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Management System

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Maintenance Management of U.S. Army Railroad Networks—the RAILER System: Demonstration of System Setup at Fort Stewart, GA

by
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D.R. Uzarski

The Railroad Maintenance Management System (RAILER), a member of the Engineered Management System (EMS) family, is being developed to support installation Directorates of Engineering and Housing in managing maintenance and repair activities for railroad track networks.

This report documents the successful implementation of RAILER version 2.0 at Fort Stewart, GA, as part of the Facilities Engineering Applications Program. Installation personnel found it immediately useful for railroad maintenance management decision support.

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FOREWORD

This demonstration was conducted for the U.S. Army Engineering and Housing Support Center (USAEHSC), under Facilities Engineering Applications Program (FEAP), Project F58, "Railroad Track Maintenance Management System (RAILER)." The work was conducted by the Engineering and Materials Division (EM), U.S. Army Construction Engineering Research Laboratory (USACERL). The USAEHSC Technical Monitor was Robert Williams, CEHSC-FB. His support is very much appreciated.

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Dr. Paul Howdyshell is Acting Chief of USACERL-EM. COL Everett R. Thomas is Commander and Director of USACERL, and Dr. L.R. Shaffer is Technical Director.

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MAINTENANCE MANAGEMENT OF U.S. ARMY RAILROAD NETWORKS— THE RAILER SYSTEM: DEMONSTRATION AT FORT STEWART, GA

1 INTRODUCTION

Background

The Railroad Maintenance Management System (RAILER) is a member of the Engineered Management System (EMS) family being developed to support installation Directorates of Engineering and Housing (DEHs) in managing maintenance and repair (M&R) activities for railroad track networks. As a decision support tool, RAILER can be used, in part, to analyze and evaluate track segments, determine and prioritize work needs, develop annual and long-range work plans, estimate maintenance and repair costs, and develop budgets. The system is intended to help the DEH schedule M&R in a way that allows the track to meet its mission at the least possible cost.

Developed at the U.S. Army Construction Engineering Research Laboratory (USACERL), RAILER includes field procedures for collecting data and a computer program for manipulating these data to facilitate maintenance management decisions. While an interim version (1.0) of RAILER¹ had been tested successfully at several U.S. Army installations, the current version 2.0 included several modifications and additional capabilities that had not been demonstrated within a DEH organization. For example, the track inspection procedures² had been greatly enhanced to capture all of the track defects specified in the Army Track Maintenance Standards.³ The inventory procedures had also been revised.⁴ Another capability of RAILER version 2.0 that had not yet been demonstrated was the customization of maintenance policies. To support these changes and enhancements, the RAILER computer software also had been largely rewritten for version 2.0.

To ensure that these new features would meet the DEH needs, Fort Stewart, GA was chosen as a demonstration site for RAILER version 2.0. This implementation was conducted as part of the FY87 Facilities Engineering Applications Program (FEAP).

Objective

The threefold objective of this FEAP demonstration was to:

1. Implement RAILER'S data collection and computer procedures, especially the recent enhancements and modifications of version 2.0. In the field, these activities include the inventory and inspection procedures, and on the computer, they include data entry and report (information and analysis) generation.

¹ D.R. Uzarski, D.E. Plotkin, and D.G. Brown, *The RAILER System for Maintenance Management of U.S. Army Railroad Networks: RAILER I Description and Use*, Technical Report (TR) M-88/18/ADA199859 (U.S. Army Construction Engineering Research Laboratory [USACERL], 1988).

² D.R. Uzarski, D.G. Brown, R.W. Harris, and D.E. Plotkin, *Maintenance Management of U.S. Army Railroad Networks—The RAILER System: Detailed Track Inspection Manual*, Draft TR (USACERL, 1988).

³ Technical Manual (TM) 5-628, *Railroad Track Standards*, Draft (Headquarters, Department of the Army [HQDA], March 1988).

⁴ D.R. Uzarski, D.E. Plotkin, and D.G. Brown, *Maintenance Management of U.S. Army Railroad Networks—The RAILER System: Component Identification and Inventory Procedures*, TR M-88/13/ADA200276 (USACERL, 1988).

2. Test the ability of the computer software and field procedures to work together in providing maintenance management decision support.

3. Establish a working implementation of RAILER version 2.0 to permit an effective, practical evaluation of RAILER by both the prospective users and system developers.

Approach

A full implementation of RAILER version 2.0 was performed at Fort Stewart by USACERL personnel with assistance from the U.S. Army Engineering and Housing Support Center (USAEHSC) and the installation DEH. The demonstration was conducted following an approach that would be expected from a private contractor; this process permitted USACERL and USAEHSC to develop guidelines for future contract implementations of RAILER at other sites.

During this FEAP demonstration, USACERL collected data on RAILER's performance and the users' reactions. This feedback is being used to refine RAILER and has suggested forthcoming enhancements.

Scope

This report describes only the implementation and initial use phase of RAILER version 2.0 at Fort Stewart, including system turnover to the installation. It does not include a long-term case history of RAILER's use at Fort Stewart.

Mode of Technology Transfer

It is expected that RAILER will be implemented at more sites by private contractors under the guidance of USAEHSC. These implementations will include training for installation personnel. A RAILER course, jointly developed by USAEHSC and USACERL, will provide more training. As this report goes into final publication, RAILER version 3.01 has been released for general implementation on domestic Army installations. It is available to Army installations through the USAEHSC. For more information contact:

U.S. Army Engineering and Housing Support Center
ATTN: CEHSC-FB-P
Fort Belvoir, VA 22060

RAILER version 3.01 has also been released for general use, and is available through the RAILER support center at the University of Illinois. For more information contact:

University of Illinois at Urbana-Champaign
Conferences and Institutes
ATTN: RAILER Support Center
302 East John Street, Suite 202
Champaign, IL 61820

2 FIELD WORK

The field work required to implement RAILER includes stationing and segmenting the installation railroad network, and collecting data which is later entered into the computer. Stationing establishes a location referencing system for each track in the network. The track segment is the maintenance management unit within RAILER; segmentation is concerned with dividing each track into one or more track segments. Most of the data collection effort is devoted to inventory and inspection; other data are collected on traffic, installation, work history, and maintenance policy. For this demonstration, the inventory, inspection, installation, and traffic information was collected on one trip. The maintenance policy data was gathered during a second visit; the work history data collection was left for installation personnel to complete.

Procedures for stationing, segmenting, and collecting inventory data are documented elsewhere,⁵ as are the detailed inspection procedures.⁶ Procedures for collecting other data elements are documented for an earlier version of RAILER⁷ (they are largely the same for version 2.0). The effective, efficient use of all procedures requires some office preparation before going to the field.

Office Preparation

Office preparation involves becoming familiar with the track network layout (including identifying all tracks and estimating their lengths), establishing a preliminary track segmentation (and component identification), acquiring and organizing supplies, and developing a work plan to be followed in the field. All of these activities require information about the installation network. In the case of Fort Stewart, this information was obtained from the most recent Military Traffic Management Command Transportation Engineering Agency (MTMC-TEA) installation Transportation System Capability Study (TSCS)⁸ and from other maps previously acquired from the Fort Stewart DEH.

The office preparation for this demonstration was conducted at USACERL. Table 1 lists time requirements for the various office preparation activities. While all these functions were performed by engineers, most could be done by properly trained technicians.

Preliminary Track Segmentation

Table 2 summarizes the preliminary track segmentation based on the maps and lists track length estimates. As discussed below, this preliminary segmentation was later modified in the field.

In addition to track segments, two other track components--turnouts and curves--are given identification (ID) numbers within RAILER. These numbers were also assigned during the preliminary track segmentation. The turnout ID numbers were taken from a preexisting numbering sequence found

⁵ D.R. Uzarski, D.E. Plotkin, and D.G. Brown, TR M-88/13.

⁶ D.R. Uzarski, D.G. Brown, R.W. Harris, and D.E. Plotkin.

⁷ D.R. Uzarski, D.E. Plotkin, and D.G. Brown, TR M-88/18.

⁸ *Installation Outloading Capability Study: Fort Stewart, Georgia and Camp Blanding, Florida*, MTMC Report TE 81-3a-42 (Military Traffic Management Command Transportation Engineering Agency [MTMC-TEA], July 1982).

Table 1
Office Preparation Activities and Time Required

Function	Manhours
Preliminary Track Segmentation:	
Reproducing, reviewing and correlating available maps for track verification and numbering	5
Segmenting the network	6
Estimating track lengths (for estimating station plate requirements and work plan)	5
Assigning turnout and curve ID numbers	1
Review by rest of staff	2
Drawing up and distributing track diagram (Appendix A)	2
	<u>21</u>
Supplies:	
Organizing station plates for individual tracks	11
Determining supply requirements	3
Acquiring supplies	3
Reviewing track cart assembly procedures	4
Preparing supplies for shipment to Fort Stewart	4
Reproduction and distribution of data collection forms	2
	<u>27</u>
Work Plan:	
Formulating plan	4
Communicating with staff at meeting (8 people)	10
	<u>14</u>
Total	<u>62</u>

on maps supplied by the Fort Stewart DEH. The track segment and curve ID numbers were assigned using established RAILER procedures.⁹

After the network was segmented, a track diagram was created that included the ID numbers for all tracks, track segments, turnouts, and curves (see Appendix A). Copies of this diagram and the segmentation summary (Table 2) were distributed to all personnel who would be going into the field.

Supplies

The supplies taken to Fort Stewart were based on expected tasks, network size, and crew size. The equipment required for track inspection is documented elsewhere.¹⁰ Additional equipment included a hammer, nails, station plates, and the track cart for stationing. Supplies for personal comfort included bug repellent, sun screen, and coolers for liquid refreshment. The required number of data collection forms,

⁹ D.R. Uzarski, D.E. Plotkin, and D.G. Brown, TR M-88/13.

¹⁰ D.R. Uzarski, D.G. Brown, R.W. Harris, and D.E. Plotkin.

Table 2
Preliminary Track Segmentation

Track Number	Length (ft)	Number of Segments
1	3000	3
2	1100	1
3	4800	8
4	2600	2
5	300	1
6 (Not used)	-	-
7	900	1
8	1400	1
9	3000	4
10	8400	9
11	500	1
12	1400	1
13	1450	2
14	2600	1
15	2200	1
L	32700	3
P	2400	1
Y	1000	1
17 (Total used)	69750	41

crayons, paint markers, and station plates is primarily a function of network size. For each of these items, more than the number estimated were brought to avoid a shortage. In the case of most forms, the amount packed was 150 percent of the estimated required quantity, based on network size (Table 2).

Some supplies, such as station plates, need to be organized as part of office preparation. During track stationing, a prenumbered embossed station plate is attached to the track every 200 ft,* with a new numbering sequence beginning at 0+00 for each track.¹¹ The station plates used at Fort Stewart were taken from an existing supply at USACERL. The plates for each track were strung together on a separate wire in numerical order, beginning with the 0+00 plate. For example, based on the preliminary track length estimates (Table 2), Track 1 was expected to require 15 station plates ending with a 30+00 plate. Extra plates were taken in case the track length estimates were in error or there were other tracks not represented on the available maps.

Work Plan

To complete the field work within a 10-workday schedule, a relatively large crew was involved in the main visit to Fort Stewart; it included eight persons from USACERL and one from USAEHSC. (Not all of the crew was present for the entire site visit, nor was everyone entirely devoted to implementation

* 1 ft = 0.305 m.

¹¹ D.R. Uzarski, D.E. Plotkin, and D.G. Brown. TR M-88/13.

activities during the visit.) The large crew size made a structured, but flexible, work plan even more important than usual. The initial work plan, developed by the project supervisor, is presented in Appendix B. The actual work schedule is discussed below.

Site Visits

The field work entailed three site visits to Fort Stewart. The various site visit activities during the first two visits are summarized in Table 3 along with the time required to complete each.

The first site visit to Fort Stewart for RAILER implementation was June 1 through 11, 1987. Activities of the individual crew members during this period are indicated in Table 4. Note that not all crew members were available during this entire period, either because they arrived later, departed early, or were given another related assignment (continued RAILER research and work at Hunter Army Airfield).

Each workday generally began at 0700 and ended at 1830 with short meetings. At the morning meeting, crew assignments were announced and the day's modified work plan was discussed. In the evening, actual accomplishments were summarized and compared with expected results, and feedback was solicited from all (especially crew leaders) for formulating the next day's work plan. More informal meetings were often conducted during the lunch break. All of these meetings were important for coordinating the activities of different crews who often did not see each other during the rest of the day.

Table 3
Site Visit Activity Times

Information Area	Manhours
Stationing	76.0
Track segment inventory	91.0
Track inspection	180.0
Traffic	1.0
Installation information	2.0
Maintenance policy (second site visit)	20.0
Total	<u>370.0</u>

Stationing

A portable track cart with an attached measuring wheel was used for almost all of the stationing at Fort Stewart (Figure 1). A crew of two performed the stationing, often accompanied and aided by the project supervisor and/or the inventory crew leader. As indicated in Table 4, stationing was completed during the first week of the site visit.

Table 4
Crew Work Calendar

Day	Major Activities					
	Travel and Equipment	Stationing and Segmenting	Inventory	Inspection	Administration and Documentation	Other Assignments
Monday June 1	DU, DP, DB, SW, & RH					
Tuesday June 2	MK, MB, JB, JH, SW, & RH	SW, RH, DU, & DB		DP	DU, DP, & DB	
Wednesday June 3		SW, RH, & DU	DB, MK, & MB	DP & JB	DU & DP	
Thursday June 4		SW, RH, & DU	DB, MK, & MB	DP & JB	DU & DP	
Friday June 5		SW, RH, DU, DB, JB, & JH		DP, JB, MK, & MB	DU & DP	
Sunday June 7				DP		
Monday June 8	JH		DB, MB, & JB	DP, DU, SW, MB, & JB	DU & DP	MK & RH
Tuesday June 9	DP		DB	DU, SW, JB, & MB	DU & DP	MK, RH, JB, & MB
Wednesday June 10				DU, DB, & JB	DU	SW, RH, MK, & MB
Thursday June 11	DU, DB, SW, RH, MK, MB, & JB					

DB: David Brown	JB: John Borse	MK: Mohammed Kahn
DP: Don Plotkin	JH: Joe Hovell	RH: Rich Harris
DU: Don Uzarski	MB: Mike Britton	SW: Sue Wagers

During the stationing procedure, all required inventory station locations were recorded on paper for later use by the inventory crew; they were also recorded on the rail web. Data included the beginning and end station locations of track segments, grade crossings, and obstructions; centerline locations for grade crossings and drainage structures; switch point locations; and the locations of rail weight changes. Obtaining these locations at this stage helped speed the inventory process that followed. In addition to recording station locations and attaching station plates, the stationing crew was responsible for placing mile posts and whistle posts on the main line into Fort Stewart.

During stationing, the crew leader generally managed the track cart and recorded station locations. The other crew member attached station plates. If other persons were available, they would help by marking locations on the rail, dispensing station plates, guarding traffic at road crossings, and looking for inventory items such as rail weight changes and drainage structures. Organizing the station plates sequentially on wires, as described above, greatly increased the efficiency of the stationing process.



Figure 1. Portable track cart with attached measuring wheel.

Segmenting

While stationing, it was found that changes were required in the preliminary track segmentation. The final segmentation of Fort Stewart is shown in Appendix C and summarized in Table 5. The three changes involved tracks L, 3, 6, 9, CR1, and CR2, and can be analyzed by comparing Appendices A and C, and Tables 2 and 5.

Installation personnel had previously established a two-part classification of the track network: (1) the lead track and passing siding, and (2) yard track, beginning at the switch points of turnout 1 (where tracks L, 3, and 10 come together). Under the usual RAILER segmentation guidelines, turnout 1 would have been included in segment L03 of lead track L. However, since this turnout is considered part of the yard track, it would be more logical to include it with yard track 3. Turnout 1 was therefore entered into the Fort Stewart RAILER database as a separate additional segment of track 3, and track segment L03 was defined as ending at the switchpoints of the turnout.

Table 5
Final Track Segmentation

Track Number	Length (ft)	Number of Segments
1	2922	3
2	1099	1
3	4844	9
4	2470	2
5	349	1
6	1375	3
7	313	1
8	1443	1
9	1555	2
10	8195	8
11	387	1
12	1364	1
13	2304	2
14	2413	1
15	1488	1
CR1	165	1
CR2	165	1
L	32639	3
P	2230	1
Y	778	1
20	68538	44

In the maps available to USACERL during office preparation, there was no track 6, and it was assumed that the ladder access track to tracks 5, 7, 8, and 9 was part of track 9--thus giving track 9 the four segments indicated in Table 2. However, installation personnel noted that the ladder track was track 6. Therefore, the preliminary track segmentation of track 9 was changed and track 6 was added; this change is reflected in Table 5 and Appendix C. For consistency, the conjunction of tracks 6, 8, and 9 at turnout 15 was segmented like the conjunction of tracks L, 3, and 10 described above. As a result, track 9 has two segments.

Crossover tracks are treated as separate tracks within RAILER only if the distance between last switch ties is at least 50 ft.¹² Most crossovers between relatively close tracks do not meet this criterion. Therefore, the three crossovers between tracks 1, 3, and 4 were not identified as separate tracks in the preliminary segmentation. However, in the field, it was determined that both crossovers between tracks 1 and 3 are long enough to be identified as separate tracks CR1 and CR2.

Inventory

Figure 2 is an example of a completed inventory data collection form used at Fort Stewart. Most of the Fort Stewart inventory data was collected by a three-person crew, with two people making appropriate measurements and the third entering data on the form. By starting one day later, the inventory crew was able to work on track segments after the stationing crew had completed its work. The inventory crew usually had a copy of the station location information previously recorded by the stationing crew, thus greatly reducing the workload and speeding the inventory process.

The inventory crew worked together for approximately 2-1/2 days while inventorying the yard tracks of Fort Stewart. During one day, the inventory crew leader worked with the stationing crew and project supervisor to simultaneously station and inventory the lead track and passing siding. The inventory crew leader later spent 1-1/2 days validating the data and checking for missing or clearly erroneous entries.

Inspection

Figures 3 through 10 are completed examples of the eight inspection forms used at Fort Stewart. The Tie, Turnout and Vegetation inspection forms had already been tested as part of the interim track inspection procedures of RAILER I.¹³ However, the inspection forms for Crossings, Drainage Structures, Track Fastenings, Rail, and Roadway and Ballast had been just recently developed and pilot-tested in order to incorporate the remaining track defects specified in the Army Track Maintenance Standards.¹⁴ The inspection procedures, especially for the five new component areas, were demonstrated on a total network basis as part of this project.

About 18 mandays were spent on track inspection at Fort Stewart. Several different inspection crews of 1, 2, 3, and 4 persons were used during the site visit; sometimes two crews were simultaneously inspecting different parts of the network. Because each inspection component area has its own separate inspection form, the inspectors tended to specialize in component areas. This also meant that most track segments were inspected in multiple passes, often by different inspectors.

¹² D.R. Uzarski, D.E. Plotkin, and D.G. Brown, TR M-88/13.

¹³ D.R. Uzarski, D.E. Plotkin, and D.G. Brown, TR M-88/18.

¹⁴ TM 5-628, Draft.

TRACK SEGMENT #: 1401 RAILER II
 INSTALLATION NAME: El. Stewart TRACK SEGMENT INVENTORY INFORMATION

DATE: June 4, 1987

SEGMENT IDENTIFICATION						BALLAST		
Begin Location (station)	End Location (station)	Track Category	Track Use	Track Rank	Preceding Track Segment Number(s)	Support Ballast Depth (inches)	Depth to Crib Ballast (inches)	Ballast Type
0+93	25+06	(B) B	Acc Aux (L) Se St		1007		Ø	Rock
Comments:						Comments:		

BRIDGES					CLEARANCE RESTRICTIONS			
Facility Number	Begin Location (station)	End Location (station)	Deck Type	Construction Type	Begin Location (station)	End Location (station)	Obstruction	Measurement (feet) Horiz. Vert.
			Open Ballast					
			Open Ballast					
Comments:					Comments:			

CULVERTS				CURVES											
Centerline Location (station)	Size (inches)	Type	Material	Curve ID Number	Curvature (Degrees)										Max Desired Speed (m.p.h.)
					1	2	3	4	5	6	7	8	Avg		
17+07	30"	Box (Pipe)	Concrete	2C14	13	12	13	14	14				14.2	5	
		Box Pipe		1C14	7	9	8	13	14	10			10.2	5	
		Box Pipe													
		Box Pipe													
Comments:				Comments:											

PLATES/FASTENINGS				RAIL		RAIL CROSSING					
Tie Plate Length (inches)	Shoulder	Nail Anchors (#/200 TF)	Base Nails (#)	Weight (lbs/yd)	Section	Begin Location (Station)	Centerline Location (Station)	Crossing Segment Number	Rail Weight (lbs/yd)	Frog Type	Crossing Angle (degree)
9	SS/DS NS NO	100	8	8.5	ASIE	0+93				B NI SH	
	SS DS NS NO										
	SS DS NS NO										
	SS DS NS NO										
Comments:				Comments:		Comments:					

RELATED FACILITIES		ROAD CROSSINGS						
Facility Number	Facility Type	Road Name	Centerline Location (Station)	Road Crossing ID Number	Crossing Length (feet)	Crossing Type	Protection	Bolted Joints
	Ramp						6 F S N	N Y
Comments:							6 F S N	N Y
							6 F S N	N Y
		Comments:						

TIES			TURNOUTS							
Cross Section (in. x in.)	Tie Quantity (#/200 TF)	Material Type	Turnout ID Number	Switch Point Location (Station)	Direction	Point Length (LF)	Rail Weight (lbs/yd)	Frog Type	Frog Size	Guard Rail Length (LF)
7 x 9	114	Wood			LH EQ RH			B SG RBN SP		
					LH EQ RH			B SG RBN SP		
Comments:			Comments:							

5/6/87
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Figure 2. Completed track segment inventory form.

RAILER II INSPECTION
TIESDATE: 6/9/87
INSPECTOR: S.A.W.

TRACK SEGMENT #	CONSECUTIVE DEFECTIVE TIES					ALL JOINT TIES DEFECTIVE	AVERAGE SPACING PER RAIL LENGTH > 22 in.	ROTATED OR SKEWED TIES	MISSING/ BUNCHED/BADLY SKEWED TIES (tie spacing along either Rail > 48 in.)	TOTAL DEFECTIVE TIES

	2	3	4	5 or more						
1006	III	I				I	0	III		
Check if no defects: ☐										
TOTAL	3	1	0	0	1	0	8	0	34	
COMMENTS:										
1007	III	II						III		
Check if no defects: ☐										
TOTAL	8	2	0	0	0	0	22	0	127	
COMMENTS:										
1008	III	I				I		III		
Check if no defects: ☐										
TOTAL	5	1	0	0	1	0	9	0	91	
COMMENTS:										
1401	III							III		
Check if no defects: ☐										
TOTAL	6	0	0	0	0	0	4	0	54	
COMMENTS: Difficult to inspect - cars on track										

* 22 inches per tie is equivalent to 21.3 ties per 39' rail and 18 ties per 33' rail

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Figure 3. Completed tie inspection form.

TRACK SEGMENT #: 102
TURNOUT ID #: 6

RAILER II INSPECTION
TURNOUTS

DATE: 6/4/87
INSPECTOR: D.E.P.

GENERAL				TIES			
Rail Weight changes within Turnout limits		Y		0 of Defective Ties in a row (worst case)			
Reversing tangent Past Frog Less than 50 Feet		Y		0 of Occurrences where Joint Ties are Defective			
Switch Difficult to Operate <u>Com 2</u>		N		0 of Occurrences where Tie Spacing > 22 in.			
Flangeways Dirty or Fouled		Y		0 of Skewed Ties			
Crib Areas Dirty or Fouled		N		0 of Missing/Bunched/Badly Skewed Ties (Tie spacing along either rail) 48 in.)			
Line & Surface		Good	Fair	Poor	TOTAL 0 of Defective Ties <u>Com 3</u>		

COMPONENTS		NO DEFECTS	IMPROPER SIZE/ TYPE/POSITION/ DESIGN (Y or 0)	LOOSE (Y or 0)	CHIPPED/WORN/BENT/ CRACKED/BROKEN/ CORRODED/ALTERED (Y or 0)	MISSING (Y or 0)
S	Switch Stand	<u>Com 2</u>	Y	Y	Y	Y
W	Point Lock/Lever Latch	✓	Y	Y	Y	Y
I	Connecting Rod	✓	Y	Y	Y	Y
T	Switch Point - Left	<u>Com 1</u>	Y	Y	Y	Y
C	Switch Point - Right	<u>Com 1</u>	Y	Y	Y	Y
H	Switch Rods	<u>Com 4</u>	Y			
S	Rod & Clip Bolts	<u>Com 5</u>				
T	Cotter Keys					ALL
A	Slide Plates	<u>Com 4</u>				
M	Braces	<u>Com 6</u>				
D	Heel Filler & Bolts			5		
	Joint Bars/Shoulder Bars	✓				
F	Point & Top Surface	✓	Y	Y	Y	Y
R	Bolts	<u>Com 6</u>				
O						
G						
GR	Guard Rails	✓				
UA						
AI	Filler & Bolts	✓				
RL						
DS						

MEASUREMENTS (inches)		STRAIGHT SIDE	TURNOUT SIDE	COMMENTS: 1: Points are high. 2: Stand handle bent. 3: All ties covered by dirt or asphalt 4: Needs cleaning around rods and slide plates 5: Right no. 1 clip has two washers between clip & point 6: Buried in dirt 7: Flangeways need cleaning
F	Gage at Point	56.6	57.0	
R	Guard Check Gage	54.5	54.7	
D	Guard Face Gage	52.7	52.9	
G	Flangeway Width	1.9	1.8	
	Flangeway Depth	<u>Com 7</u>		
GR				
UA	Flangeway Width	2.0	2.5	
AI				
RL				
DS				
O	Gage at Switch Points	57.2		
T				
H	Gage at Joints in Curved Closure Rails	57.8		
E				
R				

* See reverse for illustrations of wear and improper positions
* See reverse for illustrations of measurements
See reverse for fraction/decimal conversion table

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Figure 4. Completed turnout inspection form.

RAILER 11 INSPECTION
VEGETATION

DATE: 6/7/87
INSPECTOR: MB

TRACK SEGMENTS	DEFECTS	LOCATION *					
		----- Left -----		----- Center -----		----- Right -----	
		Occurrences	Total	Occurrences	Total	Occurrences	Total
1007	No Defects		X		X		
	Insufficient, where needed						
	Growing in Ballast					11	2
	Prevents Track Inspection						
	Interferes with Walking						
	Interferes with Visibility of Signs						
	Brushes Sides of Rolling Stock						
	Interferes with Trains or Track Vehicles						
	Presents a Fire Hazard						
	COMMENTS:						
1008	No Defects				X		X
	Insufficient, where needed						
	Growing in Ballast	1	1				
	Prevents Track Inspection						
	Interferes with Walking						
	Interferes with Visibility of Signs						
	Brushes Sides of Rolling Stock						
	Interferes with Trains or Track Vehicles						
	Presents a Fire Hazard						
	COMMENTS:						
1101	No Defects						
	Insufficient, where needed						
	Growing in Ballast	III	3	1	1	11	2
	Prevents Track Inspection						
	Interferes with Walking						
	Interferes with Visibility of Signs						
	Brushes Sides of Rolling Stock						
	Interferes with Trains or Track Vehicles						
	Presents a Fire Hazard						
	COMMENTS: Some vine type plant growing on sides of track in ballast						
103*	No Defects						
	Insufficient, where needed						
	Growing in Ballast	III	3	1	1	III	5
	Prevents Track Inspection						
	Interferes with Walking						
	Interferes with Visibility of Signs						
	Brushes Sides of Rolling Stock						
	Interferes with Trains or Track Vehicles						
	Presents a Fire Hazard						
	COMMENTS:						

* See reverse for illustrations of location.

5/27/87
HDO

Figure 5. Completed vegetation inspection form.

RAILER II INSPECTION
ROAD AND RAIL CROSSINGS

DATE: 6/7-8/87
INSPECTOR: DEP

TRACK SEGMENTS	TYPE	ROAD NAME OR CROSSING SEGMENTS	MINIMUM FLANGE WAY DEPTHS	WIDTHS	FOULED FLANGE -WAYS	OCCURRENCES OF RELATED TRACK MATERIAL DEFECTS* (RAIL CROSSINGS ONLY)	SIGNS AND SIGNALS INOPERATIONAL, OBSCURED, OR MISSING	COMMENTS
L03	ROAD RAIL	Show Rd	2 1/2	2 1/2	Y N	TOTAL	Y N	
11	ROAD RAIL	Rt 82	1.8	2.5	Y N		Y N	
11	ROAD RAIL	Dirt Xing	2.5	2	Y N		Y N	No signs (concrete road?)
11	ROAD RAIL	Glennbryn	4.5	1 1/2	Y N		Y N	
11	ROAD RAIL	Eunice Rd	3.2		Y N		Y N	Dirt partly fills flange ways
11	ROAD RAIL	Dirt Road			Y N	Partly	Y N	
11	ROAD RAIL	Miles Pkwy			Y N		Y N	
	ROAD RAIL				Y N		Y N	
1302	ROAD RAIL	Sta 11+17		2"	Y N		Y N	Dirt fills flange ways
1302	ROAD RAIL	Sta 14+5			Y N		Y N	To Equip yard Dirt Xing
	ROAD RAIL				Y N		Y N	
	ROAD RAIL				Y N		Y N	
	ROAD RAIL				Y N		Y N	
	ROAD RAIL				Y N		Y N	
	ROAD RAIL				Y N		Y N	
	ROAD RAIL				Y N		Y N	
	ROAD RAIL				Y N		Y N	

* Includes Improper Size/Type/Position, Chipped/Worn/Bent/Cracked/Broken/Corroded/Altered (including Flame Cut), Loose and Missing

See reverse for fraction/decimal conversion table

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HRB

Figure 6. Completed road and rail crossings inspection form.

DATE: 6/5/87
INSPECTOR: M.R.B.

* Examples are Culvert, Ditch, Drain, Storm Sewer, and Drop Inlet

Figure 7. Completed drainage structures inspection form.

RAILER II INSPECTION
TIE PLATES, RAIL FASTENINGS AND JOINTS

DATE: 6/9/87
INSPECTOR: D.R.U.

TRACK SEGMENT	COMPONENTS	IMPROPER SIZE/TYPE		FLAMECUT/ALTERED		MISSING/INSUFFICIENT NUMBER/CRACKED/BROKEN		IMPROPERLY INSTALLED OR LOOSE	
		Occurrences	Total	Occurrences	Total	Occurrences	Total	Occurrences	Total
102 Check if no defects: ☒	Tie Plates ‡								
	Spikes ‡								
	Joint Bars								
	Joint Bolts								
	Compromise Bars								
	Rail Anchors ‡								
	Gage Rods								
All Joint Bolts Missing or Broken for a Rail End						COMMENTS:			
Rail End Mismatch Exceeds 3/16"						Virtually all plates,			
Rail End Gap Exceeds 1" but not 2"						spikes and bolts			
Rail End Gap Exceeds 2"						covered with soil and			
						ballast			
306 Check if no defects: ☐	Tie Plates ‡								
	Spikes ‡								
	Joint Bars								
	Joint Bolts							11	2
	Compromise Bars								
	Rail Anchors ‡								
	Gage Rods								
All Joint Bolts Missing or Broken for a Rail End						COMMENTS: Most plates			
Rail End Mismatch Exceeds 3/16"						and spikes covered			
Rail End Gap Exceeds 1" but not 2"						with ballast			
Rail End Gap Exceeds 2"									
CR201 Check if no defects: ☐	Tie Plates ‡								
	Spikes ‡								
	Joint Bars								
	Joint Bolts								
	Compromise Bars								
	Rail Anchors ‡								
	Gage Rods								
All Joint Bolts Missing or Broken for a Rail End						COMMENTS:			
Rail End Mismatch Exceeds 3/16"						Cross over embedded			
Rail End Gap Exceeds 1" but not 2"						in asphalt concrete			
Rail End Gap Exceeds 2"									
1201 Check if no defects: ☐	Tie Plates ‡					1	1		
	Spikes ‡							1	1
	Joint Bars			1	1	1	1		
	Joint Bolts	11	2					11	3
	Compromise Bars								
	Rail Anchors ‡								
	Gage Rods							1	1
All Joint Bolts Missing or Broken for a Rail End						COMMENTS:			
Rail End Mismatch Exceeds 3/16"						Virtually all plates			
Rail End Gap Exceeds 1" but not 2"		11		2		and spikes covered			
Rail End Gap Exceeds 2"						with soil & ballast			

‡ See reverse for Spiking and Rail Anchor Patterns.

‡ If defect exists continuously over significant track length, place "I" under "Occurrences" and in "COMMENTS" enter the beginning and ending station locations, along with defect type.

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Figure 8. Completed track fastenings inspection form.

INSTALLATION NAME: _____

RAILER II INSPECTION
RAIL

DATE: 6/3/87
INSPECTOR: DEF

TRACK SEGMENT NUMBER	DATE	LOCATION (STATION)	RAIL (LEFT OR RIGHT)	DEFECT TYPE	COMMENTS
1003				0	
1004				0	
1501				0	
1006				0	
1009				0	
401		2 1+25	L	21	
301				0	
302				0	
303		T.O. 3		17	ST Closure
304				0	
305				0	
1009				0	
1401				0	
1001		T.O. 12		17	ST Closure
1001		T.O. 12		5	ST Closure
1002		12+10	L	23	In gage corner
1002		13+50	L	23	In gage corner
1001		5+80	R	21	
1001		5+50	L	21	Deep - top of head

RAIL DEFECT TYPES

- | | |
|--------------------------------|---|
| 0 = No Rail Defects in Segment | 14 = Split Head - Horizontal |
| 1 = Bolt Hole Crack | 15 = Split Head - Vertical |
| 2 = Broken Base | 16 = Split Web |
| 3 = Corroded Base | 17 = Torch Cut |
| 4 = Complete Break | 18 = Wear - Side (>1/2") |
| 5 = Crushed Head | 19 = Wear - Vertical (>1/2") |
| 6 = Defective Weld | 20 = Overflow |
| 7 = End Batter (>1/4") | 21 = Shelling |
| 8 = Fissure - Compound | 22 = Corrugation |
| 9 = Fissure - Transverse | 23 = Chip/Dent in Head |
| 10 = Fracture - Detail | 24 = Engine Burn |
| 11 = Fracture - Engine Burn | 25 = Flaking |
| 12 = Head/Web Separation | 26 = Rail Weight Insufficient for Mission |
| 13 = Piped Rail | 27 = Rail Less Than 13 Feet Long |

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Figure 9. Completed rail inspection form.

RAILER II INSPECTION
ROADWAY AND BALLAST

DATE: 06/28/87
INSPECTOR: Mike

TRACK SEGMENT	ITEM	Hazardous to Train Movement		Not Hazardous	
		Occurrences	Total	Occurrences	Total
1007 Check if no defects: ☒	Ballast/Subgrade Pumping				
	Insufficient Ballast				
	Erosion of Embankments and Cut Slopes				
	Embankment Sliding or Slippage				
	Potential Slope Stability Problems				
	Settlement at Approaches to Bridges				
	Washouts Under the Track				
Percent of Dirty or Poorly Draining Ballast to Nearest 10% : <u>30%</u>					
COMMENTS: <u>generally in good condition</u>					
1008 Check if no defects: ☒	Ballast/Subgrade Pumping				
	Insufficient Ballast				
	Erosion of Embankments and Cut Slopes				
	Embankment Sliding or Slippage				
	Potential Slope Stability Problems				
	Settlement at Approaches to Bridges				
	Washouts Under the Track				
Percent of Dirty or Poorly Draining Ballast to Nearest 10% : <u>20%</u>					
COMMENTS: <u>generally in good condition</u>					
1101 Check if no defects: ☒	Ballast/Subgrade Pumping				
	Insufficient Ballast				
	Erosion of Embankments and Cut Slopes				
	Embankment Sliding or Slippage				
	Potential Slope Stability Problems				
	Settlement at Approaches to Bridges				
	Washouts Under the Track				
Percent of Dirty or Poorly Draining Ballast to Nearest 10% : <u>80%</u>					
COMMENTS: <u>Ballast dirty otherwise generally in good condition</u>					
602 Check if no defects: ☒	Ballast/Subgrade Pumping				
	Insufficient Ballast				
	Erosion of Embankments and Cut Slopes				
	Embankment Sliding or Slippage				
	Potential Slope Stability Problems				
	Settlement at Approaches to Bridges				
	Washouts Under the Track				
Percent of Dirty or Poorly Draining Ballast to Nearest 10% : <u>20%</u>					
COMMENTS: <u>in good condition</u>					

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Figure 10. Completed roadway and ballast inspection form.

Before the demonstration at Fort Stewart, the track inspection procedures had been fully tested with railroad trackage of various quality levels. However, the procedures had not been implemented previously on such a large scale. As a result of the experience at Fort Stewart, the track inspection procedures were significantly modified. First, they were simplified, primarily by collapsing four of the previous inspection areas (Crossings, Drainage Structures, Track Fastenings, and Roadway and Ballast) into one called "Other Track Components." Even after simplification, the procedures were judged to be too time-consuming for regular network implementation, but were still appropriate for "project level" management which focuses on individual track segments scheduled for M&R in the near future. Therefore, the inspection forms were reorganized so that a given form was not shared by multiple segments (as was the case in Figures 3 and 5 through 10). Instead, multiple inspection areas were combined on one form for a single track segment. Additional modifications in the inspection procedures were required due to new changes in the Army Track Standards.¹⁵ The new inspection forms and data collection procedures are described elsewhere.¹⁶

Traffic Information

The inventory crew leader spent 1 hr obtaining traffic information from the Installation Transportation Office (ITO) at Fort Stewart. This information can be used for several purposes within RAILER, such as prioritizing track segments, structural analysis, and forecasting track condition.

Only total installation traffic volumes were available for a few car types at Fort Stewart; these data were not broken down by specific tracks. As a result, before being entered into the database, the traffic volume had to be allocated among the functional (nonaccess) track segments. This allocation was based on other information obtained from the ITO. For example, the total installation heavy flat car volume was about 700 cars/year. Since the track vehicles, which these cars usually carry, are generally loaded and unloaded on tracks 10 and 14, it was assumed that the heavy flat car volume for each of these tracks was 350 cars/year (Figure 11).

Information obtained from the ITO was also helpful in verifying track usage and determining the operating speed through curves (two inventory data elements).

Installation Information

The inventory crew leader also spent about 2 hr obtaining installation information from a variety of sources. The completed Installation Information form is shown in Figure 12. The installation number and relation code were obtained from the DEH office and were later verified with other sources available at USACERL. The serving railroad nearest yard information was obtained from the Fort Stewart Yard Master. The rest of the serving railroad information was acquired by a telephone call to the railroad. Much of the serving railroad information was verified with MTMC documentation.¹⁷

Maintenance Policy Data

A maintenance policy specifies what actions (if any) are taken for each defect type/track category combination, and includes a cost estimate for that action on a per-defect occurrence basis. An installation may have more than one maintenance policy. For example, one policy may indicate only the minimal

¹⁵ TM 5-628, Draft.

¹⁶ D.R. Uzarski, D.G. Brown, R.W. Harris, and D.E. Plotkin.

¹⁷ *Civil Rail Lines Important to National Defense* (MTMC, July 1986).

DATE: June 87

For cars, "Heaviest Load" is the heaviest loading (net tons) placed on the car; for locomotives, "Heaviest Load" is the total weight (gross tons) of the locomotive.

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DATE: _____

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short-term solutions required to bring all track into compliance with the Army Track Standards,¹⁸ while another maintenance policy might specify the most efficient long or medium-term maintenance solutions. All maintenance policies will meet or exceed the minimum condition levels specified by the Army Track Standards.

A workbook developed at USACERL is used to help collect the maintenance policy information. Each defect is listed in the workbook, with columns used for different track categories.

Maintenance policy data were not collected during the first site visit. Instead, one engineer from USACERL returned to Fort Stewart during July 1988 to collect this information. He talked with two representatives from the Fort Stewart DEH--the roads, grounds, and railroad foreman and an assistant facility engineer. With these individuals, the USACERL engineer first discussed the concept of maintenance management policies and how to use the workbook. He then went through the workbook with them once, soliciting their maintenance actions for "in-house" and "contract" policies. They then worked back through the workbook to develop cost estimates. Some of these estimates required some research by the installation and were mailed to USACERL later. An example of one page for one of the policies is shown in Figure 13.

¹⁸ *Installation Outloading Capability Study, Fort Stewart, Georgia and Camp Blanding, Florida.*

	Total:		
203	VEGETATION -	4	1
	INTERFERES		
	WITH MOVEMENT		
	OF TRAINS OR		
	TRACK VEHICLES		

Track Category:
 Restriction Number:
 Work Action:
 Work Type:
 Unit Costs:

Material:	
Labor:	
Equipment:	
Total:	

300 NO DEFECTS

Track Category:
 Restriction Number:
 Work Action:
 Work Type:
 Unit Costs:

Material:	
Labor:	
Equipment	
Total:	

301	BOLT HOLE CRACK	3	1
-----	-----------------	---	---

Track Category:
 Restriction Number:
 Work Action: Weld and redrill or replace
 Work Type:
 Unit Costs:

Material:	
Labor:	
Equipment:	
Total:	

302 BREAK -
 COMPLETE

Track Category:
 Restriction Number:
 Work Action:
 Unit Costs:

Material:	
Labor:	
Equipment:	
Total:	

Figure 13. Page from Fort Stewart maintenance policy workbook.

3 DATA LOADING AND PROCESSING

The data loading and processing included several steps. All data collected at Fort Stewart, including that on maintenance policy, were first entered into the computer. Then RAILER information reports were run to verify the data and check for missing entries. After discrepancies were corrected, some of these reports were run again and are presented in Appendix D. This process was completed using RAILER version 2.0, running on an AT&T PC6300 computer (IBM-compatible) with a 20-mb hard disk. Although this work was done by an engineer, it could have easily been completed by a properly trained technician.

Data Entry

After creating the Fort Stewart RAILER database, the installation and inventory information was entered first, followed by inspection, traffic, and maintenance policy data. As indicated in Table 6, the inventory and inspection data entry took the most time, followed by the maintenance policy information.

For efficient data entry, the RAILER computer screens are designed to almost duplicate the data collection forms. However, after the primary site visit and before data entry, both the inventory and inspection procedures had been modified to the extent that the Fort Stewart data collection forms did not completely match the appropriate data entry computer screens. In the case of inventory data, this mismatch was slight and increased data entry times by, at most, 10 percent. However, as discussed in Chapter 2, the changes in the inspection procedures and form layouts were more significant, probably increasing data entry times by as much as 50 percent.

Table 6
Data Entry Times

Information Area	Manhours
Installation information	0.5
Track segment inventory	20.5
Track inspection	24.5
Maintenance policy	10.5
Traffic	0.7
	—
Total	56.7

Therefore, it must be stressed that these two data entry values (inventory and inspection) in Table 6 do not reflect what should be expected at other RAILER implementations. Specifically, these values should be about 10 and 33 percent lower, respectively, if they are used to estimate data entry times for future RAILER implementations. The other data entry times presented in Table 6 were substantially unaffected by RAILER modifications.

As can be seen in Table 7, the time required to load segment inventory information varied greatly on a per-segment basis. The time required to enter these data, like the time required for collection, depends primarily on the complexity of the track segment. More specifically, the variability in per-segment loading times is mainly caused by differences in the numbers of grade crossings and loading docks (a related facility type). The values in Table 7 include only the initial data entry time spent keying in values and/or scrutinizing the forms; the values do not include the time spent correcting earlier mistakes or periodic breaks away from the computer screen. These latter times are included in the total inventory data entry time presented in the second line of Table 6.

Table 8 lists the inspection data entry times for Fort Stewart. The primary obstacle in entering these data was that the forms are generally organized by inspection area (see Figures 3 through 10), whereas the final (modified) procedures are organized mainly by track segment as discussed above. The variation in the inspection data entry times is mostly due to differences in the number of rail and joint defects, "other component" defects, and the presence of turnouts.

Data Verification and Processing

After the data were initially loaded, the following RAILER information reports were generated:

- Installation Network Information Report
- Track Segment Inventory Information Report
- Track Segment Inspection Information Report
- Traffic Information Report
- Policy Report.

These reports were then carefully compared with the data collection forms (and the collective memory of the implementation team) to look for discrepancies. The times required to compare each information area are presented in Table 9. Again, the inconsistencies between the forms used at Fort Stewart and the current procedures inflated the time requirements, possibly by as much as 20 percent.

It took about 3 hr to correct the discrepancies found. This is a relatively short time when compared with the initial data loading effort (see Table 6).

After the database was verified and corrected, three key reports were generated (Appendix D). The installation information and segment inventory reports define the more permanent characteristics of the network. The comparison reports provide a useful way to determine the track condition (relative to the track standards and based on track inspection) at different levels of detail.

Table 7
Inventory Data Loading Times*

Track Segment	Time (Min)	Track Segment	Time (Min)
101	30	1001	17
102	60	1002	10
103	10	1003	10
		1004	5
201	15	1005	10
		1006	**
301	15	1007	20
302	15	1008	15
303	15		
304	15	1101	15
305	15		
306	30	1201	15
307	10		
308	12	1301	25
309	30	1302	30
401	90	1401	15
402	**		
		1501	20
501	15		
		CR101	15
601	15		
602	10	CR201	15
603	30		
		L01	15
701	20	L02	10
		L03	120
801	30		
		P01	10
901	15		
902	15	Y01	15

*Summary statistics: average: 22 min; standard deviation: 21 min; median: 15 min; range: 5 to 120 min.

**Unknown times.

Table 8
Inspection Data Loading Times

Component Area	Average Time	Total Time (hr)
Ties	2.61 min/segment	1.9
Vegetation	2.27 min/segment	1.7
Turnouts	8.99 min/turnout	4.0
Rail and joint:		7.0
Defects	1.55 min/defect	
Defect-free segments	0.53 min/segment	
Other component:		9.9
Component defects	1.64 min/defect	
Flangeway measurements	1.70 min/crossing	
Impaired inspection	0.86 min/segment	

Table 9
Data Verification Times

Information Area	Manhours
Installation information	0.20
Track segment inventory	3.45
Track inspection	5.25
Maintenance policy	1.60
Traffic	0.50
Total	<u>11.00</u>

4 SYSTEM TURNOVER TO INSTALLATION PERSONNEL

After the Fort Stewart database had been validated against the data collection forms, RAILER was ready to be turned over to installation personnel. The turnover process included providing informal RAILER training.

The first step in the system turnover was to install the RAILER program and the Fort Stewart database on an IBM-compatible AT computer in the Fort Stewart DEH. Successful installation was verified by producing some RAILER reports which were compared with the same reports produced previously at USACERL.

After the RAILER program was installed, one Fort Stewart employee was formally trained on the computer while several others looked on. Later a briefing was presented on the entire RAILER system. During the system turnover, several Fort Stewart RAILER reports produced at USACERL were turned over. Installation personnel will later be formally trained on RAILER data collection procedures and the use of RAILER for track maintenance management.

While it is not within the scope of this document to report on the use of RAILER at Fort Stewart, it is anticipated that an ongoing liaison will continue between USACERL and Fort Stewart, possibly through a RAILER users' group.

5 CONCLUSIONS AND RECOMMENDATIONS

RAILER version 2.0 has been implemented successfully at Fort Stewart, GA as part of the FY88 FEAP. Installation personnel found it immediately useful for railroad maintenance management decision-support.

The data collection process was demonstrated, including segment inventory and track inspection procedures. The relatively new structured track inspection procedures based on the Army Track Standards worked as expected. They permitted thorough inspections with simplified recording and reporting, requiring less reliance on the inspector's memory while meeting the forthcoming regulatory requirements.¹⁹ It was shown, however, that the inspection process is very labor-intensive and time-consuming.

The experience with the RAILER detailed track inspection at Fort Stewart suggested the need for two actions. First, as discussed in Chapter 2, the inspection procedures were modified, primarily by collapsing four of the previous inspection areas into one. However, the vast quantity of detailed data acquired with these new, detailed track inspection procedures was still more appropriate for project-level management than network-level management. Therefore, to efficiently support network-level management, simplified track inspection procedures are being developed at USACERL in conjunction with the Track Structure Condition Index (TSCI). These new procedures will use sampling techniques and have much fewer defect types with less location referencing requirements. The goal is to significantly reduce the inspection effort while still supporting the safety requirement of the Army Track Standards.

Based on the experience at Fort Stewart, it was concluded that the crew size can be greatly reduced. At future implementations, a crew size of two is usually sufficient, but a third member can increase the efficiency in some cases. Using a track cart, two people could quite adequately complete stationing and inventory during the same pass. On a second pass, these two persons could completely inspect the track (using the current detailed inspection procedures).

A third person could speed some tasks such as curve measurement (an inventory data element). More importantly, the third person could shorten the site visit by collecting the office information (such as installation, traffic, maintenance policy, and maintenance history information) while the other two crew members are in the field. However, it might be more advantageous to have the office information collected by crew members who have become familiar with the installation network through the track inspection.

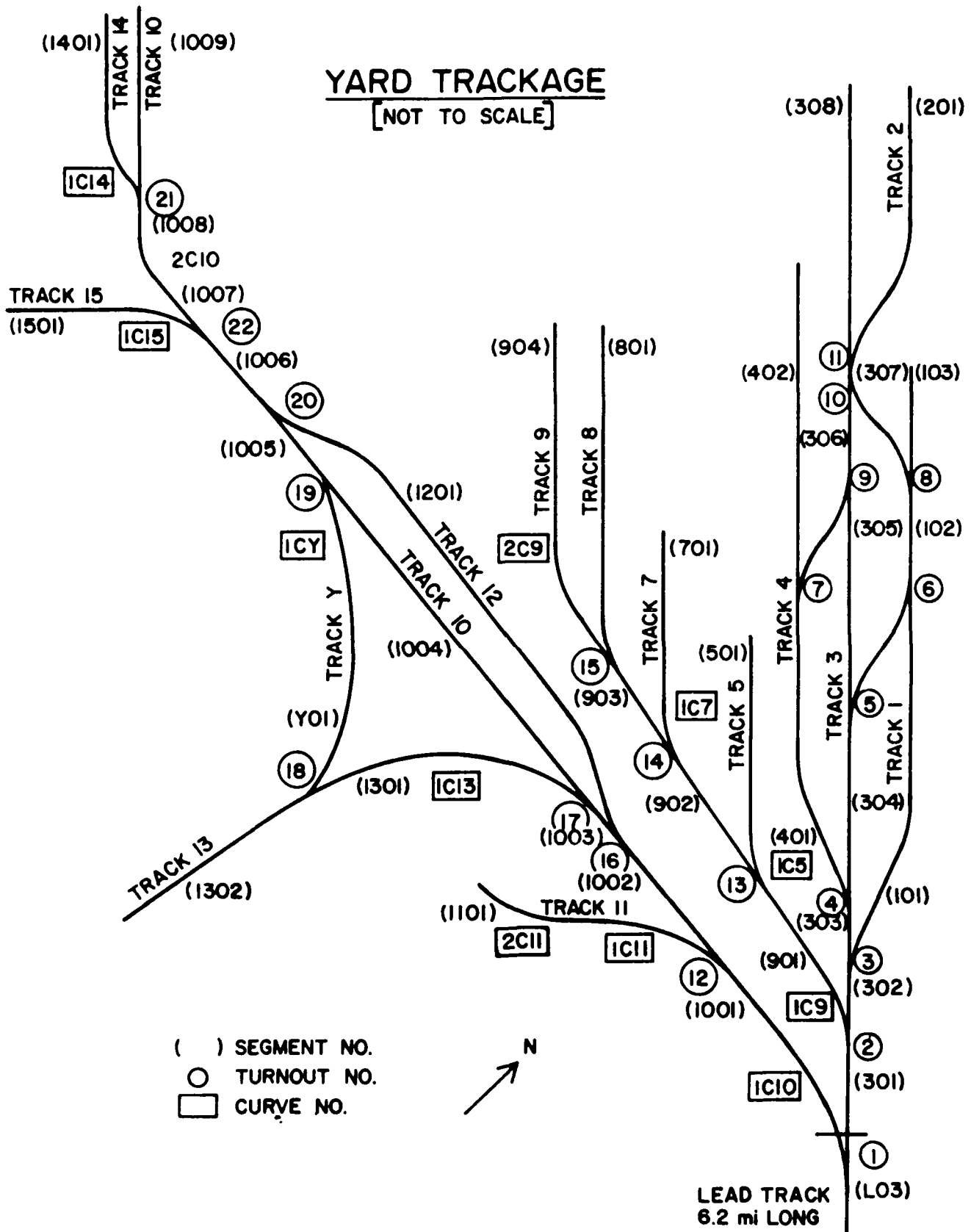
After evaluating the RAILER implementation at Fort Stewart, the system was judged ready for implementation on a contractual basis. During the following summer, RAILER was implemented by contract at another site as a FEAP project. As a result of these experiences, it is recommended that RAILER be released for general implementation on domestic Army installations.

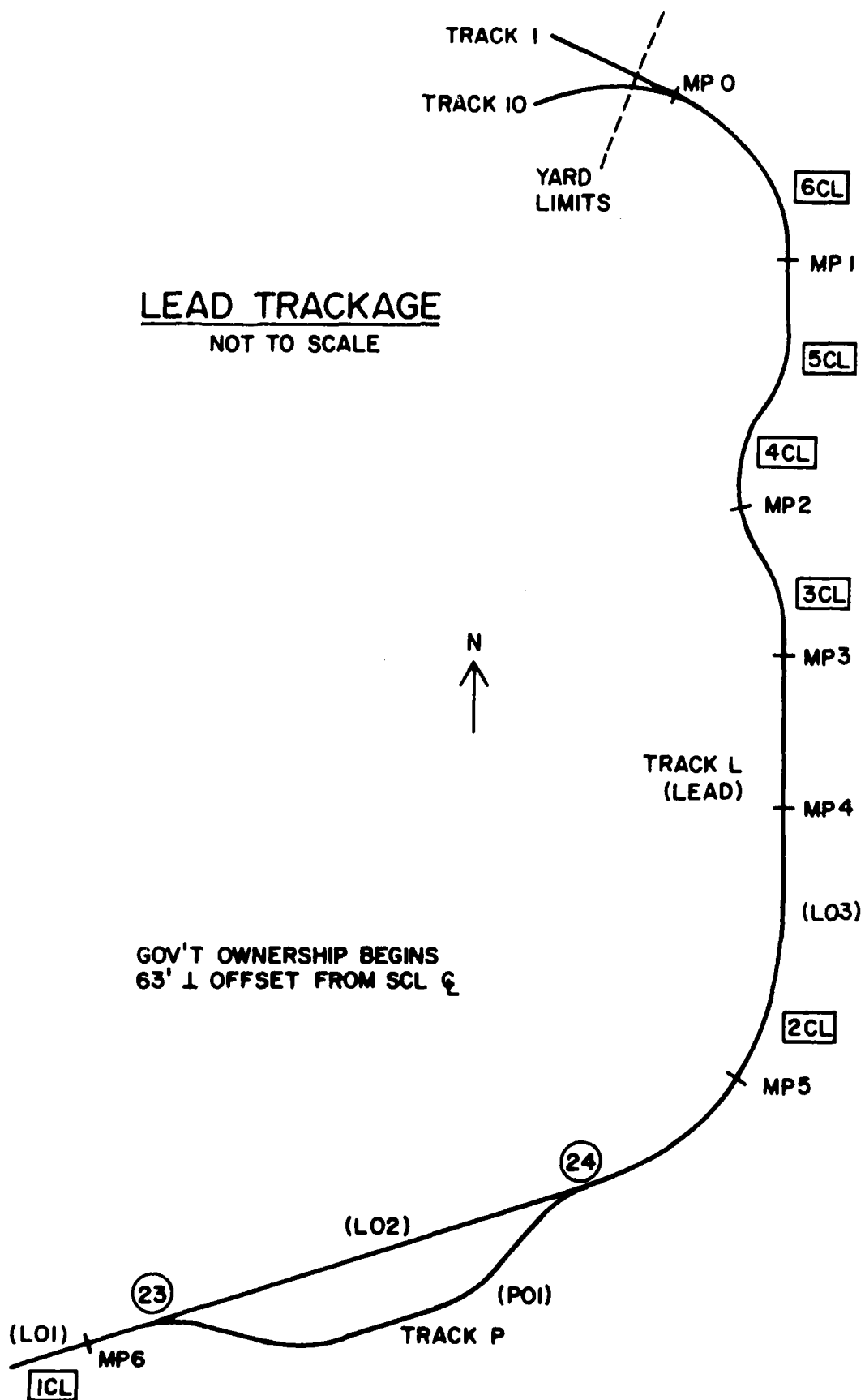
¹⁹ AR 420 72.

APPENDIX A:
PRELIMINARY SEGMENTED MAP

YARD TRACKAGE

[NOT TO SCALE]





APPENDIX B:

INITIAL WORK PLAN

This appendix includes the initial crew assignments, responsibilities, and plan of action for the FEAP field work at Fort Stewart.

A. Assignments and responsibilities

1. Overall Supervision: Don Uzarski
Assistance: Don Plotkin

Responsibilities:

- a. Overall project responsibility (administrative and technical)
- b. Project planning
- c. Coordination with installation
- d. Crew coordination
- e. Personnel assignments

2. Stationing and Segment Verification

Crew Leader: Sue Wagers
Member: Rich Harris

Responsibilities:

- a. Station the network
- b. Affix permanent markers
- c. Temporarily station with crayon key inventory components (switch point locations, culverts, etc.)
- d. Verify tracks on map

3. Inventory

Crew Leader: Dave Brown
Members: Mohammed Kahn, Mike Britton

Responsibilities:

- a. Complete segment inventory
- b. Complete network inventory
- c. Collect required information for the computation of track ranks
- d. Collect traffic information
- e. Verify all track segment numbers, turnout numbers, and curve numbers on map

4. Inspection

Crew Leader: Don Plotkin
Members: Joe Hovell (USAEHSC), John Borse

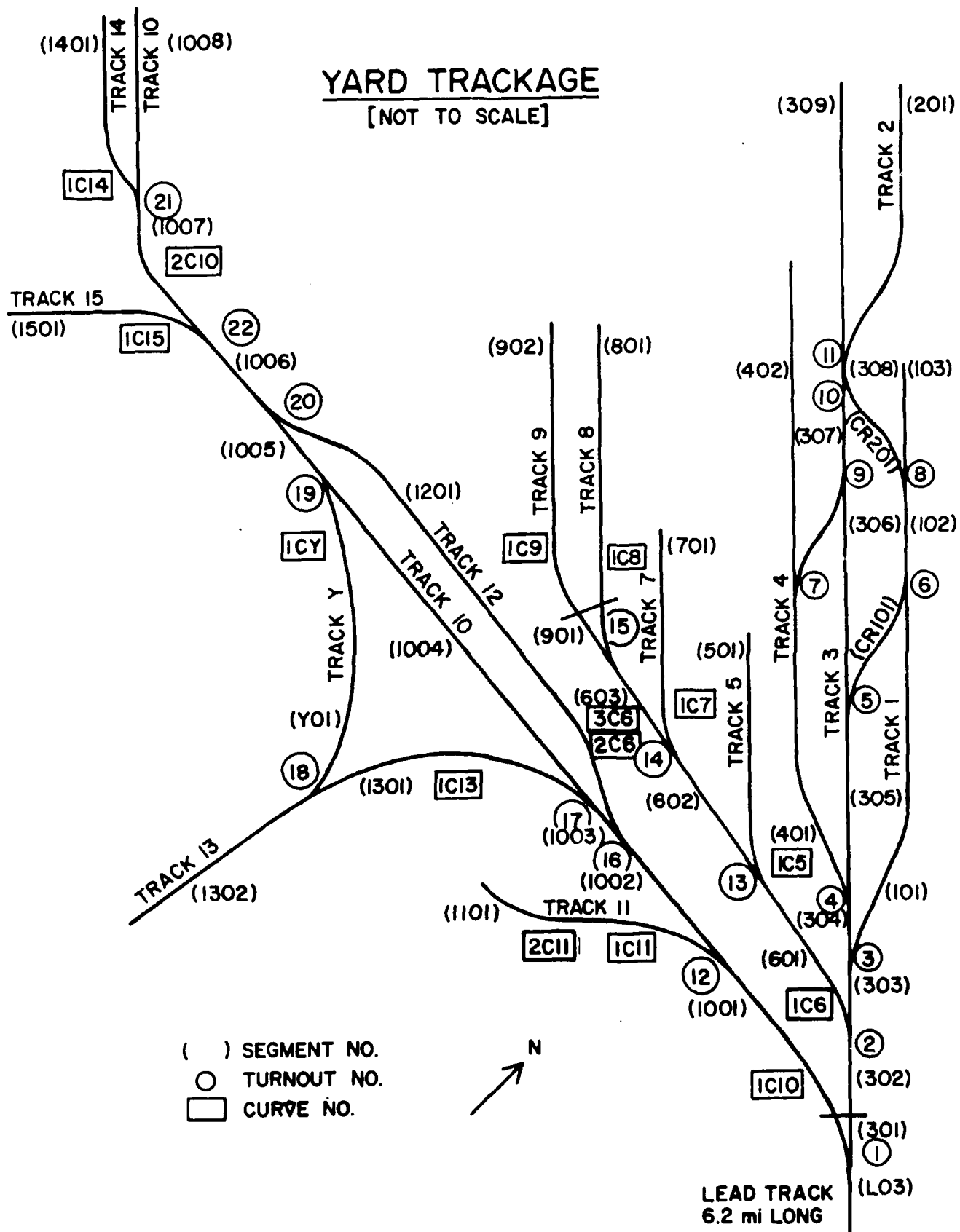
Responsibilities:

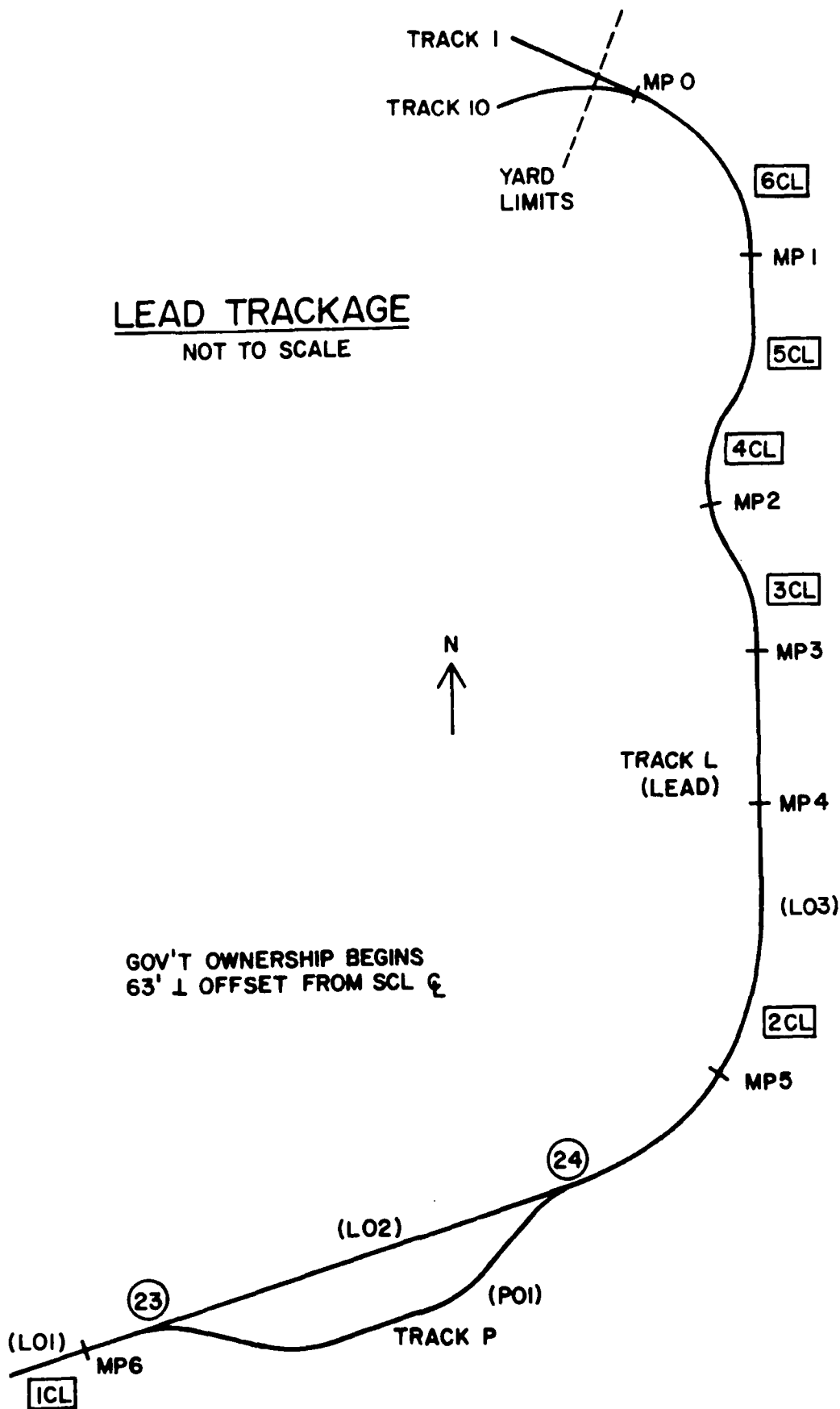
- a. Perform 100 percent track inspection of each segment
- b. Inspect related facilities

B. Action Plan

1. The stationing crew, the inventory crew leader, and supervisor will leave on 1 June, with the rest of the group to leave the next day. This will ensure that the stationing crew stays ahead of the others.
2. Plan to return on the 11th.
3. Most personnel will serve on more than one crew since none of those tasks should last the entire period. It is expected that stationing and inventory will be completed during the first week. Inspection will carry over into the second week.
4. A short meeting will be held at the close of each day to discuss the events of the day and to outline the next day's efforts.
5. Crew leaders are responsible for the completeness and accuracy of their work. Data sheets will be reviewed daily. Errors will be corrected prior to departure.
6. Work hours will generally be between 0800 and 1730. The progress of the work will dictate what actually will be done. The weekend should be free unless work dictates otherwise. Prepare to work in the rain.
7. All work must be completed within the allotted time.
8. Three station wagons will be rented so that all of the equipment can be transported easily.
9. Crew leaders need to make sure that all of the materials, tools, etc. needed to do the work are taken along.
10. Equipment will be shipped beforehand. Mohammed Kahn will coordinate this effort with the crew leaders.
11. Initially, the stationing crew will use the track cart. After that, use will be determined based on need.
12. Accomplish all key planning items as soon as possible.
13. The supervisor will work with each of the crews to some extent.
14. Data loading, extensive number crunching, and analysis work will be performed back at USACERL upon return.

APPENDIX C:
FINAL SEGMENTED MAP





APPENDIX D:

RAILER REPORTS

EE, Stewart, GA

RAILER
01/27/1989

Page: 1

INSTALLATION NETWORK INFORMATION REPORT

INSTALLATION #: 13305

PRIMARY INSTALLATION NUMBER: 13305

INSTALLATION TRACKAGE

TRACK #	TRACK LENGTH	# OF SEGMENTS
1	2922 TF	3
10	8195 TF	8
11	387 TF	1
12	1364 TF	1
13	2304 TF	2
14	2413 TF	1
15	1188 TF	1
2	1099 TF	1
3	4881 TF	9
4	2470 TF	2
5	349 TF	1
6	1375 TF	3
7	313 TF	1
8	1113 TF	1
9	1555 TF	2
CR1	165 TF	1
CR2	165 TF	1
L	32639 TF	3
P	2230 TF	1
V	778 TF	1

TOTAL # OF SEGMENTS =	44
TOTAL TRACK LENGTH =	68538 TF

TRACK SEGMENT INVENTORY INFORMATION REPORT

INSTALLATION #: 13305

PRIMARY INSTALLATION NUMBER: 13305

SEGMENT IDENTIFICATION

Track Segment #	Begin/End Location (station)	Track Length (feet)	Track Category	Track Use	Track Rank	Construction Code/Preceding Track Segment #(s)
1001	0+99 10+58	959	B	Access	0.000	P 301

Comments:

TRACK STRUCTURE

RAIL					
Track Segment #	Begin Location (station)	End Location (station)	Length (feet)	Weight (lbs/yd)	Section
1001	0+99	1+14	30	115	RE
1001	1+14	1+24	20	100	RE
1001	1+24	10+58	1868	85	ASCE

FASTENINGS			TIES			BALLAST	
Tie Plate Length (in)	Shoulder	Rail Anchors	Gauge Rods (in x in)	Cross Section Spacing (in)	Material	Support Depth (in)	Type
13.00	DS	N	N	6X8	22.02	Wood	Rock
11.00	DS	N	N	X	Wood	Rock	
9.00	SS	Y	Y	X	Wood	Rock	

Comments: 3 gauge rods were found in this track structure section, and 100 rail anchors were found in one 200 ft. length.

TURNOUTS

Track Segment #/ Turnout #	Switch Pt Location (station)	Direction	Point Length (LF)	Rail Weight Change	Frog Type/ Frog Size	Guard Rail Length (LF)
1001 12	9+69	LH	15.0	N	SELF GUARDED 8	

Reversing tangent < 50 ft Past Frog: N
Comments: Provides access to track 11

CURVES

Track Segment #	Curve ID #	Curvature (degrees)	Required Superelevation (inches)	Desired Speed (mph)
1001	1010	5.00	0.00	5

Comments:

DRAINAGE STRUCTURES

Track Segment #	Centerline Location	Type	Size (inches)	Material
1001	6+74	Pipe culve	40	Steel
1001	3+39	Pipe culve	50	Steel

Comments:

13105
 Ft. Stewart, GA

RAILR
 Condition Comparison
 by Inspection Type Report
 =====

Page: 1
 Date: 01/27/1989

Report Criteria: Condition Comparison by Inspection Type Report for All Track
 Segments.

TRACK SEGMENT #	NO OPERATION	5 MPH SPEED LIMIT	10 MPH SPEED LIMIT	FULL COMPLIANCE	DEFECT FREE
1001	TURNOUTS		RAIL & JOINTS	TIES TRACK COMP TURNOUT GEOM	VEGETATION
1002			TURNOUTS	RAIL & JOINTS TIES TRACK COMP TURNOUT GEOM	VEGETATION
1003				TIES TURNOUT GEOM	RAIL & JOINTS TRACK COMP TURNOUTS VEGETATION
1004				TIES TRACK COMP	VEGETATION
1005			TURNOUTS	TRACK COMP TURNOUT GEOM	RAIL & JOINTS TIES VEGETATION
1006		TURNOUTS	TIES	RAIL & JOINTS TRACK COMP TURNOUT GEOM VEGETATION	
1007	FLANGWAY MFA		TIES	RAIL & JOINTS TRACK COMP TURNOUTS VEGETATION	TURNOUT GEOM
1008			TIES	RAIL & JOINTS TRACK COMP	VEGETATION
101	FLANGWAY MFA TIES			TRACK COMP	RAIL & JOINTS VEGETATION
102	FLANGWAY MFA	TURNOUT GEOM	VEGETATION	TIES	RAIL & JOINTS

13305
Ft. Stewart, GA

RAILER
Condition Comparison
by Inspection Type Report
=====

Page: 2
Date: 01/27/1989

Report Criteria: Condition Comparison by Inspection Type Report for All Track Segments.

TRACK SEGMENT #	NO OPERATION	5 MPH SPEED LIMIT	10 MPH SPEED LIMIT	FULL COMPLIANCE	DEFECT FREE
TURNOUTS				TRACK COMP	
103			TIES	TRACK COMP VEGETATION	RAIL & JOINTS
1101			RAIL & JOINTS	TIES TRACK COMP VEGETATION	
1201	FLANGWAY MEA		RAIL & JOINTS TIES	TRACK COMP VEGETATION	
1301				TIES TRACK COMP	RAIL & JOINTS VEGETATION
1302		TIES	TURNOUTS	FLANGWAY MEA RAIL & JOINTS TRACK COMP	TURNOUT GEOM VEGETATION
1401				TIES TRACK COMP	VEGETATION
1501					RAIL & JOINTS TIES TRACK COMP VEGETATION
201	FLANGWAY MEA			RAIL & JOINTS TRACK COMP VEGETATION	TIES
301		TURNOUTS		TURNOUT GEOM	RAIL & JOINTS TIES TRACK COMP VEGETATION
302		TURNOUTS	TURNOUT GEOM	TIES TRACK COMP	RAIL & JOINTS VEGETATION

10305
 EL. Stewart, GA

RAILR
 Condition Comparison
 by Inspection Type Report

Page: 1
 Date: 01/27/1989

Report Criteria: Condition Comparison by Inspection Type Report for All Track
 Segments.

TRACK SEGMENT #	NO OPERATION	5 MPH SPEED LIMIT	10 MPH SPEED LIMIT	FULL COMPLIANCE	DEFECT FREE
303	TURNOUTS	TURNOUT GEOM	RAIL & JOINTS TIES	TRACK COMP	VEGETATION
304	FLANGWAY MEA	TURNOUTS		TIES TRACK COMP TURNOUT GEOM	RAIL & JOINTS VEGETATION
305	FLANGWAY MEA	TURNOUTS		TIES TRACK COMP TURNOUT GEOM	RAIL & JOINTS VEGETATION
306	FLANGWAY MEA		TIES	RAIL & JOINTS TRACK COMP	VEGETATION
307			TURNOUT GEOM TURNOUTS	RAIL & JOINTS TIES TRACK COMP	VEGETATION
308			TURNOUT GEOM TURNOUTS	RAIL & JOINTS TIES TRACK COMP VEGETATION	
309	FLANGWAY MEA			RAIL & JOINTS TIES TRACK COMP VEGETATION	
401	FLANGWAY MEA			TIES TRACK COMP	RAIL & JOINTS VEGETATION
402				RAIL & JOINTS TIES TRACK COMP VEGETATION	
501				RAIL & JOINTS TIES	

13305
Ft. Stewart, GA

RAILER
Condition Comparison
by Inspection Type Report
=====

Page: 4
Date: 01/27/1989

Report Criteria: Condition Comparison by Inspection Type Report for All Track Segments.

TRACK SEGMENT #	NO OPERATION	5 MPH SPEED LIMIT	10 MPH SPEED LIMIT	FULL COMPLIANCE	DEFECT FREE
				TRACK COMP VEGETATION	
601	TURNOUTS			TIES TRACK COMP TURNOUT GEOM	RAIL & JOINTS VEGETATION
602				TIES TRACK COMP TURNOUTS VEGETATION	RAIL & JOINTS TURNOUT GEOM
603	FLANGWAY MEA		TIES	TRACK COMP TURNOUT GEOM TURNOUTS VEGETATION	RAIL & JOINTS
701	TIES			TRACK COMP VEGETATION	RAIL & JOINTS
801	FLANGWAY MEA			RAIL & JOINTS TIES TRACK COMP VEGETATION	
902	FLANGWAY MEA			TIES TRACK COMP VEGETATION	RAIL & JOINTS
CR101			FLANGWAY MEA		RAIL & JOINTS TIES TRACK COMP VEGETATION
CR201	FLANGWAY MEA				RAIL & JOINTS TIES TRACK COMP VEGETATION
101					

13305
Ft. Stewart, GA

RAILR
Condition Comparison
by Inspection Type Report
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Date: 01/27/1989

Report Criteria: Condition Comparison by Inspection Type Report for All Track Segments.

TRACK SEGMENT #	NO OPERATION	5 MPH SPEED LIMIT	10 MPH SPEED LIMIT	FULL COMPLIANCE	DEFECT FREE
		TURNOUTS	TURNOUT GEOM VEGETATION	RAIL & JOINTS TIES TRACK COMP	
102			TIES VEGETATION	TRACK COMP	RAIL & JOINTS
103	FLANGWAY MFA TIES RAIL & JOINTS TURNOUTS		TURNOUT GEOM	TRACK COMP VEGETATION	
P01		TIES		VEGETATION	RAIL & JOINTS TRACK COMP
V01				RAIL & JOINTS TIES TRACK COMP	VEGETATION

13305
Ft. Stewart, GA

RAILR
MAR Summary Report
=====

Page: 1
Date: 01/27/1989

Condition After Repairs: Full Compliance
Policy: IN-HOUSE

Track Category: All
Track Use: All

Track Segment #	Maintenance Standard Condition	Total Cost to Raise Condition to Desired Level
1001	NO OPERATION	\$406.00
1002	10 MPH SPEED LIMIT	\$0.00
1005	10 MPH SPEED LIMIT	\$10.00
1006	5 MPH SPEED LIMIT	\$728.00
1007	NO OPERATION	\$818.00
1008	10 MPH SPEED LIMIT	\$700.00
101	NO OPERATION	\$1,327.00
102	NO OPERATION	\$282.00
103	10 MPH SPEED LIMIT	\$991.00
1101	10 MPH SPEED LIMIT	\$350.00
1201	NO OPERATION	\$700.00
1302	5 MPH SPEED LIMIT	\$2,339.00
201	NO OPERATION	\$0.00
301	5 MPH SPEED LIMIT	\$30.00
302	5 MPH SPEED LIMIT	\$28.00
303	NO OPERATION	\$994.00
304	NO OPERATION	\$10.00
305	NO OPERATION	\$0.00
306	NO OPERATION	\$291.00
307	10 MPH SPEED LIMIT	\$0.00
308	10 MPH SPEED LIMIT	\$10.00
309	NO OPERATION	\$0.00
401	NO OPERATION	\$0.00
601	NO OPERATION	\$61.00
603	NO OPERATION	\$291.00
701	NO OPERATION	\$2,072.00
801	NO OPERATION	\$0.00
902	NO OPERATION	\$0.00
CR101	10 MPH SPEED LIMIT	\$0.00
CR201	NO OPERATION	\$0.00
L01	5 MPH SPEED LIMIT	\$71.00
L02	10 MPH SPEED LIMIT	\$1,227.00
L03	NO OPERATION	\$8,766.00
P01	5 MPH SPEED LIMIT	\$3,556.00
		\$26,640.00

Note: The policy chosen may not allow the selected track segment(s) to be raised to the desired operating or condition level.

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