattern would fit in the over-all picture, and made the division head aware that if a project was falling behind in his phase of the work he must take some steps to bring the work back on schedule. By acquainting the district engineers for construction, bridge, soils, traffic, and right-of-way of the scheduled pattern, it permitted them to review these projects as they pertained to the different phases of the work well in advance of even the survey stage, with the thought that anything that came to their attention in this review that might cause delays in the progress in the division's phase of the project could be brought to the attention of the division head in Lansing for review well in advance of their entry of their phase of the work on the project schedule. It also permitted the district engineers to estimate their manpower requirements for each quarter of each year's program well in advance, so that the central personnel of-

DISTRICT 7

WORK SCHEDULE

PROGRAM

FORM 2214

CONTROL SECTION NO 11014 & 11015

PROJECT NO

COUNTY Berrien

LENGTH 24.0

EST COST 12,000,000

DESCRIPTION US-12 Relocation Indiana State Line N. to Stevensville

TYPE Grading, Surfacing and Structures

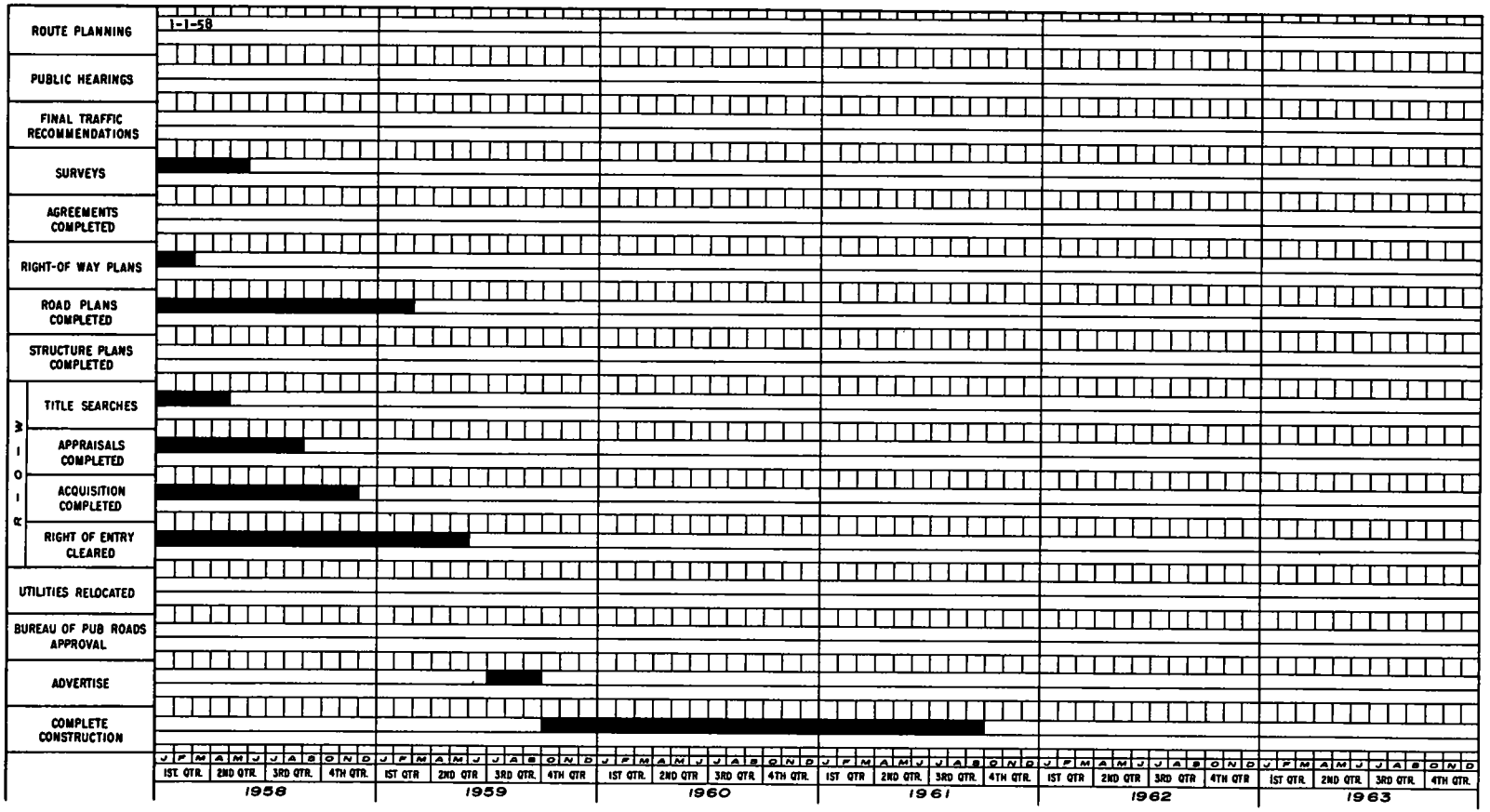


Figure 1. Work schedules.

fice might formulate necessary training programs and recruitment programs to meet these personnel requirements. It permitted the district engineers to have available information for the public within their various districts on the entire five-year program. It fixed responsibility of each division on the schedule that they would have to meet on each project to coordinate with the other divisions in the completion of each project on predetermined schedule.

The next step was to contact the various divisions for the correlating of reports from every division to flow into the central reporting section, giving current information on the status of every project in this five-year program. This was accomplished by utilizing divisional internal forms, and in some cases, designing new forms for them to use, or recommending slight changes in forms they were already using.

The third step was the development of a program performance chart, giving information on every project from the selection of the corridor, to the final disposal of any excess property which would have to be acquired in connection with the purchase of right-of-way. Figure 2 shows this form which carries approximately 70 items involved in the construction of all major projects. It is felt that although this is a transferral of information from each section of the department, that eventually it will give us valuable information for an analysis sheet to eliminate bottlenecks where undue lengths of time seem to be involved in the completion of certain phases of the project. It will furnish the department with a complete record on every project that is constructed in the future in one place, on one sheet. From this analysis, the future programing and planning sections will have substantial, realistic data on which to base their schedules, finances, and manpower requirements. In the course of this activity, we found that the Highway Department had accumulated, over the years, over $15 million worth of excess property, and very little effort had been made to dispose of this property. A plan has been inaugurated to sell this property by the auction method, and already this has restored over $2 million in excess property to the local tax rolls, and the money has been made available for highway construction. Written procedures were developed in the disposal of this property.

The fourth step was to prepare program route reports on all Interstate and arterial highways (developed from information flowing

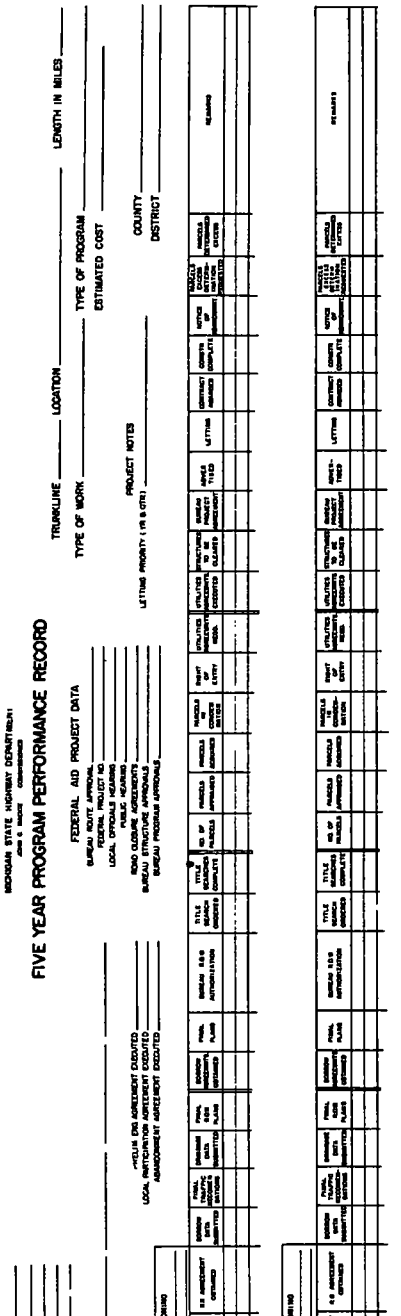


Figure 2. Construction program performance control chart.

CONSTRUCTION STATUS

Interstate Route #94
International Bridge At Port Huron To Indiana State Line
Including Edsel Ford Expressway, Detroit, Industrial Expressway & US-12

October 1, 1960

Center of International Bridge W. to M-146 (St. Clair Co.)	1.999	Open
M-146 (St. Clair Co.) S. to Griswold Rd. (St. Clair Co.)	2.600	Plotting Rd. Plan Stage
Griswold Rd. (St. Clair Co.) S. to Hessen Road	15.400	R.O.W. Title Search Stage
Hessen Rd. (St. Clair Co.) S.W. to Macomb-St. Clair Co. Line	5.800*	R.O.W. Appraisal Stage
N. Macomb Co. Line S. to M-29 (Macomb Co.)	6.200*	R.O.W. Acquisition Stage
M-29 (Macomb Co.) S. to Cotton Rd. (Macomb Co.)	0.750	R.O.W. Acquisition Stage
Cotton Rd. (Macomb Co.) S. to Joy Rd. (Macomb Co.)	3.100	R.O.W. Appraisal Stage
Joy Rd. (Macomb Co.) S. to Shook Rd. (Macomb Co.)	4.715	R.O.W. Appraisal Stage
Shook Rd. (Macomb Co.) S. to 12½ Mile Rd. (Macomb Co.)	4.491	R.O.W. Appraisal Stage
12½ Mile Rd. (Macomb Co.) S. to 8 Mile Rd. (Wayne-Macomb)	4.694	R.O.W. Acquisition Stage
8 Mile Rd. (Wayne Co.) S. to Ridgemont Rd. (Wayne Co.)	0.100*	Under Contract
Ridgemont Rd. (Wayne Co.) S. to Vernier (Wayne Co.)	0.212	Under Contract
Vernier Hwy. (Wayne Co.) W. to E. of Barrett (Detroit)	4.953	Open
E. of Barrett (Detroit) S.W. to M-14 (Washtenaw Co.)	49.244	Open
M-14 (Washtenaw Co.) W. to W. of Baker Rd. (Washtenaw Co.)	5.176	Under Contract
W. of Baker Rd. W. to Fletcher Rd. (Washtenaw Co.)	4.978	Under Contract
Fletcher Rd. W. to Jackson-Washtenaw County Line	7.815	Under Contract
E. Jackson Co. Line W. to US-12 BR (Jackson Co.)	9.873	Under Contract
US-12 BR (Jackson Co.) W. to E. of M-99 (Jackson Co.)	19.634	Open
E. of M-99 (Jackson Co.) W. to Jackson-Calhoun Co. Line	1.167	Open
E. Calhoun Co. Line W. to E. of Wheatfield (Calhoun Co.)	19.197	Open
E. of Wheatfield (Calhoun Co.) W. to Kalamazoo-Calhoun Co. Line	12.216	Open

E. Kalamazoo Co. Line SW to Van Buren-Kalamazoo Co. Line	25.054	Open
E. Van Buren Co. Line W. to M-119 (Van Buren Co.)	6.566	Open
M-119 (Van Buren Co.) W. to Hartford Rd. (Van Buren Co.)	14.514	Open
Hartford Rd. (Van Buren Co.) W. to Berrien-Van Buren Co. Line	2.947	Open
E. Berrien Co. Line S.W. to Hicks Rd. (Berrien Co.)	7.627	Open
Hicks Rd. (Berrien Co.) S.W. to Ridge Rd. (Berrien Co.)	12.292	Under Contract
Ridge Rd. (Berrien Co.) S.W. to Snow Rd. (Berrien Co.)	7.984	Under Contract
Snow Rd. (Berrien Co.) W. to S. of Easy St. (Berrien Co.)	6.789	Under Contract
S. of Easy St. (Berrien Co.) S.W. to M-60 & US-112 (Berrien Co.)	5.025	Under Contract
M-60 & US-112 W. to Indiana-Michigan State Line	3.107	R.O.W. Acquisition Stage
TOTAL MILES	276.219	

* Estimated Mileage

Open	165.118
Under Contract	60.244
R.O.W. Acquisition Stage	19.242
R.O.W. Appraisal Stage	13.615
R.O.W. Title Search Stage	15.400
Plotting Rd. Plan Stage	2.600
TOTAL MILES	276.219

Figure 3a. Route reports—Interstate and arterial systems.

into the central reporting section from the various divisions) to give top management a comprehensive picture of each project on Interstate and arterial highways covered, pointing out the project which starts falling behind the original scheduled completion dates for different phases of the work. This allows management a clear picture of where certain projects might be getting into trouble so that they can take whatever steps are necessary to bring them back on schedule. At present there are 23 Interstate and arterial route reports in progress, and these route reports are brought up-to-date monthly for management. Combined with these route reports are a quick reference, visual strip map, giving the date of the future letting on each project and the phase of work being done on the project—either surveys, design or the various steps in the acquisition of right-of-way. These reports are also kept up-to-date for top management

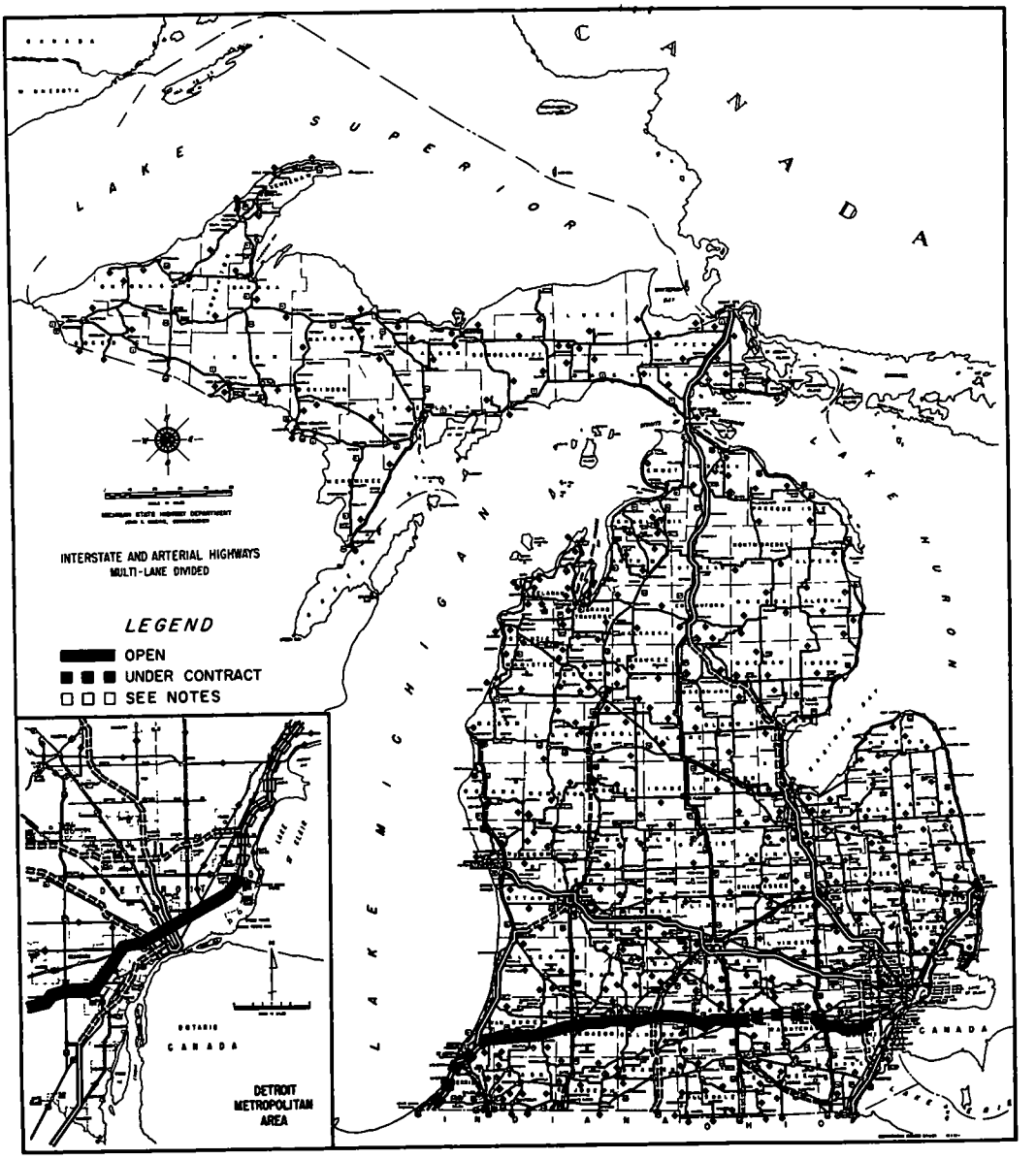
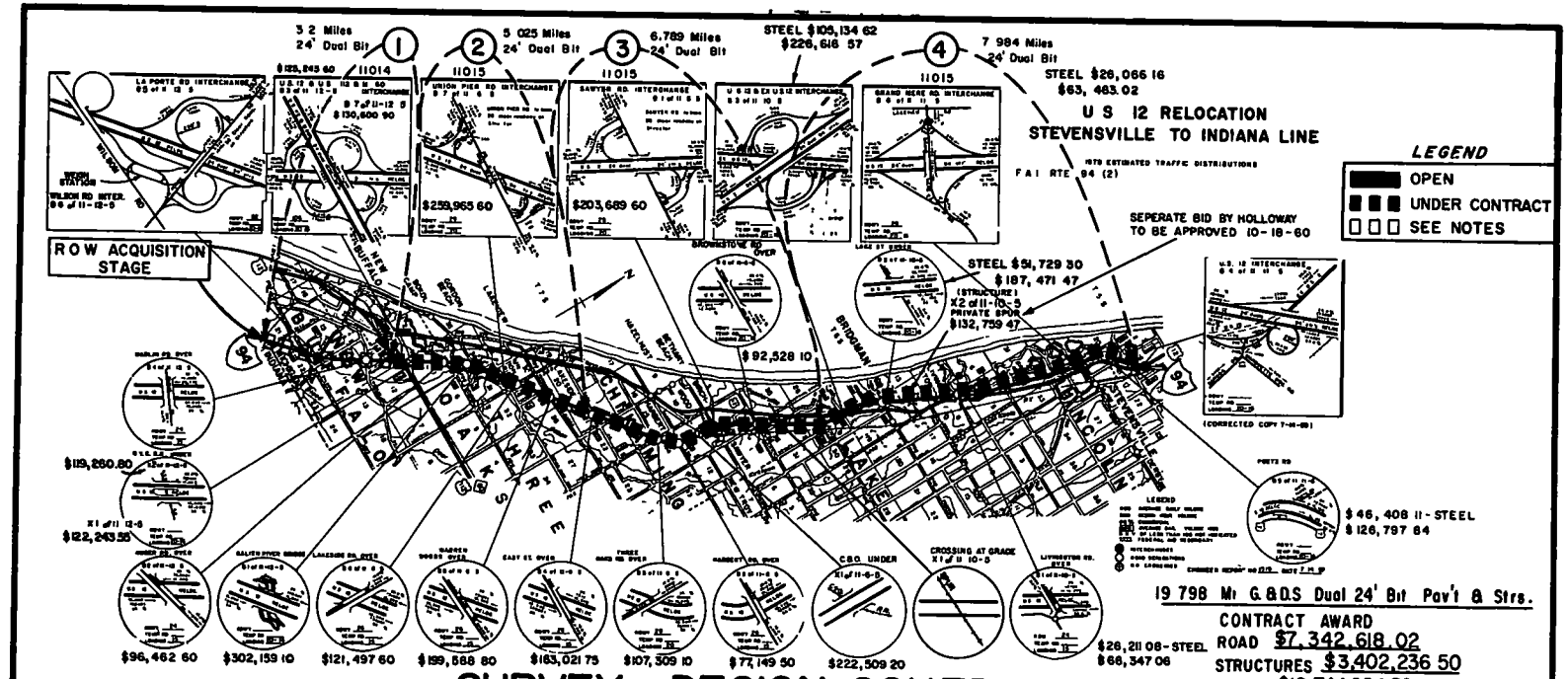


Figure 3b. Route map—Interstate and arterial systems.



SURVEY - DESIGN SCHEDULES

5 YEAR PROGRAM SCHEDULE DATES									ACTUAL DATES - SURVEY COMPLETED OR PLANS SUBMITTED							
SECTION	ENG. REP	SURVEY	PLOTTED PL. to R/W	G I & PREL R/W	FINAL R/W	LETTING QUARTER	RESCHEDULED	LOCATION DESCRIPTION	ENG REP	SURVEY	PLOTTED PL. to R/W	G I & PREL R/W	FINAL R/W	LET	COMBINED COST OF ROAD & STR'S	
①	1-1-58	6-1-58			9-1-58	3rd 59	2nd 62	State Line To M-60 & US-12	2-5-58	* 6-58	10-23-58		12-5-58 1-8-59			
②	1-1-58	6-1-58			9-1-58	3rd 59	4-6-60	M-60 & US-12 N To S of Easy St	2-5-58	* 6-58	10-15-58		11-10-58 1-6-59	4-6-60	$3,895,428,97	GARAVAGLIA
③	1-1-58	6-1-58			9-1-58	3rd 59	2-17-60	S of Easy St To Snow Road	2-5-58		5-16-58		7-31-58 10-3-58	2-17-60	$3,040,287 70	CANONIE & STUKEY
④	1-1-58	6-1-58			9-1-58	3rd 59	4-27-60	Snow Road To Ridge Road	2-5-58		5-21-58		8-21-58	4-27-60	$3,676,378.38	HOLLOWAY
														10-18-60 X2 of 11-10-60	$132,759 47	HOLLOWAY

Figure 3c. Strip maps—Interstate and arterial systems.

STATUS OF CONSTRUCTION PROGRAM SCHEDULE

BY PROGRESS OF COMPLETION

Form 2221

DATE OF REPORT October 1, 1960

ROUTE Interstate Route 94

DESCRIPTION International Bridge at Port Huron to Indiana State Line
Edsel Ford Expressway & Detroit Industrial Expressway & US-12

PROJECT DESCRIPTION	ROUTE PLANNING		SURVEYS		R O W PLANS		ROAD PLANS		TITLE SEARCH		APPRAISALS		ACQUISITION		RIGHT OF ENTRY		LETTING SCHEDULE	REMARKS
	Sched Date	Comp'l or %	Sched Date	Comp'l or %	Sched Date	Comp'l or %	Sched Date	Comp'l or %	Sched Date	Comp'l or %	Sched Date	Comp'l or %	Sched Date	Comp'l or %	Sched Date	Comp'l or %		
9 Mile Rd. to 8 Mile Rd.	completed		completed		completed		8-15-61	finals 15	completed			1/	12-1-60	2/			5-21-61	1/ 143 of 162 appraised 2/ 143 of 162 optioned 134 bldgs. in ROW
50111																		
	B12 of 50-7-4		9 Mile Rd----------					-plotting 50%										
	B13 of 50-7-4		9 Mile Rd----------					-assigned										
	B14 of 50-7-4		Shady Lane Rd----------					-plotting 50%										
WAYNE COUNTY																		
Haggerty Rd. Interchange	completed		completed		11-1-60		5-15-62	plott'g 100									2nd 62	
82021																		
	B4 of 82-21-6		Over Tot. Rte. 94----------															
	B1 of 82-21-28		Over Tot. Belleville Lake------															
WASHTENAW COUNTY																		
Interchange @ US-23																	2-22-61	
81062	B3 of 81-11-27		AA S. Belt----------					-finals 35% - separate contract			1-61							
Rawsonville Rd Interchange	completed		completed		completed		8-15-61	finals 20		90	1-2-61		4-2-61				8-2-61	
81041																		
	B4 of 81-20-13		Rawsonville Rd Reloc.----------					-assigned										
BERRIEN COUNTY																		
State Line to M-60 & US-112	completed		completed		completed		4-13-60	finals 90 *	completed		completed		3-1-60	1/ *			2nd 62	1/ 42 of 78 optioned 36 unsecured H/N 4-28-60 R/E 6-20-60 30 bldgs. in ROW
11014																		
	B4 of 11-12-5		Madlin Rd----------					-finals 100%										
	B5 of 11-12-5		LaPorte Rd----------					-finals 95%										
	B6 of 11-12-5		Wilson Rd----------					-finals 100%										

Figure 3d. Divisional status—Interstate and arterial systems.

BERRIEN COUNTY #11

STATUS OF CONSTRUCTION BY COUNTY

COMPLETED

US-112 & M-60---In Three Oaks & West

Project No:	M 11021 C1R & C2U
Type.	Concrete Patching & Bituminous Concrete Surfacing
Miles.	0.350
Date·	November 14, 1957
Award Amt·	$23,118.60

M-140 Rel.---Intersection US-12 in Watervliet and West and North to North County Line

Project No:	F 11071 C1R & C2U
Type:	G&DS, Concrete Widen & Concrete Surfacing
Miles:	5.080
Date:	October 21, 1958
Award Amt	$164,386.22

M-140 Old---North Limits Watervliet North, West and North to County Line

Project No:	M 11072 C3R
Type.	Bituminous Concrete Resurfacing
Miles	4.451
Date·	October 21, 1958
Award Amt:	$59,125.00

Structures Completed in Control Section No. 11016

5 @	$664,666.80

Structures Completed in Control Section No. 11017

6 @	$909,018.95

Structures Completed in Control Section No. 11018

2 @	$295,242.31

UNDER CONTRACT

US-12---Colome Park Road

Project No·	BM 11017 C4RN
Type·	G&DS, Aggregate Base, Bituminous Concrete Surfacing
Miles	0.212
Awarded.	September 9, 1958
Sched. Comp·	July 31, 1960
Award Amt·	$15,003.63

M-140 Existing---US-31 & US-33 North to Existing M-62

Project No:	M 11074 C1R
Type·	G&DS, Bituminous Aggregate Surfacing
Miles:	9.457
Awarded:	March 15, 1960
Sched. Comp:	October 30, 1960
Award Amt·	$249,256.40

Structures Under Contract in Control Section No. 11015

28 @	$4,293,539.11

Structures Under Contract in Control Section No. 11016

8 @	$2,050,209.76

Structures Under Contract in Control Section No. 11017

1 @	$ 91,046.00

PROGRAMED FOR LETTING OR LET

US-12---In New Buffalo & North to M-60

Project No:	M 11011
Type	Bituminous Resurface
Miles·	1.000
Let	March 1, 1960 (held)
Engr. Est:	$16,000.00

US-12 BR Rel.---(M-139) Fair Avenue East to I-94

Project No·	EBBF 11081 C5R & C6R
Type.	G&DS, 2@24' Concrete Roadways
Miles	2.300
Letting:	November 16, 1960
Engr. Est·	$650,000.00

US-31 & US-33---Whittlesey Road to Lane Drive in St. Joseph

Project No:	M 11052 C1U
Type	G&DS, Concrete Surface
Miles	0.247
Let·	September 21, 1960
Low Bid·	$116,200.50

I-94 (US-12 Rel.)---Indiana State Line Northeast

Project No·	BI 11014
Type·	G&DS, 2@24' Concrete Roadways & Structures
Miles:	3.107
Letting·	2nd Quarter 1962
Engr. Est:	$1,670,000.00

Figure 4. County status of projects.

STATUS OF PROJECTS FOR LETTING

Revised 10-14-60

2nd Qtr. 1962

M 05012
(1-59)

US-31 Eastport to Atwood

GI Held
R.O.W. - none required
Final plans - prelims 100%

BI 11014 C RN
BI B4, 5 & 6 of 11-12-5
(3-59)

I-94 (US-12 Rel.) Indiana State Line N. to M-60 & US-112 and Weigh Station & Rest Area

Engr. Report 1519 submitted to BPR 7-10-58
Abandonment Agreement - prepared
GI Held
R.O.W. - title search - 78
appraised - 78
optioned - 42
unsecured - 36 H/N 4-28-60 - R/E 6-20-60
pcls. w/bldgs. - 30
Final plans - 90%
Structure plans - BI B4 of 11-12-5 finals 100% BPR App'd
BI B5 of 11-12-5 finals 95% BPR App'd
BI B6 of 11-12-5 finals 100% BPR App'd
R.R. Agreement - none required
Utilities Advance Meeting Notice - submitted 1-12-59
Not Programed

BI 17033
BI B3 of 17-4-6
(3-61)

I-75 (US-2 Rel.) Dafter Road N. to Charlotte River

Public Hearing - scheduled 7-14-60
Engr. Report 1505 S Approved 5-58
Survey - completed 6-2-59 add'l survey completed 6-14-60
GI Held 10-6-59
R.O.W. - prelims rec'd 7-13-59
title search - ordered
Final plans - plotted 100%
Structure plans - assigned
R.R. Agreement - none required
Not programed

BI 17034
BI B1 & 2 of 17-4-6
(3-61)

I-75 (US-12 Rel.) Charlotte River N. to S. Limits of Soo

Public Hearing - scheduled 7-14-60
Engr. Report 1498 S Approved 3-58 (line change)
Survey - completed 6-14-60 - add'l survey 100%
GI required
R.O.W. - see FAS 231 N. to Easterday St.
Final plans - plotted 100%
Structure plans - BI B1 of 17-4-6 assigned
BI B2 of 17-4-6 assigned
R.R. Agreement - none required
Not programed

Figure 5. Status of projects for letting.

each month. Figures 3a-3d show samples of these strip maps, and reports. Dots indicate to management the phase of the project which is falling behind in schedule.

It became apparent, when the Commissioner and management who had to meet with

the public and county officials, and also public relations for county press releases, that it was desirable to have reports giving the complete data on every project by counties. These were developed, giving a full picture in each county of every project included in the five-year program, giving type of construction, length of project, location of project, and either the engineer's estimates, or in the case the projects had been let, the contract award amount, and the complete schedule on all projects and other pertinent data relating to each project. These county reports are kept up-to-date weekly, and any supplements to the five-year program are inserted (Fig. 4).

Ninety days before a letting, weekly reports are given to top management on the right-of-way acquisition situation, as that has been one of our problems causing some delay in letting projects on schedule in the past. This permits management to take necessary steps to, wherever possible, give these projects that are behind schedule special attention to facilitate an increase in acquisition of right-of-way involved (Fig. 5). This central reporting section, due to the current information available on all projects, receives many requests each day from divisions and others concerning the status of projects within the five-year program, and it also supplies the Bureau of Public Roads with copies of these route reports.

Additional duties of this section include information on various types of highway road and bridge construction; maintenance data on Michigan State highway system for maintenance budgets; written and map data for legal establishment and abandonment of State trunklines and for the relinquishment of service roads; designation and control of departmental chargeability of highway engineering, right-of-way acquisition, construction, maintenance and related activities by control sections; various types of records, statistics, and logs on each control section and various reports on State, Federal and county road systems; departmental reports to the Governor, Legislature, Bureau of Public Roads, U.S. Congressmen, and other agencies; data for highway needs, and finance studies; the legal historical and current status of the trunkline system revision; and presentation data for highway maps, trucker maps, construction program maps, etc. The section prepares reports and special assignments for division heads, Deputy Commissioner, Managing Director, and the Highway Commissioner.

The financial projection of future income and expenditures used by the Michigan State Highway Department is fully covered in a paper presented by Alfred H. Lawrence, at the October meeting of the AASHO.

Although the central records and reporting section has been in operation for over a year, and has contributed much to management, there have been some projects that have not been able to meet the scheduled letting dates through unforeseen difficulties. However, these have been very much in the minority, and very few have been delayed over one or two months from the original schedules. Most delays in meeting schedules have been caused in acquisition of rights-of-way.

In the fiscal year 1959-60, we had approximately 1,500 condemnation cases, and each one of these cases generally took about 90 days before right of entry was secured. This has created some delay in letting projects. We have been able to advertise projects where all right-of-way has not been secured, and all buildings have not been removed, by inserting a clause making the contractor aware of these situations so that no claims would be made against the department for delays. We are, however, holding the divisions to the previous schedules, and are making every effort to eliminate delays in advertising projects on schedule.

Central reporting can only be successful with the full cooperation between top management, the divisions, and the districts as well.

Discussion

Granum.—This is one element in carrying out a systematic programing procedure.

Near the beginning of Walker's paper there is a classic understatement to the effect that, "It also seemed desirable that some central system of reporting to top management," and so forth. This seems so essential (in fact the whole subject of our meeting

for these two days seems so essential) that we can ask, "Well, why hasn't this been done before in a comprehensive way?"

I am sure that every State has pieces of it, but I believe it is the comprehensive approach—from beginning to end—that we are trying to resolve today.

A good deal of what Walker has presented is somewhat like the telephone company's presentation. But I notice that there are some things missing—money, for example. And in Bidell's paper we have indicated the importance of money in these operations.

Babcock.—Walker, how large a staff do you have doing this work?

Walker.—On the program performance staff, we have about six people. We found that setting it up required quite a staff, but keeping it up does not require anywhere near the staff.

Most of that work is done at the lower levels. There is no way of knowing how many manhours of top level time are saved.

Another advantage that we find is that, in having this material flowing in on a current basis, we have at our fingertips many, many answers that could not be gotten together formerly in a month's time.

Babcock.—In other words, this section is fundamentally just a reporting section to management, which tries to unscramble something that is not going right?

Walker.—That is right—in the program performance area, it is.

Granum.—What do you do about the advance planning such as area, regional, corridor and city general route location studies? Is that scheduled, as well as the more detailed location studies, design, etc.?

Walker.—Yes, that is handled by planning. All of that has been done, and we expect to announce another five-year program that will be scheduled by the pre-construction engineering operations in the same way. That will be publicly announced before the first of the year.

Of course, our programs will drop. This year we hope to hit, in actual awards, around $245 million. When engineering is included, it goes up to $325 million. The next five-year program will have rather a uniform program of $140 million a year, including right-of-way and engineering.

Granum.—Is the broad-gauged advance planning, such as might involve an origin-destination study of an urban area, set into these advance schedules, with a completion date, etc.?

Walker.—Yes.

Aitken.—You referred to your major sources of money. Now, since this was made in 1957, it was before the Federal-aid trust fund was in trouble. I assume that the money from your bonds gave you enough latitude so that you could stay within your schedule. All you did was shift the source of financing. You did not have to delay projects?

Walker.—That is right. Michigan's loss, I think, was about $25 million a year. But by selling bonds we stayed on schedule.

Aitken.—That is one thing that gives us a great deal of trouble in the District of Columbia. We do not have bonds. And we are better than a year behind in terms of availability of Interstate money apportioned to the District. So it is a difficult problem.

Granum.—Aitken, you are behind on your money. Does that mean you are now a year ahead on plans?

Aitken.—We have plans more than a year ahead. We had the District funds to match, but we cannot get the Federal money. And with 90 percent coming from the Interstate fund, this is serious. This delay is hurting the program in the District, because we cannot get sections of freeway finished and in service.

Walker.—Has any other State set up a reporting and control system?

Granum. — Ontario certainly has. Bidell has just described it, generally. But what about others? Does anybody want to volunteer?

Buswell. — We have a pegboard on which we keep a record of every project, and we pull out a tape to show what the status is. It is similar to what you have here, and yet different.

Legarra. — I do not know if we follow the central control in the same manner Walker does. We do have some of the various controls that have been described here, possibly handled in a somewhat different manner. Schedules of a particular project are maintained — insofar as design is concerned, right-of-way acquisition, etc. That is prepared in every district, on a monthly basis, and, submitted to headquarters where it is used as a control.

But we do not have one single control agency that accumulates all these data in one report. On the other hand, we have other types of controls, such as Federal-aid control, so that top management will be able to tell where we are insofar as Federal-aid is concerned. That is prepared by another group in headquarters. I assume that Walker's central agency does all of that.

Granum. — Except for money, I gather, which surprises me. Mr. Walker does not seem to deal with money problems at all.

Walker. — No.

Legarra. — Essentially, California has all the controls, but possibly in a little different manner from what has been described. I believe we cover the same information.

W. Johnson. — Kansas has a few individual controls, but nothing nearly so complex.

Babcock. — We have a master control board that I keep up-to-date. We usually know where the projects are. I have been interested in both of these papers. I already have some revisions in mind, based on them.

Donnell. — We really had not planned on quite as comprehensive a set-up as Walker has, but I can see its advantage.

We have been asked to set up a procedure whereby the Commissioner or chief engineer at any time can find out, with a telephone call, the status of any project, or within a short time would be given an IBM listing of the status of the whole program.

Hart. — We do not get as specific as Michigan does in setting up these individual time schedules for the various pre-construction operations. We are operating now on a letting date procedure, and more or less permitting the individual districts to work out this schedule up to the letting date.

We are hoping to move back into this pre-construction period, getting more headquarter's control of the individual sections of the pre-engineering; but we have not got it now. We are working on only the basis of a letting date schedule, and the individual things take care of themselves through the individual sections.

Granum. — Why are there only 23 of these progress route reports? You have a lot more projects than that in Michigan, haven't you?

Walker. — Well, these route reports are confined to the arterial and the Interstate System, because we have concentrated on Interstate.

On other projects, we have control through another report that has been kept up monthly a year in advance, and weekly when you get down close to the wire, similar to our 90-day report on right-of-way, that gives the status of all of those projects as we go along.

Granum. — Obviously a construction schedule and a pre-construction engineering schedule, time-based and money-based, is no good unless it is not only kept up-to-date, but revised in accordance with the situation as it develops. In other words, there is a feed-back problem which should affect both the availability of money, and the time and personnel problem.

I would like to hear some thoughts on that subject, because I think this is one of the

areas where programs and scheduling fall down. We start out in a big way, we have everything down in black and white, and the next thing you know, six months later it is so out-of-date that everybody forgets about it. It involves a lot of work and a lot of time.

Electronic computing may eventually give us the answers, but you will run into a lot of problems in that, I am sure.

Walker. — We are in the process now of examining all of our reporting. We are contacting management that we serve to determine the effectiveness and timeliness of our data, and for any ideas that they might have of how we can improve it. I think you have to do that, from time to time, on any system of this type. I said we have five or six people on the program performance, but we also have about 26 on these other activities in the sections.

Martin. — From my own experience, it seems to me that the commissioners' value of such reports would be multiplied, not merely added to, by articulating the money situation—and I am talking especially about pre-contract activity—with the technical status, such as Walker reports in Michigan.

I do not know what other commissioners have found, but it seems to me that ability to control the money situation as we go along is essential. I mean "control" in the sense of being aware of it, so that administrative measures can be taken with respect to the expenditures, as well as with respect to the technical progress that is being made. It would seem that the high speed computer would make this possible.

The use of computers would stand a chance, it seems to me, of giving a service that would be enormously greater than the service that a commissioner could get simply from the physical progress information. That is, it would be much better if he had the two timed together, so that the expenditure data were timed with the operating data, or substantially so.

Walker. — Of course, we have that in our county reports, either the engineer's estimate or the contract award amount, that the commissioner carries with him all the time. That is, the reports show projects in every county that are on the five-year program, both moneywise and schedulewise, and what we have done and what we are doing. That is one service.

Granum. — California has a fairly effective money reporting system. They have a reservoir in which savings from award prices are thrown back into the pot and made available for use on other projects from time to time. Conversely, over-runs are paid for out of this reservoir.

Iowa has a somewhat similar procedure. Iowa has a fairly good basic programing procedure, which they are just getting into effective use over the past couple of years.

As an example, Iowa found last summer that $5 million were not going to be spent as planned in the current budget year, because of bad weather delays last spring. Projects that had been awarded did not proceed as rapidly as they had expected, and so their cash outlay would be $5 million less than anticipated.

Through their system of keeping track of the money schedule as well as the engineering schedule, they were able to pick up this $5 million and award that much more work this year, advanced from the second year construction schedule to the first year, because they had plans available.

Donnell. — At what stage in Michigan to you determine which routes are going to be improved? Evidently that follows important routes, where a decision has been made at some time by the Commissioner that route so-and-so is going to be built. That would affect the priority rating.

You might want to build low-priority sections into certain routes that had general priority; for continuity purposes you would want to build those in to improve a whole route in Michigan.

At what stage does that type of broad planning come in?

Walker. — That was all done prior to laying out the five-year program. It so happened that our Interstate routes were the ones that were really bad, as far as traffic congestion, alinement, etc. are concerned. So there was no criticism when we planned to go to work mainly on the Interstate System.

Donnell. — Who made the decision as to which one of those routes should come first?

Walker. — The planning division. We do not have to get approval from the legislature on any program. That rests within our own department. The Commissioner makes the final approval.

Hall. — I would like to throw a cautionary thought in about these detailed reports. Let me give a very recent experience.

In Phoenix, five weeks ago, I found that the residential improvement districts reports were prepared monthly at great length, some six or eight typewritten pages. I read them and could not make heads or tails of them. I asked the city manager and council, and they said, "Yes, we do receive these filings each month, but we can't understand them, either."

Then I inquired, and was given a three-page, three-foot-square report in bar chart form, which identified in great detail every step of every major street project, although none had been put to contract for about three years. It did show why the status was not moving.

I inquired of the council and the city manager what use they made of those, and they said not only did it make them mad because it indicated no progress, but it made them mad because they could not understand them.

The last report just received had only six lines on it. Top management now has: the number of petitions being circulated, year to date and last month; the hearings, year to date and last month; the approved petitions; miles under petition; miles approved; and total dollars under construction and approved. No one had figured it out until we totaled it. It was $900,000 worth of work since January 1, 1960.

Those six elements, as far as I am concerned, give me enough information to start controlling, I think, because if this does not move month to month, I will find out why. But I do not have to spend hours trying to figure out where all these particulars are.

Now, for the major streets, the big money projects, I would propose to have some sort of similar control. The point I am trying to make: I wonder sometimes, how much detail we need. I do not know the answer. But we are searching, in city work, to try to find some means for management control that will alert us quickly if something basic is going astray.

Granum. — You probably need several levels, do you not? A pyramid of less and less detail which reaches a very distilled point at the top?

Hall. — I think you summarized it very well. In the engineering division of a city, surely the bar charts and the progress details are essential; but to the director of public works, I would say quite a bit can be cut out. I do not need all that. And the council needs less than I do.

Bidell. — Would you like to discuss Ontario's tentative control system? We try to keep a rather strict control on both the money, the way the cash is going out, and on the status of the preparation of all of these jobs. Furthermore; we do not bother reporting to management anything that is on schedule, because possibly a year or so before this, they had approved this schedule. If it is on time, as far as we could see, management is not really concerned.

Therefore, we concentrate on bringing to management's attention only those projects that are falling seriously behind, and if there is a serious financial problem looming in the immediate future.

I would agree that too many details can be presented to management. We have found that if you present too much detail, they do not know anything about it, because they do not bother reading it. They just get the report and put in aside and they are not really aware of the problem, if there is any. We have found that selecting the problems that we think management should be made aware of, and only presenting those to them, is the best approach.

Granum. — How do you keep track of where you are?

Bidell. — We go through the charts and if everything is being awarded on schedule, we

are assuming that that is the way the money is going to be spent. But if we find that there are cases of serious deviations from the schedule of awards that have been set up previously, then we start studying it to see what effect it is going to make on the outflow of money.

Furthermore as in Iowa, if we find that this year, for example, we are going to have more money than we thought, we advance some projects that are ready — some of those that we were not intending to award until a later date.

Haxton. — I agree with top managements lack of interest in detail; but if you could see some of the correspondence that comes into the Washington office of the Bureau of Public Roads, you might want a little more detail. We have all of your Congressmen, Senators and constituents asking us questions, and they want answers.

Granum. — What experience have the States had with various kinds of visual aids on production control; such as, the Productrol and the Schedulegraph equipment that is commercially available? Would anyone want to comment on that?

Bidell. — We used it, but we found it was difficult to cart around to the various rooms in which meetings took place. So we discontinued the use of the Productrol.

England. — We tried it for a while and gave it up, for the same reason. We found we had to keep a staff working on it all the time to keep it up to date, plus the fact that we could not move it, unless we photographed it and took the photographs into the meetings.

Babcock. — Our biggest problem is not in the scheduling. The biggest problem that faces me and a lot of other people is the fact that we do not have as rational an understanding as I think we should have as to what can be produced in a given time. We need a measurement of engineering production efficiency, because, in setting up a construction schedule, you first make your basic assumption that it is equivalent to the efficiency of your organization. I wonder if anyone has a pat answer?

Walker, have you any data showing that we should allow X amount of time for X number of people to design a given kind of a bridge?

Walker. — We have a book that was made about a year ago, in which they went into design. I am not too familiar with it.

Granum. — Ontario could supply some information along that line. It has been suggested that the Ontario data be prepared as a Highway Research Board paper, because it was a research project and a very valuable one.

Burnes. — This gets into the area of work measurement, which I think plagues quite a few administrators, if not all of them. In an effort to get at work measurement, in one sense, by finding out what restricts plans production the Bureau of Public Roads has had a pilot study under way in Wisconsin for about 18 months. We hope to find out some of the restrictive elements, both external and internal, to plans production, and from that maybe we can work out some work measurements.