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A Standards-Based Movement and Infrastructure Aggregation Methodology for Mobility Representation in Modeling and Simulation

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Contents

Preface

The study reported herein was conducted by members of the staff of the U.S. Army Engineer Research and Development Center (ERDC), Geotechnical and Structures Laboratory (GSL), Engineer Systems and Materials Division (ESMD), Mobility Systems Branch (MSB), Vicksburg, MS. The work was conducted under the Work Item Code 004SWH, "Ground Movement Representation in Joint Warfare Simulations (JWARS)." Sponsors for the project were the Office of the Secretary of Defense, Program Analysis and Evaluation (PA&E). The work was conducted between October 1998 and March 2001.

The study was conducted under the general supervision of Dr. Michael J. O'Connor, Director, GSL, Dr. Albert J. Bush III, Chief, ESMD, and Dr. David A. Horner, Chief, MSB. The overall development--the logic and computer programming--was accomplished by Messrs. George B. McKinley and Terril C. Falls, MSB, and Dr. Niki C. Deliman, MSB, and Ms. Laura S. Bunch, MEVATEC Corporation, Vicksburg. MSB staff members supporting this study were Mses. Stephanie J. Price, F. Nora Ponder, and Mary A. Dungan.

Messrs. McKinley and Falls, Dr. Deliman, and Ms. Bunch prepared the report.

At the time of publication of this report, Dr. James R. Houston was Director of ERDC, and COL John W. Morris III, EN, was Commander and Executive Director.

1 Introduction

Background

The Mobility Systems Branch (MSB) has a long history of providing Tactical Decision Aids (TDA) for military planning systems and ground movement algorithms for Modeling and Simulation (M&S). These TDA and M&S algorithms are based on the NATO Reference Mobility Model (NRMM), which is an Army Model and Simulation Office (AMSO) standard for ground vehicle movement. There is currently a need to characterize vehicle pass rates in M&S as well as for planning and operations in the Army and Department of Defense (DoD). In particular, the theater-level Joint Warfare Simulations (JWARS) model has a requirement to represent ground movement in terms of a vehicular pass rate through an area. These pass rates are assigned to edges which are connected by nodes to form a movement network. Each edge may be required to represent several roads as a result of the large terrain areas that a theater-level model must accommodate. The MSB was tasked to provide vehicle pass rates and software to aggregate the roads provided in the Compact Terrain Data Base (CTDB) into a simpler network.

Purpose and Scope

To model the characteristic throughput of a theater transportation network, two major objectives were identified. One objective was to develop a methodology for generating representative pass rates for roads based on pertinent and readily-available system and environmental factors. A second objective involved developing a methodology for identifying and aggregating the transportation network into a simplified system of nodes and edges that retains the theater movement characteristics. The pass rate generation methodology involved categorizing roads based on road factors impacting movement rates, identifying environmental parameters affecting movement, and developing a method to create representative road profiles and conditions from which a set of pass rates could be generated to support current and future scenarios in JWARS and other M&S. The network aggregation methodology entailed developing a scalable means of reducing the number of nodes and edges in a network, identifying the roads associated with an aggregated edge, and generating a resultant aggregated capacity associated with each aggregated edge.

The purpose of this report was to present the methodology and results of a process which categorizes the transportation network and the derivation of the associated pass rates for convoys of vehicles. The first part of the report describes the process of deriving the pass rates and average speeds for vehicle convoys. Then the methodology for categorizing and aggregating the transportation network is presented. This software has been developed to generate the movement network for JWARS. The scope of this report was limited to ground vehicle movement on-road.

2 Derivation of Pass Rates

Profile Generation

Synthetic fractal elevation profiles were created to represent profiles in the three landform types of plains, hills, and mountains. Plains are flat to rolling areas with comparatively little change in elevation between high and low places (Headquarters, Department of the Army 1972). Hills are characterized by moderately high local relief of limited extent with steep slopes, and small summit areas, which rise above the surrounding area. Mountains have high elevations, steep slopes, and small summit areas with local relief greater than 610 m (2,000 ft). The profiles were placed in one of the three terrain types based on the maximum slope and the local relief. The slope was computed by taking the rise over the run between each of the postings in the profile. The local relief was defined as the difference in the highest and lowest elevation in a 100-km stretch of elevation profile. The criteria used to classify terrain are shown in Table 1.

Table 1
Landform Classification Criteria

Landform Type	Maximum Local Relief, ft[1]	Maximum Slope (%)
Plains	<500	7
Hills	500 – 2,000	10
Mountains	>2,000	>10

[1] To convert feet to meters, multiply by 0.3048.

Fractals are shapes that are both self-similar and independent of scale. The fractal profiles were created using the midpoint displacement method (Barnsley et al. 1988). This algorithm is as follows:

```
ioff := maxdim/2;
d := maxdim;
for j := 1 to maxlvl do
begin
   delta := Sigma * 0.5**(j * H) * sqrt(1.0 – 2.0**(2.0 * H – 2));
   for ny := ioff to maxdim by d do
   begin
      y[ny] := (y[ny + ioff] + y[ny – ioff])/2 + delta * Rand(Seed);
   end;
   d := d/2;
   ioff := ioff/2;
end;
```

For this study, *maxlvl* was set to 13 which yielded profiles consisting of 8193 ($2^{13} + 1$) evenly spaced elevation postings. The variable *maxdim* would be 8192 (2^{13}) since the initial elevation posting would be denoted by 0. *Rand* is a function that returns a random number from a Gaussian distribution. Postings were generated over a 300-km traverse. Profiles were created using various values for *Sigma* for fractal dimensions falling between 1.01 and 1.46. *Sigma* is the initial standard deviation. It controls the amount of overall elevation change that is produced in the resulting profile. The fractal dimension, in the midpoint displacement algorithm, is given by 2-H. The fractal dimensions and the corresponding values of *Sigma* for the profiles selected to represent a statistically significant sample size of 25 per landform category are listed in Appendix A. The procedure for screening the acceptability of profiles involved generating 45 raw profiles for each landform. The criteria for landform category (plains, hills and mountains) were applied in order to choose the 25 statistically significant profiles for each landform. The criteria used were maximum local relief and maximum slope as shown in Table 1. This resulted in synthetic profiles for plains, hills, and mountains, generated from a set of raw profiles. Examples of profiles that represent plains, hills, and mountains are shown in Figures 1 through 3, respectively.

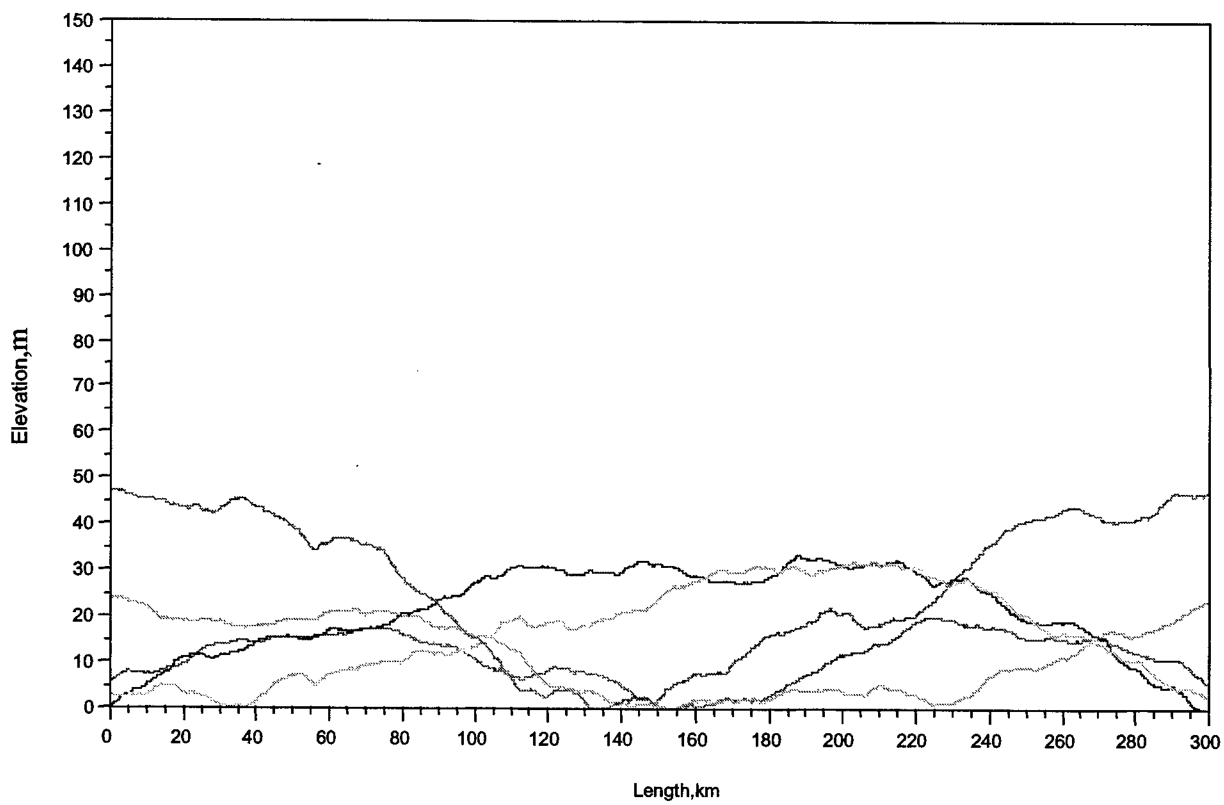

Figure 1. Example profiles representing plains

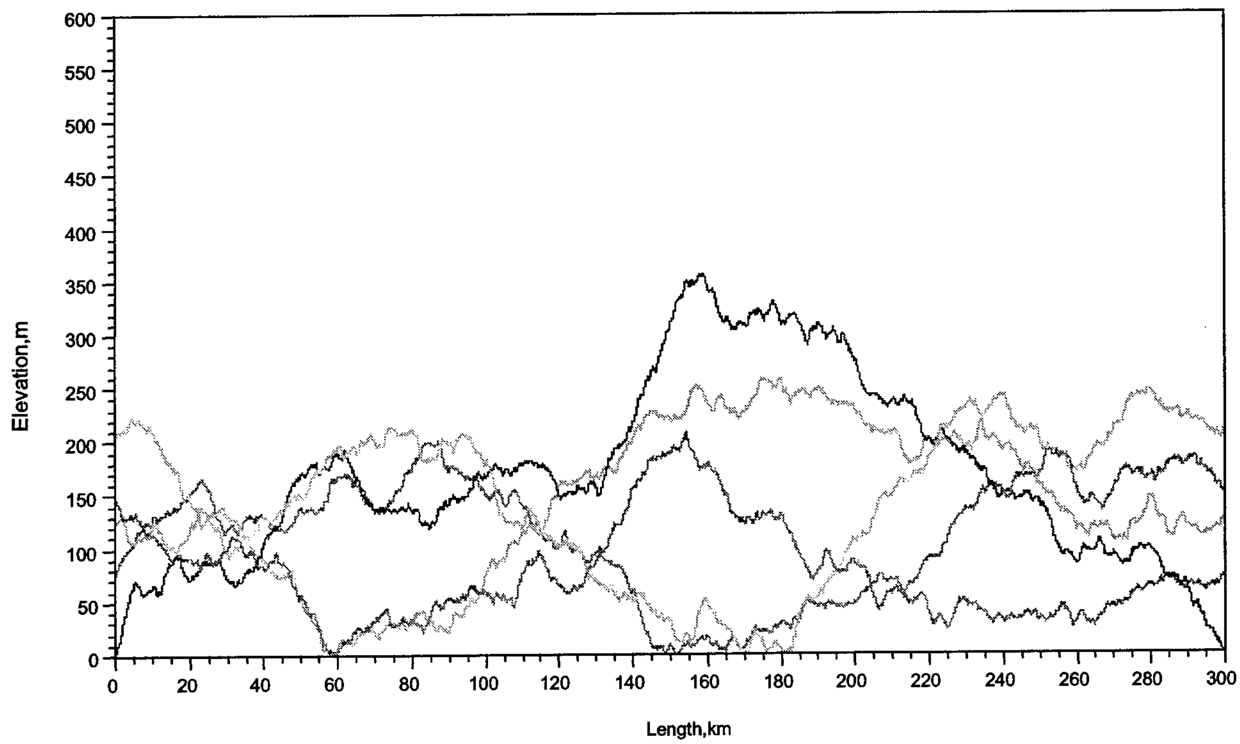

Figure 2. Example profiles representing hills

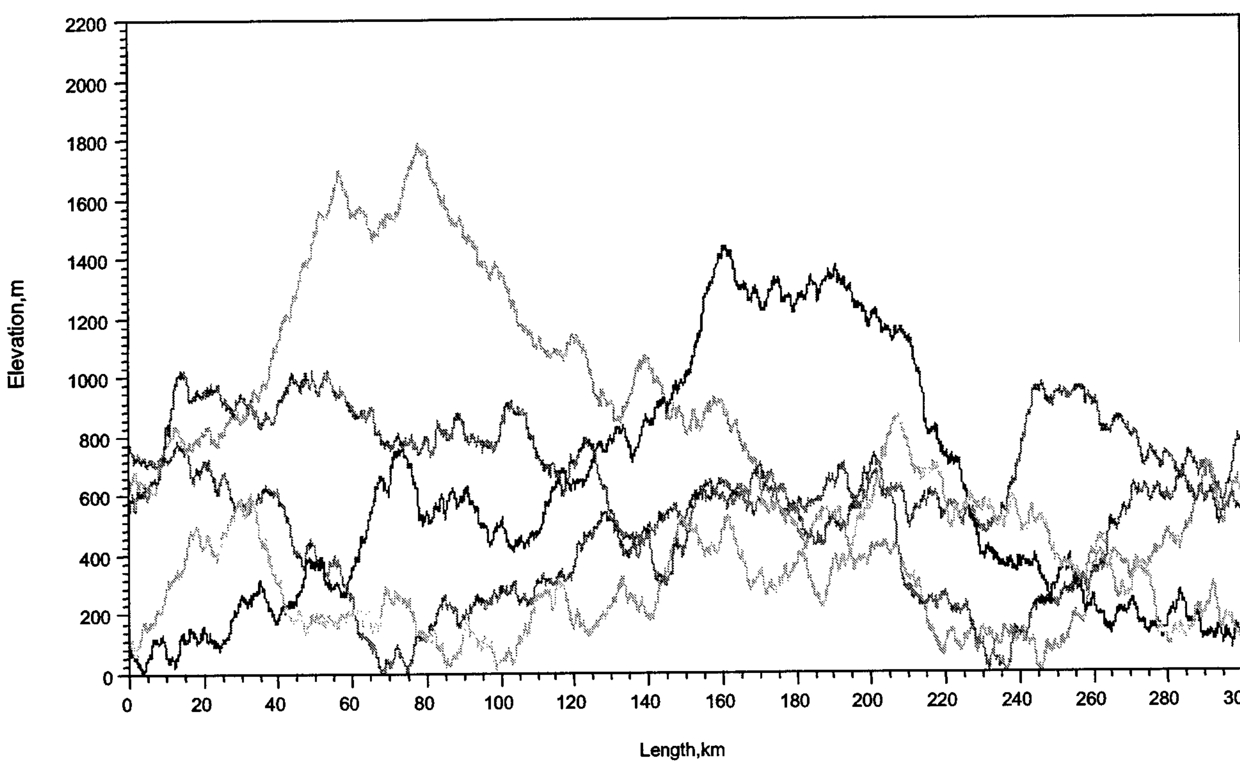

Figure 3. Example profiles representing mountains

Profile Conversion for Use with Mobility Models

The fractal elevation profiles were converted to road files in the proper format, based on conditions shown in Table 2, to be used as input to NRMMII. The NRMMII (Ahlvin and Haley 1992) is a comprehensive analytical model designed to evaluate objectively the on- and off-road mobility of vehicles by means of digital computer simulation. This model is the AMSO standard for ground vehicle movement. The NRMMII road database is divided into homogeneous units, each of which should be nominally uniform with respect to values pertinent to mobility (Mason et al. 1985). Separate road files were created for each profile to represent the road types of super highways/primaries, secondary roads, and trails. A primary road has two or more lanes consisting of an all-weather hard surface with good driving visibility used for heavy and high-density traffic. These roads have a minimum lane width of 2.74 m (9 ft). A super highway has four or more lanes with limited access to/from other roads. A secondary road is an all-weather road with two lanes, maintained, with a hard or loose surface (paved, crushed rock, gravel) and intended for medium-weight, low-density traffic. This road has a minimum lane width of 2.44 m (8 ft). A trail is a one-lane, dry-weather, unimproved, loose-surfaced road intended for low-density traffic. Trails have a minimum lane width of 2.44 m (8 ft) with no large obstacles (boulders, logs, stumps) and include gravel- and dirt-surfaced roads. The major road difference is the maximum slope allowed for each road type, as a result of the fact that more grading would be done to alleviate steep slopes on a super highway/primary as opposed to a secondary road or trail. Flat sections of road with curves were introduced if the road had the same slope direction (uphill or downhill) for a distance greater than a designated critical distance (0.402 km (1/4-mile)) (Wright and Ashford 1982). This was performed to model the effects of switchbacks in mountainous terrain. Table 2 illustrates the factors associated with each terrain/road combination. Surface roughness in the NRMMII road terrain files was purposely set to 0.1 root mean square elevation in inches, so that ride quality would not factor into the final results. The trails were modeled as hard-surfaced with soil strengths of 300 Rating Cone Index (RCI) and a Universal Soil Classification System (USCS) type of SM. The SM soil type contains silty sands with fines having low or no plasticity.

Table 2
Slopes and Curvatures for Each Terrain/Road Combination

Terrain Type	Super Highways and Primary Roads		Secondary Roads		Trails	
	Maximum Slope, %	Radius of Curvature ft[1]	Maximum Slope, %	Radius of Curvature ft	Maximum Slope, %	Radius of Curvature Ft
Plains	3	1,348	6	509	7	273
Hills	4	1,206	7	468	10	249
Mountains	6	1,091	10	432	15	229

[1] To convert feet to meters, multiply by 0.3048.

Mobility Models

The NRMMII predicts the maximum attainable safe speed of a vehicle for each terrain unit by treating each unit as if it were of sufficient length to obtain steady-state speed.[1] For its database, the NRMMII requires quantitative descriptions of terrain, vehicle, and driver attributes. Road terrain attributes were discussed previously. NRMMII was used with the resulting road terrain files for the M1084, M985, and M917, which were selected as representative of high-, medium-, and low-mobility wheeled vehicles. The M1084 with the M1095 trailer, the M985 with the M989 trailer, and the M911 with the M747 trailer were chosen to represent high-, medium-, and low-mobility wheeled vehicles towing a loaded trailer. The M1A1 tank, the M88A1 recovery vehicle, and the Armored Vehicle Launched Bridge (AVLB) were selected to represent high-, medium-, and low-mobility tracked vehicles. The M113A2 and the LAV3 were chosen to represent tracked and wheeled amphibious vehicles. Some critical vehicle parameters for these vehicles are shown in Table 3. Complete NRMMII files of these vehicles are listed in Appendix B. Driver attributes in the NRMMII characterize the driver according to his ability to perceive and react to visual stimuli affecting his behavior as a vehicle controller and his limiting tolerances to shock and vibration. For the particular surface material of interest, values of drawbar pull and rolling resistance, as coefficients, are obtained for the given vehicle operating straight-line on the surface. From these coefficients, a tractive force versus speed curve is developed. Various speeds are then computed as limited by various resistances; ride and shock (absorbed power and peak acceleration); visibility and braking; and road curvature. The least of these speeds is assigned as the operating speed for that terrain unit. Speed predictions for up-slope, down-slope, and level ground are stored to allow the selection of the appropriate prediction by the Combat Maneuver Model (CMM).

Table 3
Characteristics of Study Vehicles

Vehicle Name	Type	Mobility Class	Vehicle Weight, lb[1]	Total Length, ft[2]	Horsepower per Ton[3]
M1084	Wheeled	High	34,090	17.1	17.0
M985	Wheeled	Medium	60,250	22.5	13.4
M917	Wheeled	Low	72,900	20.7	11.0
M1084/M1095	Towed	High	55,108	36.5	10.5
M985/M989	Towed	Medium	90,820	47.1	8.9
M911/M747	Towed	Low	181,000	55.5	4.9
M1A1	Tracked	High	127,451	15.0	23.5
M88A1	Tracked	Medium	112,000	15.0	13.4
AVLB	Tracked	Low	123,000	13.9	12.2
LAV3	Wheeled	Amphibious	39,412	12.7	15.8
M113A2	Tracked	Amphibious	25,000	8.8	17.0

[1] To convert pounds to kilograms, multiply by 0.4536.
[2] To convert feet to meters, multiply by 0.3048.
[3]. To convert tons to kilograms, multiply by 9.071.

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[1] Postprocessors are available to use internal acceleration/deceleration routines to adjust the speeds between units based on the predicted time required to cross each unit for short traverse distances.

The CMM (McKinley et al. 1993) computes the time required for a group of vehicles to traverse a series of terrain units. The vehicles must travel in one of four basic formations: column, bounding over-watch, combat lines, and parallel columns. The minimum and maximum following distances for vehicles within a column formation, in addition to a maximum allowed speed, are input to the routine, thus allowing the modeling of both open and closed column formations (Headquarters, Department of the Army 1984). The CMM was used in this study with homogeneous columns made up of each of the vehicles. The CMM was run for four visibility conditions as shown in Table 4. The CMM models the column at a specified time interval (5 sec in this case). The vehicles are allowed to move along the traverse at their NRMMII-predicted speed or the allowed maximum march rate as shown in Table 4 for the time interval. If vehicle A gets too close (less than the minimum spacing) to the preceding vehicle B, then vehicle A would be required to travel at a slower pace over the time interval to maintain the columns integrity. If vehicle A gets too far behind (more than the maximum spacing) the preceding vehicle B, then vehicle B would be required to travel at a slower pace over the time interval to maintain the column's integrity. The time interval at which the first vehicle enters a terrain segment and the time when the last vehicle exits a terrain segment are saved. The difference between these times is termed the pass time for the column.

Table 4
Column Parameters for Visibility Conditions

Visibility	Recognition Distance, ft[1]	Spacing Range, m	Maximum Speed kph	Formation
Unlimited	300	50 – 100	64	Open
Fog	50	50 – 100	64	Open
Limited	30	25 – 50	24	Closed
Blackout	10	20 – 25	8	Closed

[1] To convert feet to meters, multiply by 0.3048.

Results

The following four factors were identified as affecting convoy movement and pass rate based on mobility modeling and practice: landform (hills, plains, and mountains), road type (superhighway/primary, secondary road, and trail), visibility condition (unlimited, fog, limited, blackout), and weather scenario (dry-normal, wet-slippery, and snow). Thus, to generate the representative spectrum of pass rates, CMM was applied for the 11 vehicle types under the visibility and weather combinations of the above factors for the set of profiles representing landform and road type combinations. The visibility condition dictated convoy spacing, formation rules, and maximum convoy speed (Headquarters, Department of the Army 1984). The maximum convoy speed was used in the model to prevent vehicles from exceeding that speed, even if vehicles were capable of faster velocities; this maximum speed was correlated to, but higher than, typical ordered speeds.

For statistical purposes, convoy movement was simulated for each of the vehicles moving with 25 vehicles per column traversing each of the representative profiles under specified conditions. For each profile, CMM was run for each condition. Pass rate estimates were generated at several locations along the profile and averaged to get an average pass rate for the vehicle column on that profile for specified conditions. The average of the pass times for all the profiles representing a terrain type in a given weather/visibility condition was used as the capacity for that vehicle. Appendix C lists the computed capacities for all vehicle, road type, terrain, weather, and visibility combinations. For a point of reference, the results for the M923 and the M923 towing the M1061 trailer were compared to the capacities presented by the Defense Intelligence Agency (DIA) in their document entitled "Highway Resupply Methodology" (DIA 1990). The 5-ton M923 was selected because the DIA methodology was based on a medium-sized cargo truck carrying a payload of 5 metric tons. The M923 was a 5-ton truck in operation during 1990 when the DIA methodology was published and some of its pertinent parameters are shown in Table 5. The complete NRMMII files for these vehicles are listed in Appendix B.

Table 5
Characteristics of M923 and M923 Towing M1061 Trailer

Vehicle Name	Vehicle Weight, lb[1]	Total Length, ft[2]	Horsepower per Ton[3]
M923	32,500	25.4	14.8
M923/M1061	48,350	47.1	9.3

[1] To convert pounds to kilograms, multiply by 0.4536.
[2] To convert feet to meters, multiply by 0.3048.
[3] To convert tons to kilograms, multiply by 9.071.

Table 6 shows the results for the M923 with normal visibility in a dry condition. Table 7 shows the results for the M923 towing the M1061 trailer under the same conditions.

Table 6
Capacities (Vehicles per Hour) Computed Using U.S. Army Engineer Research and Development Center (ERDC) and DIA Methodologies for a 5-ton[1] Truck

	Plains		Hills		Mountains	
Road Type	ERDC	DIA	ERDC	DIA	ERDC	DIA
Primary	1,129	600	977	480	723	360
Secondary	672	500	603	400	506	300
Trails	409	250	350	200	277	150

[1] To convert tons to kilograms, multiply by 9.071.

Table 7
Capacities (Vehicles per Hour) Computed Using ERDC and DIA Methodologies for a 5-ton[1] Truck Towing a 5-ton Trailer

	Plains		Hills		Mountains	
Road Type	**ERDC**	**DIA**	**ERDC**	**DIA**	**ERDC**	**DIA**
Primary	773	540	668	432	524	324
Secondary	485	450	410	360	328	270
Trails	257	225	211	181	164	135

[1] To convert tons to kilograms, multiply by 9.071.

The DIA figures are based on initial 24-hr capacities of 14,400 vehicles for Type I (primary) roads, 12,000 vehicles for Type II (secondary) roads, and 10,000 vehicles for Type III (trails) roads. The DIA capacities are further multiplied by a factor of 0.6 for trails to account for the effects of a one-lane road. The DIA capacities for plains are then multiplied by factors of 0.8 and 0.6 (road alignment factors) to account for the effects of hills and mountains on road capacity. A further factor of 0.9 is used to model the change in capacity from 5 to 10 tons[1] per vehicle in the DIA methodology. This factor is chosen since, in the DIA methodology, a factor of 1.8 is multiplied by the amount of tons moved forward when a 10-ton truck is used instead of a 5-ton truck. This implies that 90 percent as many 10-ton vehicles would be able to make the trip each day as opposed to 5-ton trucks.

It is not surprising that the ERDC methodology predicts higher capacities for all vehicle and road combinations, since it is modeling a 25-vehicle column. The effects of the terrain are lessened by using a short column since the effect of segments containing steep slopes or sharp curves are not as great as when multiplied along the length of a longer column. The 25-vehicle column was chosen by the JWARS Office to represent a typical march unit, thus allowing the JWARS model to handle the effects of organizing the march units into serials (two to five march units) and then the serials into a complete march column (two to five serials).

[1] To convert tons to kilograms, multiply by 9.071.

3 Network Aggregation

Vector-to-Raster Conversion

The first step in aggregating the transportation network involves the conversion of the input transportation vector data to a raster grid representation. The input transportation vectors are placed in a matrix of grid cells using Bresenham's algorithm (Newman and Sproull 1979). This algorithm performs the gridding operation with integer arithmetic and requires neither division nor multiplication. Bresenham's algorithm for the case of 0<=*deltay*<=*deltax* is as follows:

```
e := 2 * deltay – deltax;
for i := 1 to deltax do
begin
  Set(x,y);  {Make the value in Grid cell x,y a 1}
  if e>0 then
  begin
     y := y + 1;
     e := e + (2 * deltay – 2 * deltax);
   end;
   else e := e + 2 * deltay;
   x := x + 1;
end;
```

In the above algorithm, *e* is an error term. The sign of *e* is used to determine whether to increment the *y*-coordinate of the current point. A positive *e* value indicates that the exact path of the line lies above the current point; therefore the *y*-coordinate is incremented. If *e* is negative, the *y*-coordinate value is left unchanged. The variables *deltax* and *deltay* are the absolute values of the differences in the x and y directions between the two points. The user provides a sampling rate, which determines the dimensions of the grid. This sampling rate is used as the larger of the grid's dimensions. The other dimension is computed by multiplying the sampling rate by the quotient formed by dividing the mapped space's smaller dimension by the larger.

Classical Thinning Algorithm

This resulting set of raster roads is thinned using a modified classical thinning algorithm. This thinning algorithm reduces the areas of the map matrix that have values greater than a designated threshold. The pixels comprising those areas containing roads are set to 1 and all other pixels are set to 0. The classical thinning algorithm (Pavlidis 1982) was implemented as follows, and a modification was later imposed as will be discussed.

```
Set a pass counter N to 0
Set the flag REMAIN to true
While REMAIN is true do
   Increment N
   Set REMAIN to false {No change has been made}
   For J=0, 2, 4, and 6 do
      For all pixels P in the map matrix do
         If P is 1 and if its J-neighbor (Figure 4) is 0 then
            Set flag SKEL to false
            For all six patterns PA shown in Figure 5 do
               If the neighborhood of P matches any of the patterns PA, set
                SKEL to true
               {For a group of pixels to match a pattern, at least one of each
                group of pixels marked with  A or B must be non-zero}
            End Do {For}
            If SKEL is true then
               Set pixel P to 2 {skeletal pixel}
               Set the pixel corresponding to P in another matrix to N
            Else
               Set pixel P to 3 {deletable pixel}
               Set REMAIN to true
            End If
         End If
      End Do {For}
      For all pixels P in the map matrix do
         If P is 3 then
            Set P to 0
         End If
      End Do {For}
   End Do {For}
End Do {While}
```

3	2	1
4		0
5	6	7

Figure 4. Enumeration of neighbor pixels in the thinning algorithms

A	A	A
0	P	0
B	B	B

A	0	B
A	P	B
A	0	B

A	A	A
A	P	0
A	0	2

A	0	2
A	P	0
A	A	A

A	A	A
0	P	A
2	0	A

2	0	A
0	P	A
A	A	A

Figure 5. Patterns used in the classical thinning algorithm

Figure 6 shows example data resulting from the application of this algorithm. It is apparent from this test case that the classical thinning algorithm yields far too many unwanted disconnects when applied to this type of problem.

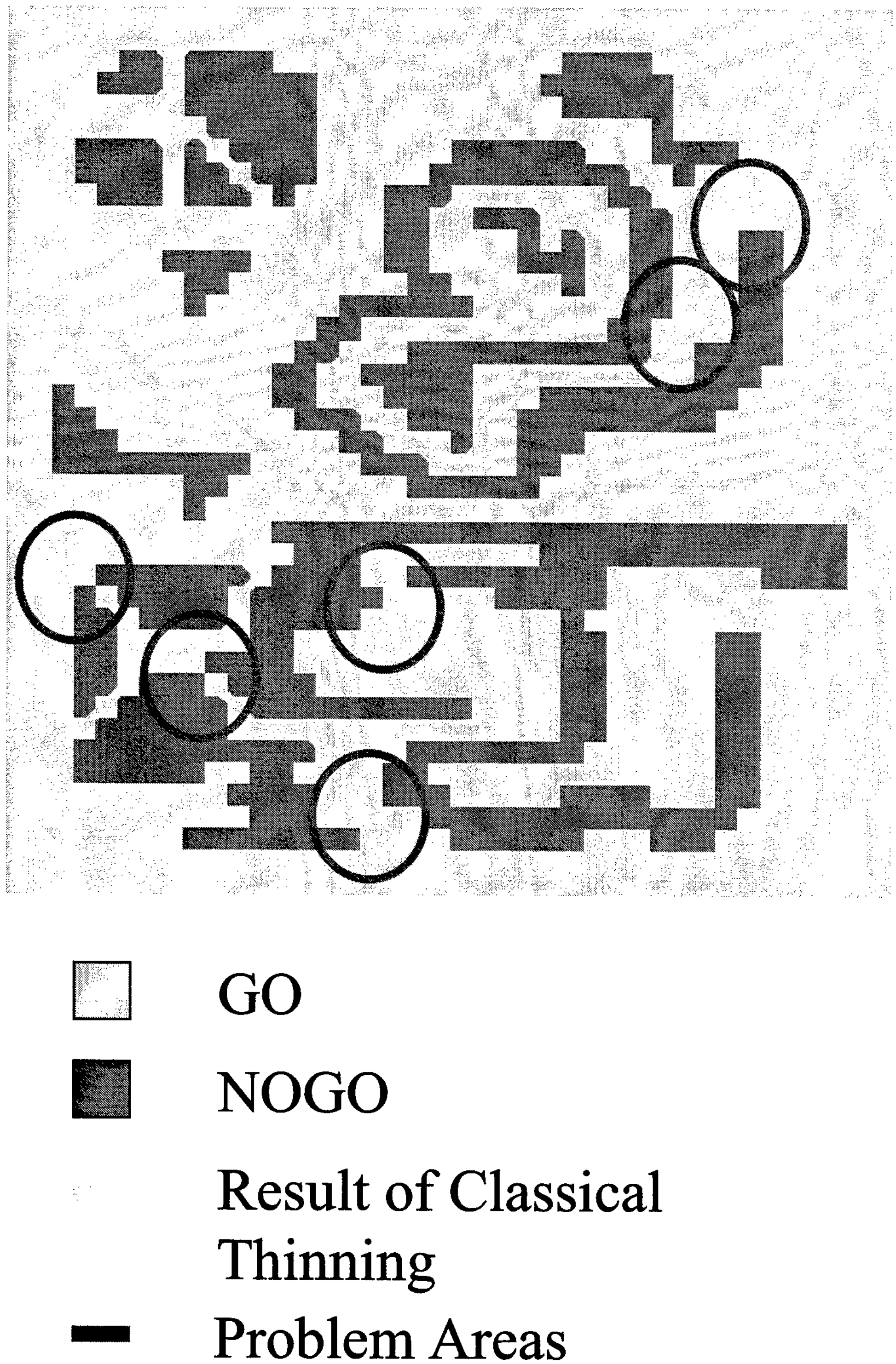


Figure 6. Result of classical thinning applied to test case

Modified Classical Thinning Algorithm

In an effort to develop an algorithm that would produce a network with few or no disconnects, the classical thinning algorithm was modified (McKinley, Falls, and Stuart 2000). The first modification consisted of allowing the last four patterns in Figure 5 to be matched by either a value of one or two when previously there had to be two. The second modification was to retain all pixels that had only one neighbor pixel set to one. Figure 7 shows the improved output resulting from the application of the modified algorithm. An example of a thinned road network for a section of Southwest Asia (SWA) is shown in Figure 8. This input road network has 30,394 edges, and many of the endpoints of roads do not connect with roads as they should. Data of this magnitude are clearly of no use in a theater level simulation. The example in Figure 8 was generated using a sampling rate of 400, which yielded a matrix size of 400 by 380. A second example was created using a rate of 100, which in turn yielded a matrix size of 100 by 95. This example is shown in Figure 9 and demonstrates that with a smaller matrix dimension a less complex transportation network will result. To further demonstrate the results of aggregation, a second set of examples was generated using a smaller portion of the SWA road network. This second input road network has 3,659 edges. The example in Figure 10 was generated using a sampling rate of 400, which yielded a matrix size of 300 by 400. A second example was created using a rate of 100, which in turn yielded a matrix size of 75 by 100. This example is shown in Figure 11.

Network Creation

The thinned roads are converted to an edge/node network format. The first step in this process is to find edges and nodes by summing the number of neighboring pixels that are nonzero for each pixel that is nonzero. When summing these nonzero neighboring pixels, if a diagonal neighbor pixel is nonzero and either the vertical or horizontal neighbor pixel adjacent to that diagonal neighbor is nonzero, then the diagonal neighbor pixel is not included in the sum. For example, if neighbor pixel 3 in Figure 4 were nonzero and either neighbor 2 or neighbor 4 is nonzero then neighbor pixel 3 will not be used in the sum. Another special case is depicted in Figure 12. In this case, the thinning process yielded four adjacent pixels. The solution was to not include a connection between the upper two adjacent pixels in their sums. Nodes are the pixels assigned a sum of one or greater than two. Each node's location is stored and the node is assigned a number. The node numbers are generated sequentially. Segments are formed connecting the adjacent cells using the same rules for their generation as was used in the pixel enumeration.

The next step toward network creation involves traversing (between nodes) the segments that form each edge. Each edge is added to the edge list of the two nodes that it connects. The thinned transportation assets shown in Figure 8 yielded a network consisting of 6,747 edges and 4,687 nodes, while those shown in Figure 9 yielded a network consisting of 401 edges and 280 nodes. The thinned transportation assets shown in Figure 10 yielded a network consisting of

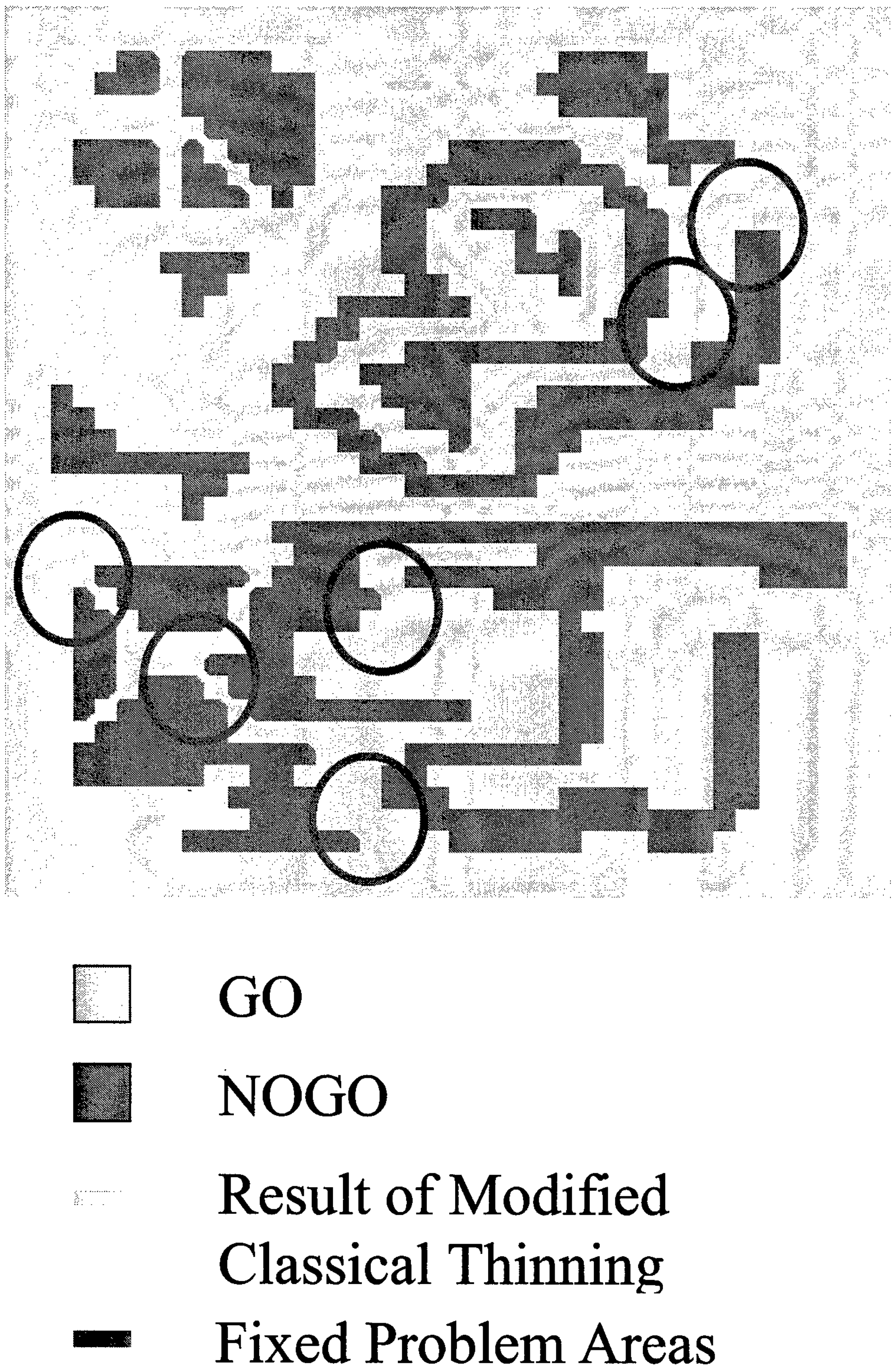
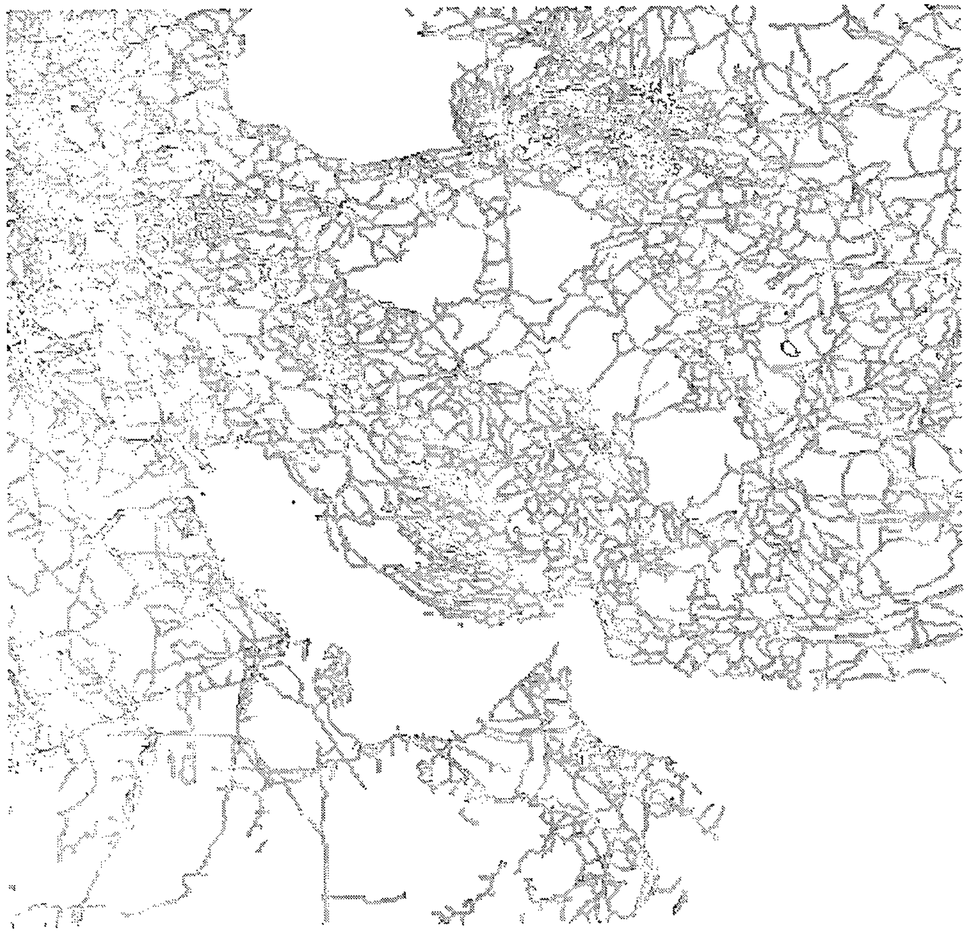


Figure 7. Result of modified classical thinning applied to test case



Input Roads

Aggregated Representation

Figure 8. Example of aggregation on SWA data using a dimension of 400

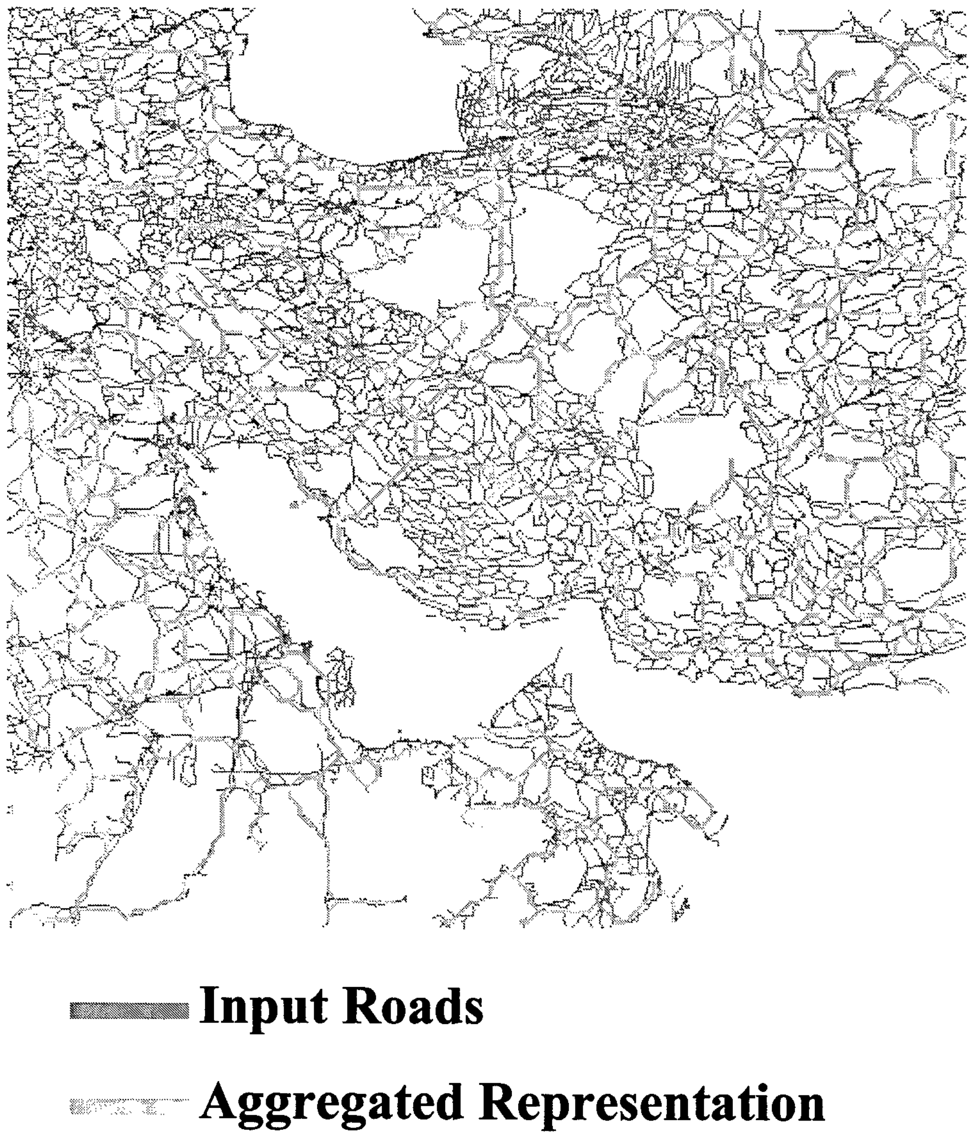


Figure 9. Example of aggregation on SWA data using a dimension of 100

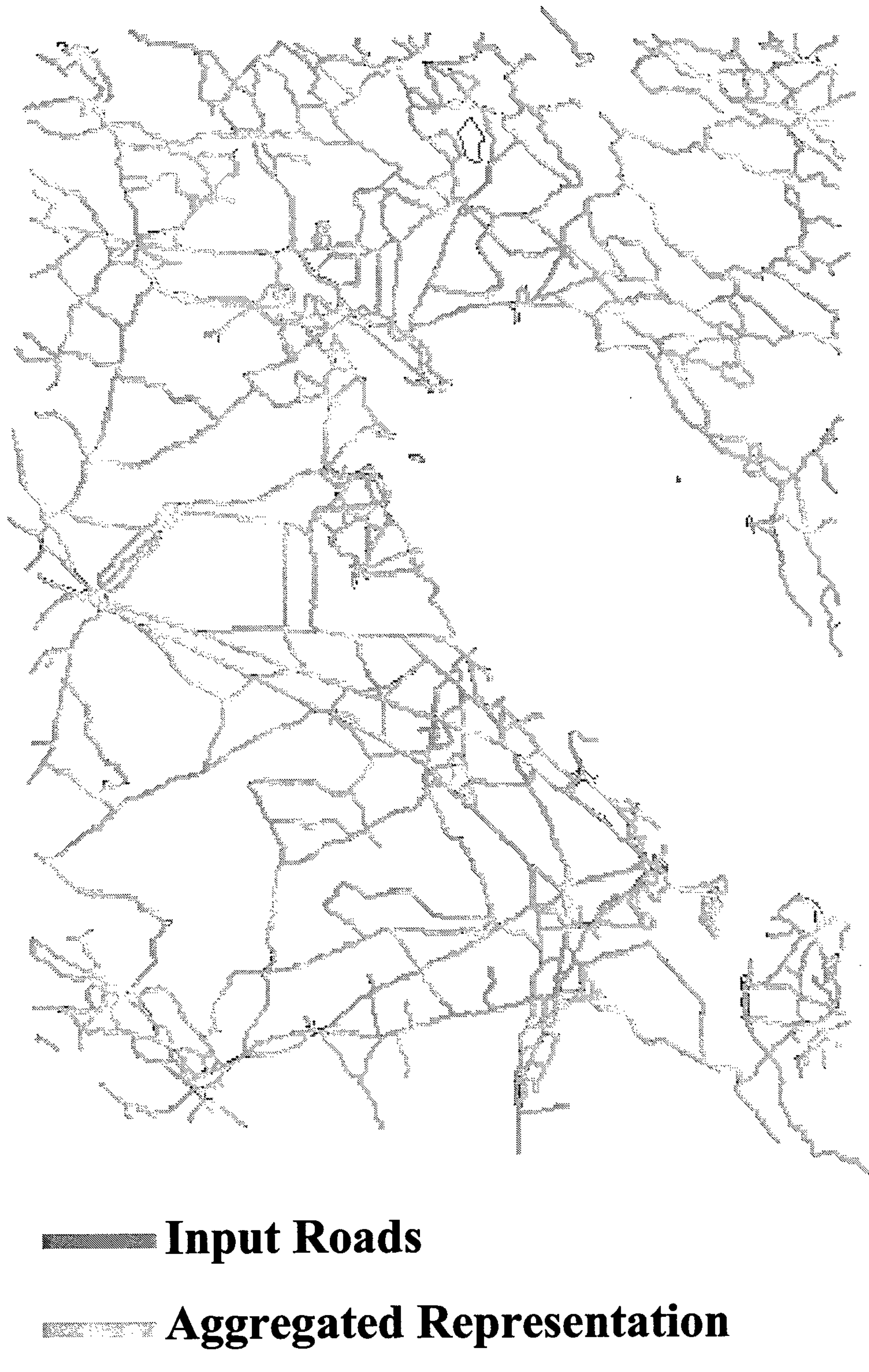


Figure 10. Example of aggregation on portion of SWA data using a dimension of 400

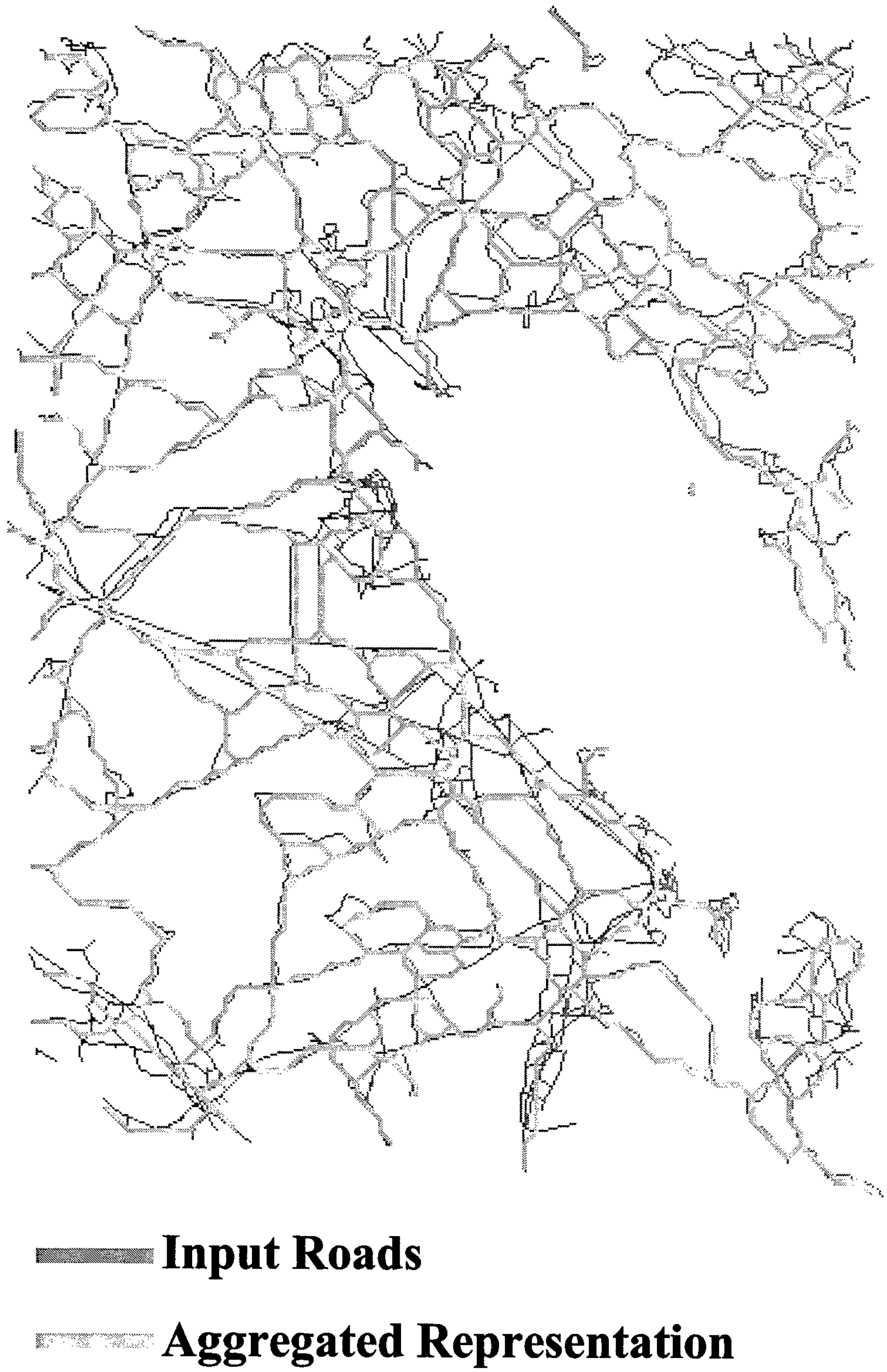


Figure 11. Example of aggregation on portion of SWA data using a dimension of 100

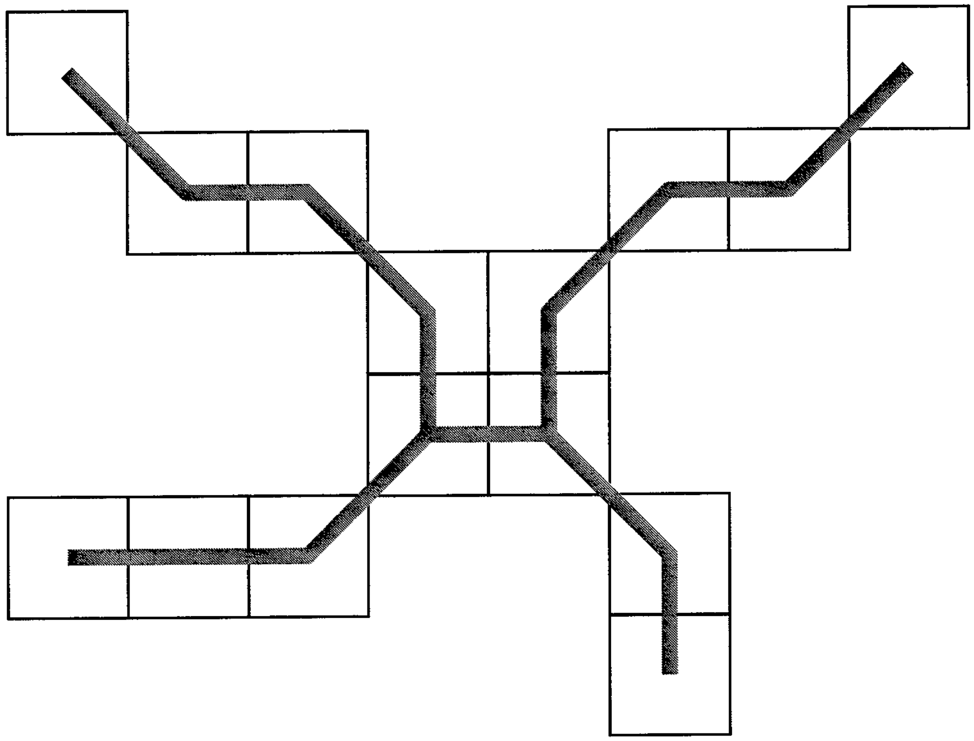


Figure 12. Network creation solution to special case of four adjacent pixels

1,188 edges and 878 nodes, while those shown in Figure 11 yielded a network consisting of 377 edges and 276 nodes.

The final road network for JWARS contains only the endpoints/nodes of each edge. Thus, if an edge went around the boundary of a body of water or a mountain, the final edge could pass through the obstacle. Another algorithm was developed to help alleviate this problem. In this algorithm, the edge is broken up based on the distances for each point from the line segment formed by the first and last point in the edge. This algorithm was implemented as follows:

Set a break point counter N to 0
Set a flag F to *false*
For each point P in the edge E do
    Compute the distance D between P and the line between the first and last points in E
    If D is greater than the prescribed distance then
        If F is *false* then
            Set F to *true*
            Increment N
            Set the distance for break point N to D
            Set the position for break point N to P
        Else
            If D is greater than the current distance for break point N then
                Set the distance for break point N to D
                Set the position for break point N to P

```
            End If
        End If
    Else
        Set F to false
    End If
End Do {For}
Break E at each of the N break points
```

This algorithm must also be run on the newly formed edges, because they may in turn be divided further, as shown in Figure 13. This example edge would be broken at points A and B yielding three edges. The second edge would in turn be broken at point C. Thus, the example edge would yield four final edges. Currently the prescribed distance used in this algorithm is set to the length of the shortest side of the mapped space divided by 50. After the process of breaking edges where geometry dictated, the sampling rate of 400 applied to the SWA road data yielded a network consisting of 6,758 edges and 4,698 nodes, while the sampling rate of 100 yielded a network comprised of 430 edges and 309 nodes. The sampling rate of 400 applied to the smaller SWA road data yielded a network consisting of 1,218 edges and 908 nodes, while the sampling rate of 100 yielded a network comprised of 414 edges and 313 nodes.

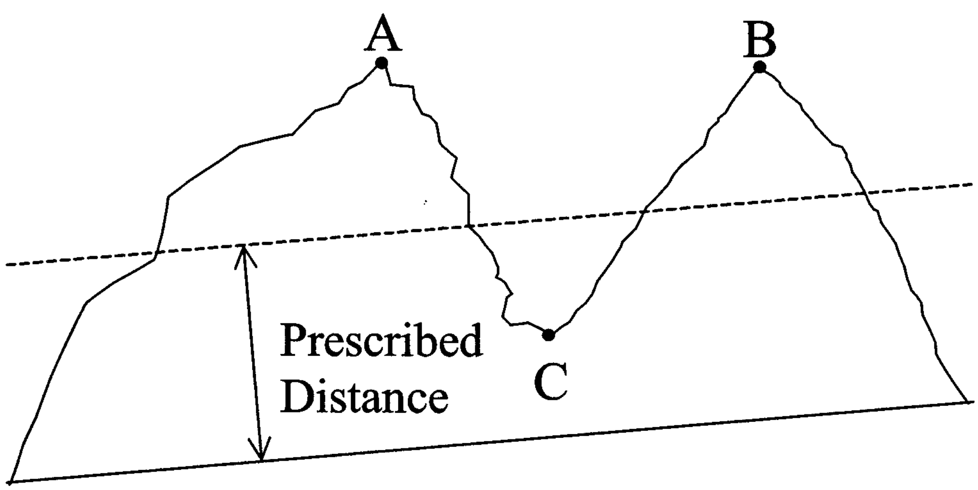


Figure 13. Example of breaking an edge to maintain geometry

The width associated with each pixel is based on the number of passes required to thin the area surrounding that pixel. It is assumed that the average number of thinning passes for the edge multiplied by the minimum of the x- and y-cell resolutions is one-half the width of the aggregated transportation resources represented by the edge. This assumption appears valid since the lines are generally reduced from two sides on each thinning pass. Cross sections perpendicular to the newly created arcs are used to sample the input transportation arcs to develop a description of the edges that comprise the simplified network. Between 1 and 5 cross sections are used for each edge. This number is dependent on the length of the edge. The length of the cross section is set to the width associated to the edge pixel nearest to the cross section. A portion of a network with cross sections displayed is shown in Figure 14. The edges shown in

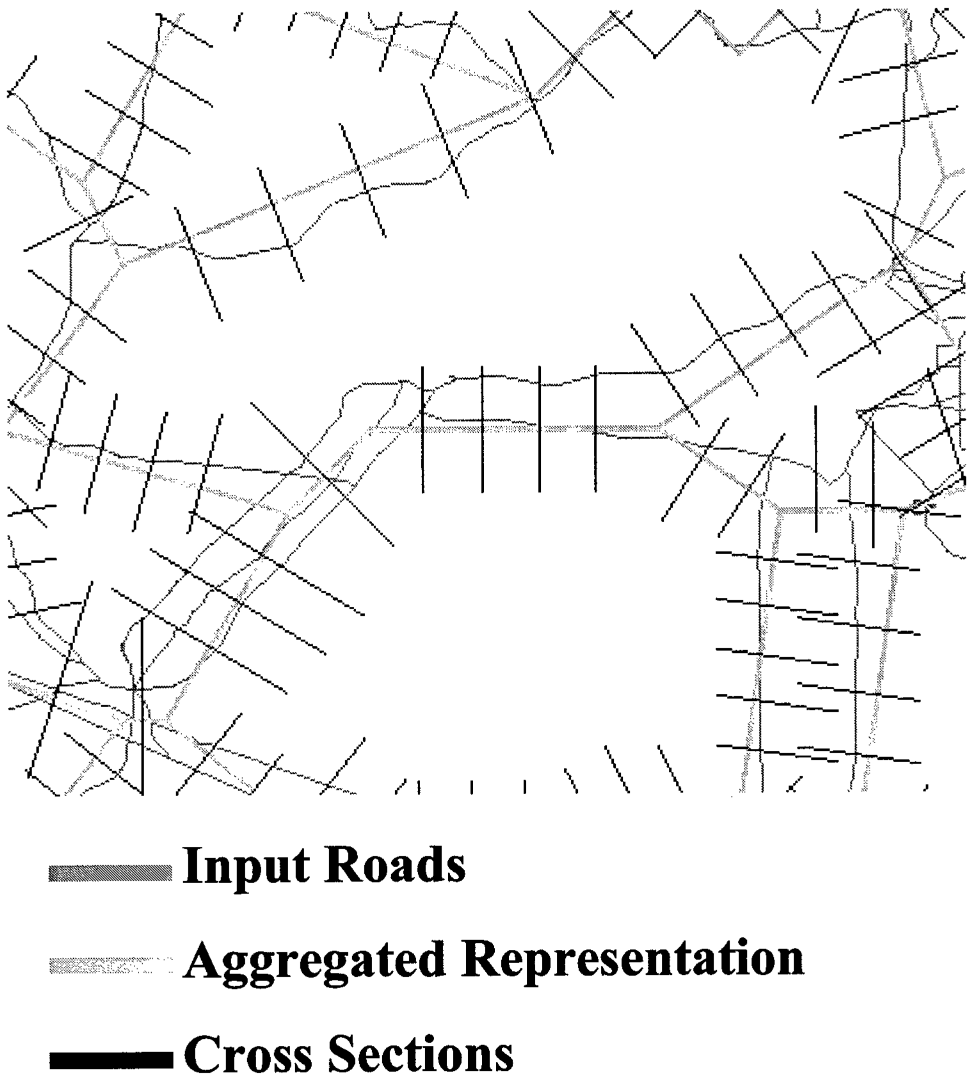


Figure 14. Portion of SWA network with cross sections displayed

Figure 14 are the final ones formed by the first and last point of each edge. These cross sections relate each edge to a corresponding capacity for that edge. The capacity for each cross section is the sum of the value found in Appendix C for each road that the cross section intersected. The cross section that has the lowest corresponding capacity is chosen as representative of the edge. This cross section methodology allows the modeling of target interdiction. For example, if a bridge on a primary road was destroyed, the capacity of the nearest cross section with a primary road would be reduced by the capacity supplied by a primary road. The capacities of the cross sections on that edge would again be compared and the lowest computed capacity would be assigned to the edge. Figures 15 through 18 show the SWA examples with the corresponding capacities for each edge displayed. These capacities were computed using the capacity values for the M985 operating in dry conditions with normal visibility.

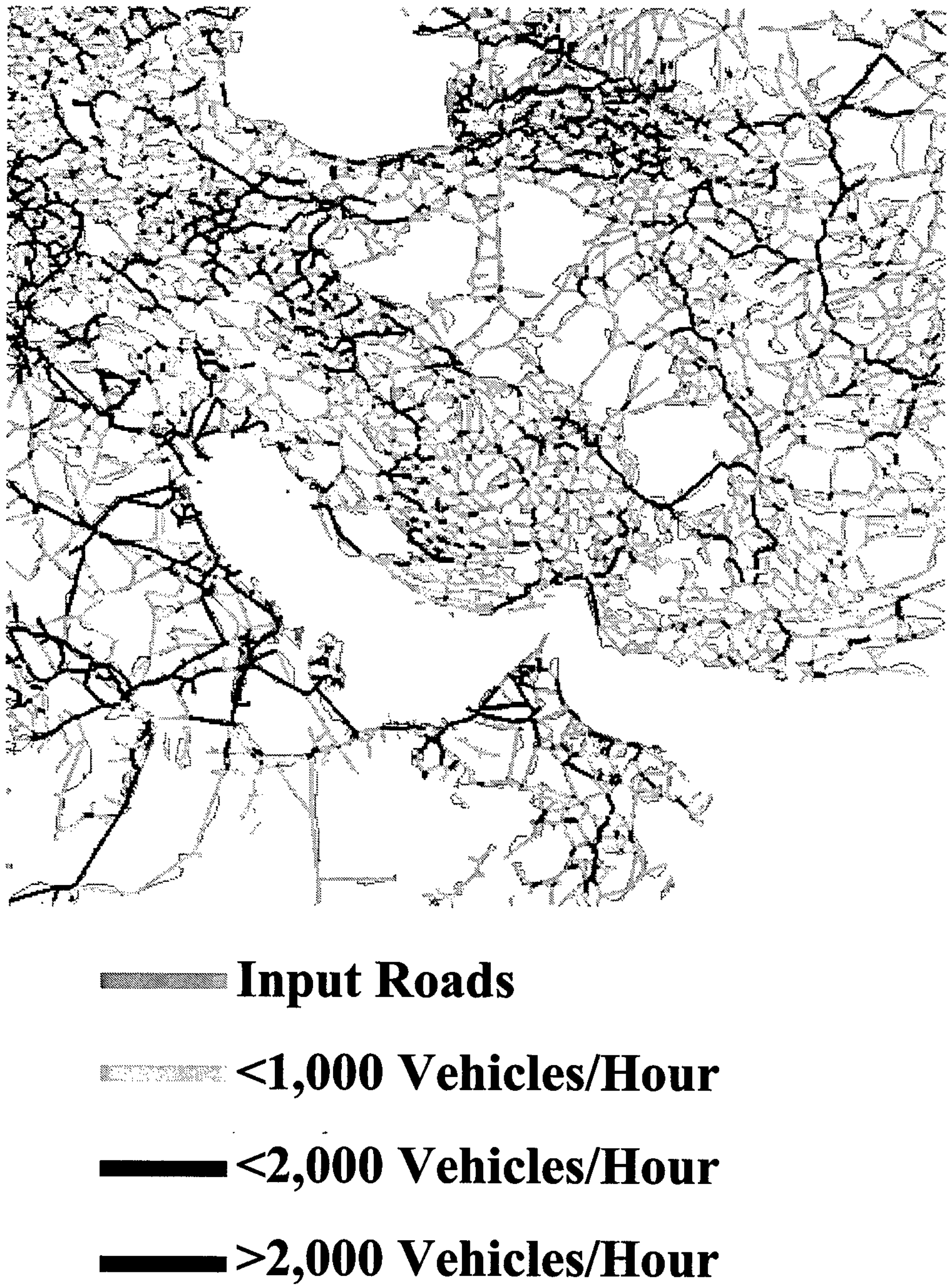


Figure 15. Final aggregation of SWA data using a dimension of 400

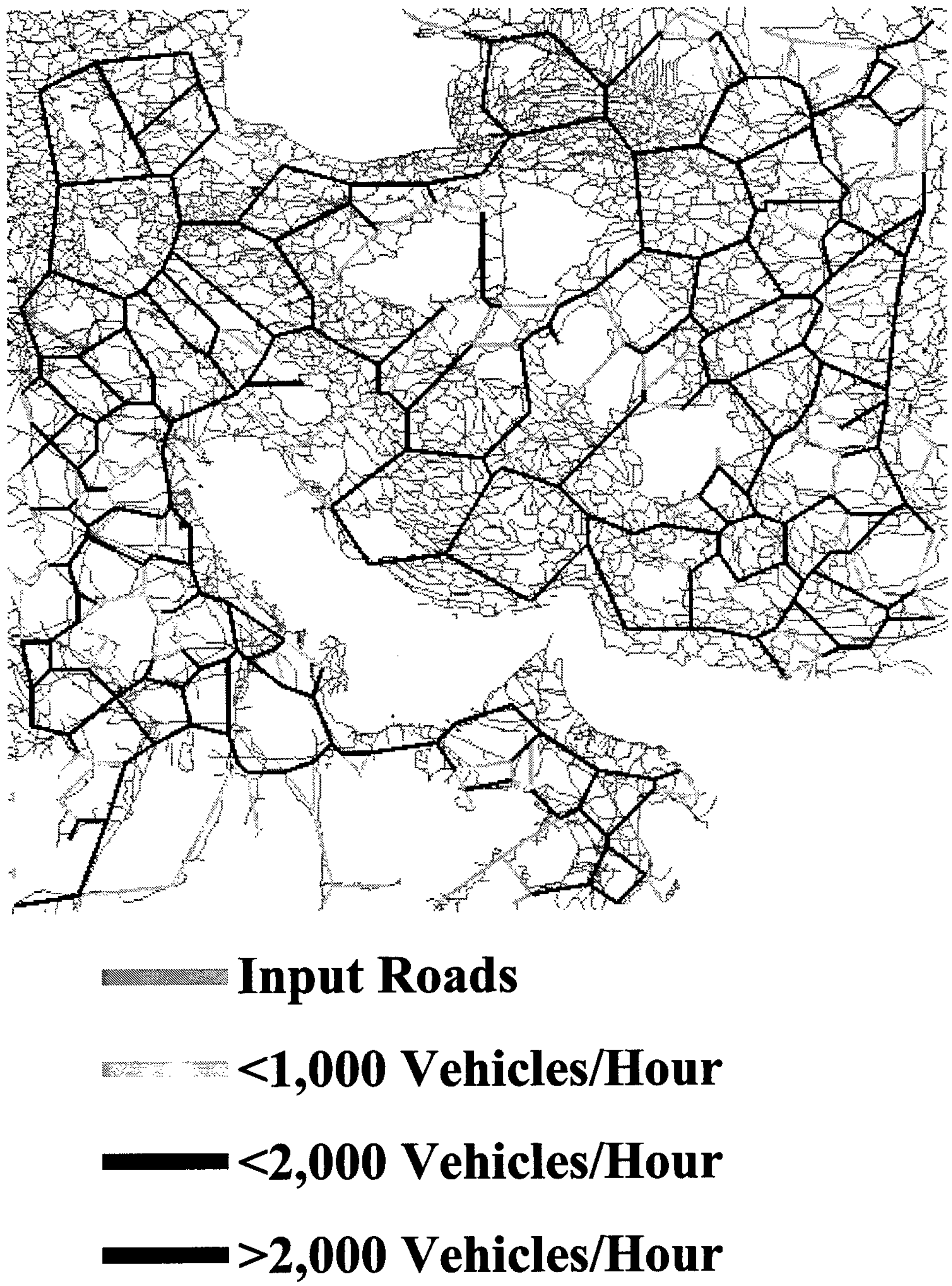


Figure 16. Final aggregation of SWA data using a dimension of 100

Figure 17. Final aggregation of portion of SWA data using a dimension of 400

Figure 18. Final aggregation of portion of SWA data using a dimension of 100

4 Conclusions and Recommendations

Conclusions

Accurate and efficient assessment of network throughput potential in a theater of operation is critical to Army Transformation studies and analysis, doctrine, force design, system impacts evaluation, and theater-level M&S functionality. Existing approaches for estimating capacities are typically based on limited empirical data and are not readily extensible to other geographic regions. Standard procedures do not exist, thus impeding model interoperability. A methodology to represent in-theater mobility and network flow was developed to overcome these limitations.

a. A scalable, expedient, globally applicable network aggregation methodology has been developed for theater-level combat modeling based on the NRMM.

b. The network aggregation methodology was developed to simplify representation of movement and retain capacity characteristics within a theater of operations.

c. The methodology is based on readily available data and provides aggregated capacities.

d. The sampling rate affects the "goodness" of the resultant network. Fewer tiles imply fewer edges and, in general, higher capacities per edge. There is a tradeoff in complexity and fidelity of results.

Recommendations

Based on the information presented in this study, it is recommended to:

a. Extend the pass rate methodology to account for heterogeneous convoy makeup.

b. Perform verification of the network aggregation methodology.

c. Incorporate effects of road degradation and subsequent capacity reduction into the network characterization and existing software.

References

Ahlvin, R. B., and Haley, P. W. (1992). "NATO reference mobility model edition II, NRMM II user's guide," Technical Report GL-92-19, U.S. Army Engineer Waterways Experiment Station, Vicksburg, MS.

Barnsley, M. F., Devaney, R. L., Mandelbrot, B. B., Peitgen, H., Saupe, D., Voss, R. F., Fisher, Y., and McGuire, M. (1988). *The science of fractal images*. H. Peitgen and D. Saupe, ed., Springer Verlag, NY.

Defense Intelligence Agency. (1990). "Highway resupply methodology," Defense Intelligence Management Document DDB-2010-18-90, Washington, DC.

Headquarters, Department of the Army. (1972). "Military geographic intelligence (terrain)," FM 30-10, Washington, DC.

________. (1984). "Army motor transport, units and operations," FM 55-30, Washington, DC.

McKinley, G. B., Butler, C. D., Horner, D. A., Robinson, J. H., and Dickson, W. C. (1993). "Enhanced automated selection and evaluation of mobility corridors and isochrone computation," Technical Report GL-93-12, U.S. Army Engineer Waterways Experiment Station, Vicksburg, MS.

McKinley, G. B., Falls, T. C., and Stuart, D. C. (2000). "Eagle Terrain Preprocessor," Technical Report ERDC/GL TR-00-10, U.S. Army Engineer Research and Development Center, Vicksburg, MS.

Mason, G. L., Smith, R. P., Gray, M. W., and Ahlvin, R. B. (1985). "Development of a terrain and road data base for HML transporter concepts," Technical Report GL-85-12, U.S. Army Engineer Waterways Experiment Station, Vicksburg, MS.

Newman W. M., and Sproull R. F. (1979). *Principles of interactive computer graphics*. McGraw-Hill, New York.

Pavlidis, T. (1982). *Algorithms for graphics and image processing*. Computer Science Press, Inc., Rockville, MD.

Wright, P. H., and Ashford, N. J. (1982). *Transportation engineering: planning and design*. Wiley, New York.

Appendix A
Fractal Dimensions of Elevation Profiles

Profiles Selected to Represent Super Highways and Primary Roads on Plains

Profile Number	Fractal Dimension	Sigma
1	1.253	525
2	1.266	550
3	1.266	625
4	1.260	750
5	1.280	750
6	1.276	825
7	1.306	625
8	1.340	550
9	1.360	525
10	1.343	750
11	1.326	750
12	1.376	525
13	1.346	725
14	1.343	825
15	1.396	525
16	1.350	850
17	1.373	750
18	1.396	625
19	1.386	725
20	1.403	650
21	1.436	525
22	1.400	825
23	1.426	725
24	1.446	650
25	1.472	525

Profiles Selected to Represent Super Highways and Primary Roads on Hills

Profile Number	Fractal Dimension	Sigma
1	1.073	2250
2	1.093	2250
3	1.110	2250
4	1.126	3000
5	1.143	3000
6	1.163	3000
7	1.206	2250
8	1.246	1500
9	1.190	3000
10	1.193	3000
11	1.256	1800
12	1.313	1250
13	1.303	1500
14	1.260	2250
15	1.310	1500
16	1.313	1500
17	1.290	2000
18	1.343	1250
19	1.336	1500
20	1.310	2000
21	1.350	1500
22	1.416	900
23	1.326	2250
24	1.350	2250
25	1.440	1250

Profiles Selected to Represent Super Highways and Primary Roads on Mountains

Profile Number	Fractal Dimension	Sigma
1	1.143	4000
2	1.133	5000
3	1.140	5000
4	1.163	5000
5	1.193	4000
6	1.196	3500
7	1.213	3500
8	1.223	3500
9	1.210	4000
10	1.216	4000
11	1.233	3500
12	1.246	3500
13	1.260	3500
14	1.223	5000
15	1.263	3500
16	1.240	5000
17	1.253	5000
18	1.296	3500
19	1.283	4000
20	1.260	5000
21	1.290	3500
22	1.276	5000
23	1.300	5000
24	1.323	5000
25	1.356	4000

Profiles Selected to Represent Secondary Roads on Plains

Profile Number	Fractal Dimension	Sigma
1	1.356	550
2	1.330	750
3	1.320	850
4	1.336	850
5	1.330	1000
6	1.416	525
7	1.423	550
8	1.376	850
9	1.413	650
10	1.436	550
11	1.396	825
12	1.443	550
13	1.450	550
14	1.433	650
15	1.453	550
16	1.420	750
17	1.430	750
18	1.446	650
19	1.453	650
20	1.443	725
21	1.443	750
22	1.446	750
23	1.453	750
24	1.450	850
25	1.485	625

Profiles Selected to Represent Secondary Roads on Hills

Profile Number	Fractal Dimension	Sigma
1	1.346	1250
2	1.316	1800
3	1.310	2000
4	1.363	1250
5	1.300	2250
6	1.370	1250
7	1.353	1500
8	1.313	2250
9	1.316	2250
10	1.363	1500
11	1.333	2000
12	1.336	2000
13	1.390	1250
14	1.340	2000
15	1.356	1750
16	1.380	1500
17	1.436	900
18	1.406	1250
19	1.356	2000
20	1.346	2250
21	1.420	1250
22	1.426	1250
23	1.370	2250
24	1.393	2000
25	1.393	2250

Profiles Selected to Represent Secondary Roads on Mountains

Profile Number	Fractal Dimension	Sigma
1	1.216	3500
2	1.246	4000
3	1.260	3500
4	1.280	3500
5	1.270	4000
6	1.296	3500
7	1.283	4000
8	1.260	5000
9	1.303	3500
10	1.263	5000
11	1.290	4000
12	1.267	5000
13	1.293	4000
14	1.273	5000
15	1.276	5000
16	1.306	4000
17	1.326	3500
18	1.290	5000
19	1.296	5000
20	1.300	5000
21	1.343	3500
22	1.316	5000
23	1.350	4000
24	1.376	3500
25	1.346	5000

Profiles Selected to Represent Trails on Plains

Profile Number	Fractal Dimension	Sigma
1	1.430	575
2	1.450	500
3	1.430	625
4	1.453	525
5	1.443	585
6	1.446	585
7	1.436	650
8	1.396	925
9	1.453	550
10	1.420	800
11	1.430	750
12	1.456	585
13	1.416	875
14	1.420	880
15	1.416	885
16	1.423	860
17	1.420	925
18	1.456	650
19	1.443	750
20	1.426	885
21	1.440	800
22	1.450	725
23	1.436	860
24	1.456	750
25	1.456	885

Profiles Selected to Represent Trails on Hills

Profile Number	Fractal Dimension	Sigma
1	1.296	2250
2	1.366	1250
3	1.373	1250
4	1.330	1800
5	1.326	2000
6	1.320	2250
7	1.326	2250
8	1.353	1800
9	1.380	1500
10	1.340	2250
11	1.453	900
12	1.400	1500
13	1.403	1500
14	1.386	1800
15	1.376	2000
16	1.380	2000
17	1.370	2250
18	1.386	2000
19	1.376	2250
20	1.443	1250
21	1.453	1250
22	1.393	2250
23	1.413	2000
24	1.403	2250
25	1.430	2000

Profiles Selected to Represent Trails on Mountains

Profile Number	Fractal Dimension	Sigma
1	1.256	5000
2	1.306	3500
3	1.266	5000
4	1.276	5000
5	1.280	5000
6	1.326	3500
7	1.290	5000
8	1.293	5000
9	1.333	3500
10	1.296	5000
11	1.336	3500
12	1.303	5000
13	1.343	3500
14	1.346	3500
15	1.313	5000
16	1.356	3500
17	1.360	3500
18	1.323	5000
19	1.330	5000
20	1.336	5000
21	1.343	5000
22	1.346	5000
23	1.390	3500
24	1.356	5000
25	1.363	5000

Appendix B
NRMMII Vehicle Files

M1084 Vehicle File

```
 M1084 MTV,STEWART STEVENSON, 6X6, CTI, 5TON CARGO TRUCK With MHE(Crane)
 3/07/01 Use this file for WARSIM and JWARS
 Modified: 15Feb01 obsmod data
 Use this for WARSIM and JWARS; corrected version
 Project: D. Moore, tested at Letourneau 20,21 Sept.95
 Built by: Stewart & Stevenson Vehicle
 Date entered:25JAN.94            DATA By: T.HUTTO & D.MOORE
 DESCRIPTION:MHE(Crane)Material Handling Equipment,6x6,CTI,5Ton Cargo
Truck
 File name:C:\VEHICLES\NRMMII\M1084.DAT
OBSMOD: From RBA 20ct.95
 MTV            MTV, STEWART STEVENSON, 6X6, CTI, 5TON CARGO WITH MHE
 $VEHICLE
   NAMBLY= 3,
   WGHT(1)=12800,10380,10910, !FROM D.MOORE 1-24-94 TR-GL-00-00
   NVUNTS = 1,
   VULEN(1)=306.1,    !FROM TRUCK NOMENCLATURE PANEL HUTTO 10-27-93
  !VAA=40,            !FROM TRUCK NOMENCLATURE PANEL HUTTO 10-27-93
  !VDA=39,            !FROM TRUCK NOMENCLATURE PANEL HUTTO 10-27-93
 CGH   =59,           !FROM TRUCK NOMENCLATURE PANEL HUTTO 10-27-93
 CGLAT =1.5,          !FROM TRUCK NOMENCLATURE PANEL HUTTO 10-27-93
 CGR   =91.7,         !FROM TRUCK NOMENCLATURE PANEL HUTTO 10-27-93
 CL    =13.75,        !WES MEASURED T. HUTTO 1-24-94
 CLRMIN(1)=13.75,13.75,13.75,
 EYEHGT=96,           !WES MEASURED T. HUTTO 1-24-94
 PBF   =34090,        !FROM D.MOORE 1-24-94 TR-GL-00-00
 PBHT  =42.2,         !FROM TRUCK NOMENCLATURE PANEL HUTTO 10-27-93
 PFA   =51.3,         !Calculated T. HUTTO
 WDTH  =96,           !FROM TRUCK NOMENCLATURE PANEL HUTTO 10-27-93
   AVGC=720,
   AVGC=682,          !22Sept95
   AXLSP(1) =149.4,55.6,  !FROM TRUCK NOMENCLATURE PANEL HUTTO 10-27-93
DFLCT(1,1)=1.94,1.42,1.42, !HWY FROM D. MOORE 1-24-94 17.1% 13.0% 13.0%
DFLCT(1,2)=2.49,2.17,2.17, !CC  FROM D. MOORE 1-24-94 22.4% 19.8% 19.8%
DFLCT(1,3)=3.55,3.02,3.02, !SAND FROM D.MOORE 1-24-94 32.1% 28.1% 28.1%
DFLCT(1,4)=4.17,3.63,3.63, !EMER FROM D.MOORE 1-24-94 38.0% 33.5% 33.5%
   DIAW(1)   =3*46.9,      !FROM DENNIS MOORE 1-24-94
   ICONST(1)=3*0,
   ID(1)     =3*0,
   IT(1)     =0,1,1,
   KCTIOP(1)=8*0,          !CTI VEH USE THE BEST DFLCT
   KTSFLG   =3*1,
   NCHAIN(1)=3*0,
   NJPSI     =  4,
   NVEH(1)   =  1,1,1,
   NWHL(1)   =3*2,
   RDIAM(1) =3*20,
   RIMW(1)   =3*10,
   SECTH(1) =3*10.4,
   SECTW(1) =3*15.4,
   TL=205,
   TIREID(1)='395(15.5)85R20XML MICHELIN',
             '395(15.5)85R20XML MICHELIN',
             '395(15.5)85R20XML MICHELIN',
   TPLY(1)   =14,14,14,
   TPSI(1,1)=62,62,62,          !HWY  FROM DENNIS MOORE 1-24-94
```

```
  TPSI(1,2)=38,38,38,          !CC   FROM DENNIS MOORE 1-24-94
  TPSI(1,3)=23,23,23,          !SAND FROM DENNIS MOORE 1-24-94
  TPSI(1,4)=19,19,19,          !EMER FROM DENNIS MOORE 1-24-94
  VTIRMX(1)=60,40,12,5,        !D. R. HWY,CC,SAND,EMER
  WT(1)    =80.5,80.5,80.5,    !FROM TRUCK NOMENCLATURE PANEL 10-27-93
  WTE(1)   =64,64,64,          !FROM TRUCK NOMENCLATURE PANEL 10-27-93
CID=403,                       !STEWART & STEVENSON SCHEMATIC 1-11-91
ICONV1=0,
CONV1 =  ,  ,
ICONV2= 0,
CONV2 =  ,  ,
IENGIN= 0,
ENGINE=    ,    ,
  FD(1) =7.8, .97,             !STEWART & STEVENSON SCHEMATIC 1-11-91
  HPNET =290,                  !STEWART & STEVENSON SCHEMATIC 1-11-91
  IB(1) =3*1,
  IDIESL=  1,
  IP(1) =3*1,
  ITVAR =  0,
  JVPSI =  2,
  LOCDIF=  1,
  LOCKUP=  1,
  NCYL  =  6,                  !STEWART & STEVENSON SCHEMATIC 1-11-91
  NENG  =  1,
  QMAX  =732,                  !STEWART & STEVENSON SCHEMATIC 1-11-91
  REVM(1) =447,447,447,        !Calculated by Hutto
  TCASE(1)=1.0,1.0,
  TQIND =   ,
  NGR   = 7,                   !STEWART & STEVENSON SCHEMATIC 1-11-91
  TRANS= 6.93,0.97,
         4.18,0.97,
         2.24,0.97,
         1.69,0.97,
         1.20,0.97,
         0.90,0.97,
         0.78,0.97,
 !AVERAGE NET HORSE POWER= 189.687
  IPOWER =119,
 !I/P FROM STEWART & STEVENSON 1-14-91 (O/P NRMMII FORMAT 12-30-94)
          ! ( Speed         Force          HP
   POWER =    0.000000       36592.0      !    0.000000
              0.500000       34000.1      !     45.3334
              1.00000        31408.1      !     83.7550
              1.50000        28816.2      !     115.265
              2.00000        26014.0      !     138.741
              2.50000        23364.9      !     155.766
              3.00000        21209.1      !     169.673
              3.50000        19108.0      !     178.342
              4.00000        17007.0      !     181.408
              4.50000        15248.6      !     182.983
              5.00000        13567.6      !     180.902
              5.50000        12583.8      !     184.562
              6.00000        11163.0      !     178.608
              6.50000        10477.8      !     181.614
              7.00000        9792.50      !     182.793
              7.50000        9107.25      !     182.145
              8.00000        8422.00      !     179.669
              8.50000        7947.88      !     180.152
              9.00000        7581.01      !     181.944
              9.50000        7214.13      !     182.758
```

10.0000	6503.00	!	173.413
10.5000	6293.50	!	176.218
11.0000	6084.00	!	178.464
11.5000	5874.50	!	180.151
12.0000	5665.00	!	181.280
12.5000	5462.62	!	182.087
13.0000	5305.83	!	183.935
13.5000	5245.91	!	188.853
14.0000	5186.00	!	193.611
14.5000	5103.75	!	197.345
15.0000	5021.50	!	200.860
15.5000	4939.25	!	204.156
16.0000	4857.00	!	207.232
16.5000	4737.00	!	208.428
17.0000	4617.00	!	209.304
17.5000	4497.00	!	209.860
18.0000	4377.00	!	210.096
18.5000	4233.38	!	208.847
19.0000	4089.75	!	207.214
19.5000	3946.13	!	205.199
20.0000	3797.00	!	202.507
20.5000	3738.00	!	204.344
21.0000	3679.00	!	206.024
21.5000	3620.00	!	207.547
22.0000	3561.00	!	208.912
22.5000	3488.50	!	209.310
23.0000	3416.00	!	209.515
23.5000	3343.50	!	209.526
24.0000	3271.00	!	209.344
24.5000	3189.00	!	208.348
25.0000	3107.00	!	207.133
25.5000	3025.00	!	205.700
26.0000	2943.00	!	204.048
26.5000	2749.56	!	194.302
27.0000	2727.38	!	196.371
27.5000	2705.19	!	198.380
28.0000	2683.00	!	200.331
28.5000	2654.75	!	201.761
29.0000	2626.50	!	203.116
29.5000	2598.25	!	204.396
30.0000	2570.00	!	205.600
30.5000	2535.25	!	206.200
31.0000	2500.50	!	206.708
31.5000	2465.75	!	207.123
32.0000	2431.00	!	207.445
32.5000	2392.25	!	207.328
33.0000	2353.50	!	207.108
33.5000	2314.75	!	206.784
34.0000	2276.00	!	206.357
34.5000	2233.25	!	205.459
35.0000	2190.50	!	204.447
35.5000	2147.75	!	203.320
36.0000	2105.00	!	202.080
36.5000	2059.58	!	200.466
37.0000	2014.17	!	198.731
37.5000	1949.00	!	194.900
38.0000	1934.00	!	195.979
38.5000	1917.50	!	196.863
39.0000	1901.00	!	197.704
39.5000	1884.50	!	198.501

```
             40.0000          1868.00       !     199.253
             40.5000          1849.00       !     199.692
             41.0000          1830.00       !     200.080
             41.5000          1811.00       !     200.417
             42.0000          1792.00       !     200.704
             42.5000          1771.50       !     200.770
             43.0000          1751.00       !     200.781
             43.5000          1730.50       !     200.738
             44.0000          1710.00       !     200.640
             44.5000          1688.00       !     200.309
             45.0000          1666.00       !     199.920
             45.5000          1644.00       !     199.472
             46.0000          1622.00       !     198.965
             46.5000          1598.75       !     198.245
             47.0000          1575.50       !     197.463
             47.5000          1552.25       !     196.618
             48.0000          1529.00       !     195.712
             48.5000          1504.78       !     194.618
             49.0000          1480.55       !     193.459
             49.5000          1456.33       !     192.235
             50.0000          1441.00       !     192.133
             50.5000          1423.25       !     191.664
             51.0000          1405.50       !     191.148
             51.5000          1387.75       !     190.584
             52.0000          1370.00       !     189.973
             52.5000          1351.00       !     189.140
             53.0000          1332.00       !     188.256
             53.5000          1313.00       !     187.321
             54.0000          1294.00       !     186.336
             54.5000          1274.25       !     185.191
             55.0000          1254.50       !     183.993
             55.5000          1234.75       !     182.743
             56.0000          1215.00       !     181.440
             56.5000          1194.41       !     179.958
             57.0000          1173.82       !     178.421
             57.5000          1015.78       !     155.752
             58.0000          852.000       !     131.776
             58.5000          692.667       !     108.056
             58.7500          613.000       !     96.0367
ACD   =.75,                   !STEWART & STEVENSON SCHEMATIC 1-11-91
CD    =.7,
XBRCOF=.8,
 KOHIND=1,
 NHVALS= 10,  !Letourneau test 20,21 Sept.95 Final Ride * Shock Curve
              !With Final Production on Cab
  HVALS=        0,     2,    4,    6,     8,
               10,    12,   14,   16,   100,
  VOOB(1,1) =100,     50,   35,   22,    17,
              10.5,    5,    3,    2,     2,
  VOOB(1,2) =,
  VOOB(1,3) =,
  KVRIND(1)=1,
  MAXL= 1,
  ABSPWR(1)= 6,
  MAXIPR= 11,  !Letourneau test 20,21 Sept.95 Final Ride & Shock Curve
               !With Final Production on Cab
  RMS =          0,     0,  0.2,  0.4,  0.6,
               1.0,   2.0,  3.0,  4.0,  5.0,
               6.0,
 VRIDE(1,1,1)=100,     60,    45,    35,    30,
```

```
                25,  12.0,    10,     8,     6,
               2.0,
   VRIDE(1,2,1)=,
   VRIDE(1,3,1)=,
   ABSPWR(2)=  ,
   VRIDE(1,1,2)=,
   VRIDE(1,2,2)=,
   VRIDE(1,3,2)=,
 DRAFT =,
 FORDD =,
 SAE    =  ,
 SAI    =  ,
 VFS    =  ,
 VSS    =  ,
 VSSAXP=  ,
 WC     =  ,
 NWR    =  ,
 WDAXP =  ,
 WDPTH(1)=  ,
 WRAT(1) =  ,
 WRFORD=  ,
 $END
NOHGT      ! 1 M1084, 6X6, 16Dec.97
      3    !c:\vehicles\nrmmii\obsmod\m1084.obv   !I/P
NANG       !c:\vehicles\nrmmii\obsmod\m1084.obW
      8    !c:\vehicles\nrmmii\obsmod\m1084.obo   !O/P
NWDTH      !c:\tacom-ob\obsmod\obsdp < obsdp.inp !Reran 16Dec.97
      3
```

CLRMIN INCHES	FOOMAX POUNDS	FOO POUNDS	HOVALS INCHES	AVALS RADIANS	WVALS INCHES
11.40	6238.4	228.4	3.15	1.95	5.88
-1.35	21640.4	1335.5	15.75	1.95	5.88
-12.12	31359.0	3085.6	33.46	1.95	5.88
11.40	6238.4	231.2	3.15	2.48	5.88
0.61	17679.2	1099.5	15.75	2.48	5.88
-9.72	17716.1	2068.3	33.46	2.48	5.88
11.41	5678.4	198.3	3.15	2.69	5.88
4.60	11955.5	959.1	15.75	2.69	5.88
-8.89	11966.4	1615.8	33.46	2.69	5.88
11.41	3494.0	186.6	3.15	2.86	5.88
8.04	7221.3	669.8	15.75	2.86	5.88
1.55	6834.9	930.7	33.46	2.86	5.88
13.08	3523.2	197.5	3.15	3.42	5.88
9.86	7433.2	531.9	15.75	3.42	5.88
6.39	7592.3	838.7	33.46	3.42	5.88
13.50	5701.6	188.3	3.15	3.60	5.88
6.31	5805.8	571.8	15.75	3.60	5.88
0.25	12570.0	988.8	33.46	3.60	5.88
14.01	3463.4	113.4	3.15	3.80	5.88
8.85	8455.2	417.9	15.75	3.80	5.88
-7.87	8557.7	177.1	33.46	3.80	5.88
14.40	2105.2	38.2	3.15	4.33	5.88
13.66	3926.3	71.1	15.75	4.33	5.88
10.84	11610.1	722.4	33.46	4.33	5.88
11.72	6061.9	78.8	3.15	1.95	29.88
7.15	21673.6	715.7	15.75	1.95	29.88
-10.56	30868.6	1294.5	33.46	1.95	29.88
11.72	6061.9	78.8	3.15	2.48	29.88
7.15	17692.5	661.3	15.75	2.48	29.88
-9.62	17731.9	1571.2	33.46	2.48	29.88

11.41	5678.4	177.8	3.15	2.69	29.88
7.36	11908.1	649.9	15.75	2.69	29.88
-5.75	11773.3	1358.0	33.46	2.69	29.88
11.77	3494.0	135.3	3.15	2.86	29.88
8.34	7221.1	630.5	15.75	2.86	29.88
4.76	5439.1	831.0	33.46	2.86	29.88
13.00	3523.3	182.9	3.15	3.42	29.88
9.85	7451.0	652.9	15.75	3.42	29.88
5.92	7592.9	792.8	33.46	3.42	29.88
13.00	5710.2	210.3	3.15	3.60	29.88
4.53	7637.5	521.7	15.75	3.60	29.88
0.77	12711.0	1194.2	33.46	3.60	29.88
13.11	6388.2	298.8	3.15	3.80	29.88
3.87	8506.7	545.1	15.75	3.80	29.88
-10.01	18567.2	1028.9	33.46	3.80	29.88
11.97	6302.4	-62.3	3.15	4.33	29.88
4.23	16298.6	526.2	15.75	4.33	29.88
-6.65	30348.8	572.9	33.46	4.33	29.88
12.99	6155.2	130.3	3.15	1.95	141.60
7.06	18016.2	493.2	15.75	1.95	141.60
-10.56	30943.5	891.9	33.46	1.95	141.60
12.99	6155.2	132.3	3.15	2.48	141.60
7.15	8364.7	414.4	15.75	2.48	141.60
-0.12	18779.2	1057.0	33.46	2.48	141.60
12.98	5678.4	118.1	3.15	2.69	141.60
7.36	11746.1	449.7	15.75	2.69	141.60
5.47	12738.8	1074.3	33.46	2.69	141.60
13.06	3494.0	115.0	3.15	2.86	141.60
10.91	7442.3	406.1	15.75	2.86	141.60
10.91	7593.7	879.8	33.46	2.86	141.60
12.54	3087.0	107.3	3.15	3.42	141.60
10.62	7446.9	432.7	15.75	3.42	141.60
10.45	7595.0	829.0	33.46	3.42	141.60
12.65	5710.2	144.8	3.15	3.60	141.60
5.05	12330.6	662.4	15.75	3.60	141.60
-1.35	12743.7	897.0	33.46	3.60	141.60
12.58	4600.9	56.7	3.15	3.80	141.60
3.87	9238.8	547.9	15.75	3.80	141.60
-12.13	18710.8	1160.5	33.46	3.80	141.60
12.44	4725.7	69.2	3.15	4.33	141.60
2.12	17833.3	593.2	15.75	4.33	141.60
-17.65	31041.9	1257.5	33.46	4.33	141.60

```
M1084, 6X6
$OBSMOD I/P
  NUNITS =     1  ! Number of units
  NSUSP  =     2  ! Number of suspension supports
  NVEH1  =     1  ! Vehicle type; 0=tracked, 1=wheeled
  NFL    =    ,   ! Track type; 0=rigid, 1=flexible
  REFHT1 =  41.7 ! Height of hitch from ground
  HTCHFZ =     0  ! V-force on hitch
  SFLAG(1) = 0,1  ! Type suspension @supt-i,0=indp,1=bogie
! Power flags ((IP(i,j), i=1,nsusp) j=1,2)
  IP(1,1)  = 1,1,1,1,
! Brake flags ((IB(i,j), i=1,nsusp) j=1,2)
  IB(1,1)  = 1,1,1,1,
  EFFRAD(1)=  21,21,          !Effective loaded radius of wheels
  ELL(1)   = 253.4, 76.2      !Horizontal pos. suspension WRT hitch
  BWIDTH(1)=   0,    55.6,    !Bogie arm length (wheel to wheel)
  BALMU(1) =   0,    10.0, !Bogie max CCW. angle, (+=CCW.)
15"Jounce,6"rebound
```

```
  BALMD(1) =  -0,  -10.0, !Bogie max CW. angle, (+=CCW.)
  EQUILF(1)=12800, 21290, !Equilibrium force
  CGZ1     =   59         ! V-cg, Unit-1 WRT ground
  CGZ2     =    0         ! V-cg, Unit-2 WRT ground
  DEE1     =    0         ! H-cg, Unit-1 payload WRT hitch
  ZEE1     =    0         ! V-cg, Unit-1 payload WRT ground
  DEE2     =    0.0       ! H-cg, Unit-2 payload WRT hitch
  ZEE2     =    0.0       ! V-cg, Unit-2 payload WRT ground
  DELTW1   =    0.0       ! Payload weight, Unit-1
  DELTW2   =    0.0       ! Payload weight, Unit-2
  NPTSC1   =      9       ! #Pts, bottom profile, Unit-1
 XCLC1(1) = 307.6, 308.2, 290.2, 231.0, 129.4, 77.8, 24.8,  2.5, 0,
 YCLC1(1) =  44.9,  37.1,  22.9,  23.0,  25.2, 14.4, 22.5, 32.4, 41.7,
  NPTSC2   =,         ! #Pts, bottom profile, Unit-2
  XCLC2(1) =,         ! X, Bottom profile, Unit-2
  YCLC2(1) =,         ! Y, Bottom profile, Unit-2
  SFLAG(4) =,         ! Type suspension front "spridler" (always zero)
  IP(4,1)  =,         ! Power flag, front "spridler"
  IB(4,1)  =,         ! Brake flag, front "spridler"
  ELL(4)   =,         ! H-pos front "spridler" WRT hitch
  ZS(4)    =,         ! V-pos front "spridler" WRT ground
  EFFRAD(4)=,         ! Effective radius front "spridler"
  SFLAG(5) =,         ! Type suspension rear "spridler" (always zero)
  IP(5,1)  =,         ! Power flag, rear "spridler"
  IB(5,1)  =,         ! Brake flag, rear "spridler"
  ELL(5)   =,         ! H-pos rear "spridler" WRT hitch
  ZS(5)    =,         ! V-pos rear "spridler" WRT ground
  EFFRAD(5)=,         ! Effective radius rear "spridler"
$END
```

M985 Vehicle File

```
HEMTT M985 CARGO TRUCK, 8X8 10TON PAYLOAD
3/07/01  Use for WARSIM and JWARS
DATA FROM TEMPLE'S FILES D5-7 NRMM
DATE:29 OCT.92     by: Temple
FILE NAME:C:\VEHICLES\NRMMII\M985-10T.DAT !M985 WITH 10TON PAYLOAD
M985         HEMTT CARGO TRUCK, 8X8 10 TON PAYLOAD !HEMTT M985
$VEHICLE
  NAMBLY= 4,
  WGHT(1)=13560,13440,16750,16500,
  NVUNTS=1,
  VULEN(1)=400.5,      !from HEMTT 1-89
CGH   =62.0,
CGLAT = 0,
CGR   =124,
CL    =13.8,
CLRMIN(1)=13.8,13.8,13.8,13.8,
EYEHGT=90,
PBF   =60250,
!VAA=43,
!VDA=43,
PBHT  =42,
PFA   =68,
WDTH  =96,             !from HEMTT 1-89
  ASHOE(1) =  0,
  AVGC=905,
  AXLSP(1) =60,150,60,
  DFLCT(1,1)= 3.2,3.2,3.2,3.2, !CC
  DFLCT(1,2)= 4.3,4.3,4.3,4.3, !SAND
  DFLCT(1,3)= 2.0,2.0,2.0,2.0, !HWY
  DFLCT(1,4)= 4.3,4.3,4.3,4.3, !EMERGENCY
  DIAW(1)   = 52.6,52.6,52.6,52.6,
  GROUSH(1)=  0,
  ICONST(1)=  0,0,0,0,
  ID(1)     =  0,0,0,0,
  IT(1)     =  1,1,2,2,
  KCTIOP(1)=3,3,2,1,2,2,1,2,
  KTSFLG    =  1,1,1,1,
  NBOGIE(1)=  0,
  NCHAIN(1)=  0,0,0,0,
  NFL(1)    =  0,
  NJPSI     =  4,
  NPAD(1)   =  0,
  NVEH(1)   =  1,1,1,1,
  NWHL(1)   =  2,2,2,2,
  RDIAM(1)  = 20,20,20,20,
  RIMW(1)   = 10,10,10,10,
  RW(1)     =  0,
  SECTH(1)  =13.8,13.8,13.8,13.8,
  SECTW(1)  =16.0,16.0,16.0,16.0,
  TL=270,
  TIREID(1)='16.00R20','16.00R20','16.00R20','16.00R20',
  TPLY(1)   =28,28,28,28,
  TPSI(1,1)=35,35,50,50,   !CC
  TPSI(1,2)=20,20,30,30,   !SAND
  TPSI(1,3)=60,60,70,70,   !HWY
  TPSI(1,4)=20,20,30,30,   !EMERGENCY
```

```
  TRAKLN(1)= 0,
  TRAKWD(1)= 0,
  VTIRMX=40,12,60,12,    !CC,SAND,HWY,EMERGENCY
  WT(1)     =79,79,79,79,
  WTE(1)    =61.4,61.4,61.4,61.4,
CID=  736,
ICONV1=0,
CONV1 =  ,  ,
ICONV2= 0,
CONV2 =  ,  ,
IENGIN= 0,
ENGINE=     ,    ,
  FD(1) =6.21,.9,
  HPNET =403,
  IB(1) =  1,1,1,1,
  IDIESL=  2,
  IP(1) =  1,1,1,1,
  ITVAR =  0,
  JVPSI =  1,
  LOCDIF=  1,
  LOCKUP=  1,
  NCYL  =  8,
  NENG  =  1,
  QMAX  =1250,
  REVM(1) =408,408,408,408,
  TCASE(1)=1.0,
  TQIND =   ,
  NGR   = 10,
  TRANS=10.55,.9,
        6.50,.9,
        5.18,.9,
        4.22,.9,
        3.19,.9,
        2.85,.9,
        2.07,.9,
        2.04,.9,
        1.40,.9,
        1.00,.9,
  IPOWER= 28,
  POWER=     0,52206,
          1.0,47144,
          2.0,41262,
          3.0,35500,
          4.0,26894,
          4.9,23654,
          5.9,18322,
          6.9,16860,
          7.9,15386,
          8.9,13892,
          9.9,12890,
         10.9,12395,
         12.8, 9882,
         14.8, 8875,
         16.8, 6753,
         19.8, 5954,
         22.7, 5556,
         24.7, 5100,
         27.7, 4566,
         29.6, 3536,
         34.6, 3328,
```

```
          39.5, 3042,
          44.4, 2425,
          49.4, 2351,
          52.3, 2260,
          54.3, 2159,
          59.3, 2108,
          62.2, 2057,
 ACD    =.75,
 CD     =.75,
 XBRCOF= .8,
 KOHIND= 1,
   NHVALS=12,
   HVALS=         0,   7, 7.1, 7.2, 7.5,
                  8,   9,  10,  12,  14,
                 24,  60,
   VOOB(1,1) = 63, 63,   20,  11, 7.5,
               5.5,   5, 4.5, 3.5, 2.8,
                 2,   2,
   VOOB(1,2) = ,
   VOOB(1,3) = ,
   MAXIPR=14,
   MAXL=   1,
   RMS=            0,.15,  .2, .3,  .4,
                 .5, .6, .75,  1, 1.5,
                  2,  3,   4,  5,
   ABSPWR(1)=6,
   VRIDE(1,1,1)=63, 63,  50, 38,    29,
                22, 18,  15, 13,    11,
               9.5,  8, 6.5,  6,
   VRIDE(1,2,1)=,
   VRIDE(1,3,1)=,
   ABSPWR(2)=,
   VRIDE(1,1,2)=,
   VRIDE(1,2,2)=,
   VRIDE(1,3,2)=,
    DRAFT =   ,
 FORDD =   ,
 SAE   =   ,
 SAI   =   ,
 VFS   =   ,
 VSS   =   ,
 VSSAXP=   ,
 WC    =   ,
 NWR   =   ,
 WDAXP =   ,
 WDPTH(1)=   ,
 WRAT(1) =   ,
 WRFORD=   ,
 $END
NOHGT
      3  !Obsmod data from Keafur Grimes
NANG
      8
NWDTH
      3
 CLRMIN    FOOMAX    FOO       HOVALS    AVALS     WVALS
 INCHES    POUNDS    POUNDS    INCHES    RADIANS   INCHES
  14.79   11762.1    2741.8      3.15      1.95      5.88
   2.95   44839.5    4634.0     15.75      1.95      5.88
  -9.41   56075.4    7064.0     33.46      1.95      5.88
```

14.79	11762.1	2746.8	3.15	2.48	5.88
6.01	31125.6	4283.8	15.75	2.48	5.88
-9.42	31448.9	5418.6	33.46	2.48	5.88
14.76	11031.8	2727.2	3.15	2.69	5.88
8.12	21627.9	3892.0	15.75	2.69	5.88
-9.34	21989.2	4734.3	33.46	2.69	5.88
14.86	7517.4	2675.0	3.15	2.86	5.88
8.41	13978.5	3338.6	15.75	2.86	5.88
0.50	14242.7	3626.3	33.46	2.86	5.88
16.38	7553.4	2600.0	3.15	3.42	5.88
13.10	14246.2	2831.6	15.75	3.42	5.88
-0.01	14570.9	3449.4	33.46	3.42	5.88
17.14	8453.6	2599.0	3.15	3.60	5.88
14.61	10863.6	2564.6	15.75	3.60	5.88
1.06	22581.5	3613.0	33.46	3.60	5.88
17.55	6410.1	2494.8	3.15	3.80	5.88
14.80	14859.5	2694.9	15.75	3.80	5.88
13.16	24876.0	2984.7	33.46	3.80	5.88
17.85	4031.2	2428.4	3.15	4.33	5.88
17.18	8318.9	2582.3	15.75	4.33	5.88
15.28	15367.7	2814.0	33.46	4.33	5.88
14.96	11732.7	2656.9	3.15	1.95	29.88
8.25	42030.0	3664.1	15.75	1.95	29.88
-9.41	56113.3	5906.8	33.46	1.95	29.88
14.96	11732.7	2660.0	3.15	2.48	29.88
7.70	31190.2	3655.0	15.75	2.48	29.88
-9.36	31422.9	5009.8	33.46	2.48	29.88
14.93	11015.5	2676.3	3.15	2.69	29.88
7.97	21615.1	3442.6	15.75	2.69	29.88
-6.40	22010.2	4428.5	33.46	2.69	29.88
15.35	7511.2	2603.0	3.15	2.86	29.88
8.40	13977.7	3131.7	15.75	2.86	29.88
3.75	14122.9	3389.3	33.46	2.86	29.88
16.27	7563.0	2593.9	3.15	3.42	29.88
9.18	14337.8	3043.6	15.75	3.42	29.88
-0.81	14558.6	3523.3	33.46	3.42	29.88
16.25	11141.9	2671.3	3.15	3.60	29.88
14.19	22037.5	2870.9	15.75	3.60	29.88
-7.73	22675.5	3919.2	33.46	3.60	29.88
16.27	11220.3	2651.6	3.15	3.80	29.88
14.77	14834.0	2645.4	15.75	3.80	29.88
1.04	32556.5	3710.6	33.46	3.80	29.88
15.29	14931.3	2822.2	3.15	4.33	29.88
14.59	15222.1	2715.3	15.75	4.33	29.88
14.59	13668.3	2596.1	33.46	4.33	29.88
16.03	10359.6	2590.5	3.15	1.95	141.60
7.13	32966.4	3172.7	15.75	1.95	141.60
-10.04	57941.7	4818.9	33.46	1.95	141.60
16.03	10359.6	2591.9	3.15	2.48	141.60
8.16	30251.1	3165.7	15.75	2.48	141.60
-5.24	31888.8	4175.3	33.46	2.48	141.60
16.07	10818.3	2591.0	3.15	2.69	141.60
8.30	20745.2	3062.4	15.75	2.69	141.60
-1.61	21761.1	3877.9	33.46	2.69	141.60
16.03	7458.2	2574.2	3.15	2.86	141.60
11.72	13349.2	2923.4	15.75	2.86	141.60
8.97	13880.6	3470.6	33.46	2.86	141.60
16.00	7536.9	2555.6	3.15	3.42	141.60
5.80	14337.6	2945.4	15.75	3.42	141.60
0.01	14563.4	3243.9	33.46	3.42	141.60

```
  16.05   11014.4    2604.3      3.15       3.60    141.60
   3.14   22230.4    3273.6     15.75       3.60    141.60
 -12.78   22678.4    3739.6     33.46       3.60    141.60
  16.00   10845.6    2615.7      3.15       3.80    141.60
   2.96   32154.7    3346.8     15.75       3.80    141.60
 -17.99   32774.5    3984.5     33.46       3.80    141.60
  15.98   11227.8    2621.5      3.15       4.33    141.60
   2.94   35657.9    3345.1     15.75       4.33    141.60
 -18.74   57877.5    4338.2     33.46       4.33    141.60
$LFVDAT
! Over-all description:
   IVTYPE=      1, ! 1=wheeled, 2=flex-track, 3=gird-track
   IVCONF=      3, ! if wheeled; 1=4x4, 2=6x6, 3=8x8
                   ! if tracked; 1=Normal, 2=Dozer, 4=Comb. 1&2
   GVW   =  60250, ! Gross vehicle weight {lbs}
   VVCI1 =    33 , ! Vehicle 1-pass VCI for fine-grained soils {RCI}
! Geometry:
VLEN   = 400.5, !from HEMTT 1-89, Over-all length {in}
VWIDTH =    96, !from HEMTT 1-89, Over-all width {in}
VAADEG =    43, !Approach/departure angle {deg}
VCLR   =    24, !Frame end clearance ("clearance line") {in}
VRR    =  23.1, !Road-wheel radius (+ track-thickness if tracked) {in}
VTL    =   270, !Front-rear ground wheel center-line distance {in}
VCGF   =   146, !Horizontal-distance CG to front-wheel center-line {in}
VCGH   =  38.9, ! Vertical distance CG to front-wheel center-line {in}
! Wheeled vehicle additional geometry data
   WHLGWS =   150, ! Distance between wheels of greatest span {in}
   WBCLR  =    24, ! Clearance between wheels of greatest span {in}
! Tracked vehicle additional data
   TRKLEN =      , ! Length of track on ground (one-side) {in}
   TRKWID =      , ! Width of one track (one-side) {in}
   TRKD   =      , ! Hull depth above end clearance line {in}
   KTPAD  =      , ! Track pad code 1=HAS-pads; 0=NO-pads
! Tracked vehicle sprocket/idler configuration for non-dozer
! (i.e. IVCONF=1,4)
RR1 =  , ! Sprocket/idler radius {in}
RR2 =  , ! Horizontal dist. road-wheel ctr. to sprocket/idler ctr. {in}
RR3 =  , ! Vertical dist. road-wheel ctr. to sprocket/idler ctr. {in}
! Swimming/fording characteristics
   VSWIM  =     0, ! Vehicle swim speed (0.=NON-SWIMMER) {mph}
   VFORD  =      , ! Vehicle fording speed (pre-set to 5mph)
   DFLOAT =    48, ! Vehicle maximum fording depth {in}
 $ END
```

M917 Vehicle File

```
M917, DUMP TRUCK, 20 TON 8X6
Updated for NRMMII Model 25Jan99, added VULEN,NVUNTS,KCTIOP,NJPSI,JVPSI
File Name: c:\vehicles\nrmm\m917.dat !Original file
File Name: c:\vehicles\nrmmii\m917.dat !Updated to NRMMII Model
Date 19JULY91  By: B. Temple   Data: D7-6
M917, DUMP TRUCK, 20 TON 8X6
$VEHICLE
  NAMBLY=   4,
  WGHT(1)= 8300, 20000, 22300, 22300,
NVUNTS=1,
VULEN(1)= 350,  !25Jan.99, Jane's Military Veh. Logistics 92-93, pg450
CGH    = 47.5,
CGLAT =    0,
CGR    = 82.8,
CL     =   12,
CLRMIN(1)=  4*12,
EYEHGT=   86,
PBF    = 72900,    !27Jan.99 loaded weight
PBHT  =   30,
PFA    =   80,
WDTH  =   98,
  AVGC=  800,
  AXLSP(1) =136, 56, 56,
  DFLCT(1,1)= 1.6,1.6,1.6,1.6,     !cc
  DFLCT(1,2)= 2.7,2.7,2.7,2.7,     !sand
  DFLCT(1,3)= 1.6,1.6,1.6,1.6,     !hwy
  DFLCT(1,4)= ,                    !21April99, other
  DIAW(1)   = 4*47.8,
  ICONST(1)= 4*1,
  ID(1)     = 0,3*1,
  IT(1)     = 0,0,1,1,          !21April99 corrected
  KTSFLG    = 4*2,
  KCTIOP(1)= 3,3,2,1,2,2,1,2,
  NJPSI     = 3,                !21April99
  JVPSI     = 1,
  NCHAIN(1)= 4*0,
  NVEH(1)   = 4*1,
  NWHL(1)   = 2,3*4,
  RDIAM(1)  = 4*24,
  RIMW(1)   = 4*10,
  SECTH(1)  = 4*10.9,
  SECTW(1)  = 4*11.5,
  TL=  248,
  TPLY(1)   = 4*14,
  TPSI(1,1)= 4*90,       !cc
  TPSI(1,2)= 4*50,       !sand
  TPSI(1,3)= 4*90,       !hwy
  TPSI(1,4)=  ,         !21April99, other
  VTIRMX=  50, 30, 50,  !21April99
  WT(1)     =  78,73,73,73,
  WTE(1)    = 66.5,61.5,61.5,61.5,
  CID=      855,
ICONV1=      ,
CONV1 =      ,      ,
ICONV2=      ,
CONV2 =      ,      ,
```

```
IENGIN=     ,
ENGINE=      ,        ,
  FD(1) =  5.29, .9,
  HPNET =   400,
  IB(1) = 1,0,1,1,
  IDIESL=     1,
  IP(1) = 1,0,1,1,
  ITVAR =     0,
  LOCDIF=     1,
  LOCKUP=     1,
  NCYL  =     6,
  NENG  =     1,
  QMAX  = 1150,
  REVM(1) = 4*437,
  TCASE(1)=1.0,1.0,
  TQIND =      ,
  NGR   =    16,
  TRANS=  14.77, .9,
          12.21, .9,
          10.07, .9,
           8.33, .9,
           6.89, .9,
           5.70, .9,
           4.70, .9,
           3.89, .9,
           3.14, .9,
           2.60, .9,
           2.14, .9,
           1.77, .9,
           1.47, .9,
           1.21, .9,
           1.00, .9,
           0.83, .9,
  IPOWER=    22,
  POWER=  0    , 38733,
          2.5  , 38733,
          3.   , 37626,
          4.   , 26261,
          5.   , 21614,
          6.   , 17897,
          7.   , 14892,
          8.   , 12342,
         10.   , 10203,
         12.   ,  8247,
         14.   ,  8019,
         15.   ,  6818,
         16.   ,  6747,
         18.   ,  5617,
         20.   ,  5510,
         25.   ,  4511,
         30.   ,  3750,
         35.   ,  3125,
         40.   ,  2611,
         45.   ,  2528,
         50.   ,  2154,
         54.5  ,  2093,
  ACD   =  1.2,
  CD    =   0.7,
  XBRCOF=   0.8,
  NHVALS=  15,
```

```
   HVALS=    0,    2,  2.5,     3,  3.5,
             4,  4.5,    5,   5.5,    6,
             7,    8,   20,    60,  100,
   VOOB(1,1) =  56,   50, 29.6, 19.8, 13.9,
               10.4, 7.8,  6.7,  5.8,  5.2,
                4.6, 4.2,    4,    2,    2,
   VOOB(1,2) =,
   VOOB(1,3) =,
   MAXIPR=   13,
   MAXL=    1,
   RMS=            0,  .1, .15, .2, .25,
                  .3,  .5,  .7,  1, 1.5,
                   2,   3,   5,
   VRIDE(1,1,1)= 56,  56,  56, 50,  40,
                 23,  14,  10,  9, 7.5,
                7.5, 6.5,   6,
   VRIDE(1,2,1)=        ,
   VRIDE(1,3,1)=        ,
 DRAFT =       ,
 FORDD =       ,
 SAE   =       ,
 SAI   =       ,
 VFS   =       ,
 VSS   =       ,
 VSSAXP=       ,
 WC    =       ,
 NWR   =       ,
 WDAXP =       ,
 WDPTH(1)=       ,
 WRAT(1)  =      ,
 WRFORD=       ,
 $END
NOHGT          !Obsmod data from K. Grimes
     3
NANG
     8
NWDTH
     3
```

CLRMIN INCHES	FOOMAX POUNDS	FOO POUNDS	HOVALS INCHES	AVALS RADIANS	WVALS INCHES
13.88	17190.8	1168.1	3.15	1.95	5.88
6.28	49851.7	3975.6	15.75	1.95	5.88
-11.38	53579.7	8443.6	33.46	1.95	5.88
13.88	17190.8	1178.9	3.15	2.48	5.88
6.36	43980.1	3192.2	15.75	2.48	5.88
-11.34	44144.4	4879.2	33.46	2.48	5.88
13.82	16211.4	1215.8	3.15	2.69	5.88
6.37	32292.3	2614.0	15.75	2.69	5.88
-11.27	32341.1	4091.8	33.46	2.69	5.88
13.81	10046.8	1171.2	3.15	2.86	5.88
6.41	20745.4	2096.6	15.75	2.86	5.88
-1.83	22009.0	3376.8	33.46	2.86	5.88
13.84	10091.2	1106.0	3.15	3.42	5.88
11.43	20735.5	1612.0	15.75	3.42	5.88
5.45	20735.3	2734.9	33.46	3.42	5.88
13.57	11821.8	884.5	3.15	3.60	5.88
10.65	15993.0	1381.9	15.75	3.60	5.88
2.53	32246.6	2801.2	33.46	3.60	5.88
13.85	10228.5	978.8	3.15	3.80	5.88
11.98	25453.6	2083.9	15.75	3.80	5.88

-4.20	40191.6	1984.2	33.46	3.80	5.88
14.00	5250.7	770.1	3.15	4.33	5.88
13.59	11524.4	862.6	15.75	4.33	5.88
12.63	27679.9	1806.8	33.46	4.33	5.88
13.85	16888.1	1021.9	3.15	1.95	29.88
6.28	49851.7	2205.2	15.75	1.95	29.88
-11.38	53579.7	5510.8	33.46	1.95	29.88
13.85	16888.1	1028.5	3.15	2.48	29.88
6.36	43980.1	2480.2	15.75	2.48	29.88
-11.39	44144.4	4224.8	33.46	2.48	29.88
13.82	16211.4	1085.3	3.15	2.69	29.88
6.37	32292.3	2288.6	15.75	2.69	29.88
-9.76	32340.9	3740.9	33.46	2.69	29.88
13.83	10007.7	997.5	3.15	2.86	29.88
6.37	20745.4	2020.3	15.75	2.86	29.88
1.26	22050.3	3226.8	33.46	2.86	29.88
13.85	10097.1	1085.6	3.15	3.42	29.88
11.43	20735.2	1872.8	15.75	3.42	29.88
4.37	20735.4	2764.4	33.46	3.42	29.88
13.86	16433.6	1191.7	3.15	3.60	29.88
9.67	32247.2	1776.9	15.75	3.60	29.88
-3.68	32247.3	3090.2	33.46	3.60	29.88
13.75	17096.2	1113.7	3.15	3.80	29.88
8.86	23413.4	1482.7	15.75	3.80	29.88
-8.25	43828.2	2758.4	33.46	3.80	29.88
11.69	26308.1	1679.0	3.15	4.33	29.88
11.95	29984.8	1681.9	15.75	4.33	29.88
-5.02	31414.2	1407.2	33.46	4.33	29.88
13.84	16985.1	1000.5	3.15	1.95	141.60
7.86	49330.1	2307.0	15.75	1.95	141.60
-5.95	52298.0	4413.2	33.46	1.95	141.60
13.84	16985.1	1003.3	3.15	2.48	141.60
8.23	41939.8	2136.2	15.75	2.48	141.60
-2.13	44768.0	3196.3	33.46	2.48	141.60
13.77	15977.8	1027.0	3.15	2.69	141.60
8.83	34195.0	1945.7	15.75	2.69	141.60
2.22	34063.9	2969.3	33.46	2.69	141.60
13.86	9955.1	1000.6	3.15	2.86	141.60
10.83	22011.7	1801.7	15.75	2.86	141.60
9.11	22006.5	2675.8	33.46	2.86	141.60
13.85	10066.6	1058.6	3.15	3.42	141.60
10.44	20735.4	1834.0	15.75	3.42	141.60
8.31	20735.4	2635.1	33.46	3.42	141.60
13.88	16218.9	1023.8	3.15	3.60	141.60
9.67	32247.7	2064.8	15.75	3.60	141.60
-6.21	32247.5	3021.5	33.46	3.60	141.60
13.77	16306.2	956.6	3.15	3.80	141.60
8.86	39564.9	2175.9	15.75	3.80	141.60
-15.40	43825.0	3497.4	33.46	3.80	141.60
13.74	17091.0	1010.8	3.15	4.33	141.60
8.31	49225.0	2230.2	15.75	4.33	141.60
-15.40	51825.0	4497.4	33.46	4.33	141.60

M1084/M1095 Vehicle File

```
 M1084/M1095
 File Name:c:\vehicles\nrmmii\m1084.trl !m1084/m1095
 MTV-M1095
 $VEHICLE
   NAMBLY= 5,
WGHT(1)= 12800,11339,11869,9550,9550,!7Mar00,trl tot.19100 from AEC
NVUNTS = 2,
VULEN(1)=306.1, 230.5,  !7Mar00,trl from Joe Rouse AEC
CGH    =59,            !FROM TRUCK NOMENCLATURE PANEL HUTTO 10-27-93
 CGLAT =1.5,           !FROM TRUCK NOMENCLATURE PANEL HUTTO 10-27-93
 CGR = 233,            !11Dec97 Dennis Moore
CL     =13.75,         !WES MEASURED T. HUTTO 1-24-94
CLRMIN(1)=13.75,13.75,13.75,14.5,14.5, !7Mar00,trl from Joe Rouse AEC
 EYEHGT=96,            !WES MEASURED T. HUTTO 1-24-94
 PBF    = 36008,       !truck weight only
PBHT   =42.2,          !FROM TRUCK NOMENCLATURE PANEL HUTTO 10-27-93
PFA    =51.3,          !Calculated T. HUTTO
WDTH   =96,            !FROM TRUCK NOMENCLATURE PANEL HUTTO 10-27-93
AVGC=720,
AXLSP(1) =149.4,55.6,184.7,48,  !FROM TRUCK NOMENCLATURE PANEL 10-27-93
                                !7March00, trl from Joe Rouse AEC
   DFLCT(1,1)=1.94,1.42,1.42,1.42,1.42, !29Dec97 trl HWY FROM D. MOORE
                                        ! 1-24-94 17.1% 13.0% 13.0%
   DFLCT(1,2)=2.49,2.17,2.17,2.1,2.1,   !29Dec97 trl CC FROM D. MOORE
                                        ! 1-24-94 22.4% 19.8% 19.8%
DIAW(1)   =5*46.9,         !FROM DENNIS MOORE 1-24-94
   ICONST(1)=5*0,
   ID(1)    =5*0,
IT(1)     =0,1,1,2,2,       !8March00 corrected
KCTIOP(1)=8*0,              !7March00 CTI
   KTSFLG   =5*1,
   NCHAIN(1)=5*0,
   NJPSI    =  2,
   NVEH(1)  =  1,1,1,1,1,
   NWHL(1)  =5*2,
   RDIAM(1) =5*20,
   RIMW(1)  =5*10,
   SECTH(1) =5*10.4,
   SECTW(1) =5*15.4,
   TL=437.7,
   TIREID(1)='395/80R20, 39580R20 Michelin',
TPLY(1)   =14,14,14,14,14,
   TPSI(1,1)=62,62,62,62,62,     !29Dec97 HWY  FROM DENNIS MOORE 1-24-94
   TPSI(1,2)=38,38,38,38,38,     !29Dec97 CC   FROM DENNIS MOORE 1-24-94
VTIRMX(1)=60,40,              !29Dec97 HWY,CC
WT(1)     =80.5,80.5,80.5,80.5,80.5,  !TRUCK NOMENCLATURE PANEL 10-27-93
WTE(1)    =64,64,64,64,64,      !TRUCK NOMENCLATURE PANEL HUTTO 10-27-93
 CID=403,                         !STEWART & STEVENSON SCHEMATIC 1-11-91
 ICONV1=0,
 CONV1 =  ,  ,
 ICONV2= 0,
 CONV2 =  ,  ,
 IENGIN= 0,
 ENGINE=     ,    ,
   FD(1) =7.8, .97,              !STEWART & STEVENSON SCHEMATIC 1-11-91
   HPNET =290,                   !STEWART & STEVENSON SCHEMATIC 1-11-91
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```
 IB(1) =5*1,
 IDIESL=  1,
 IP(1) =3*1,2*0,
 ITVAR =  0,
 JVPSI =  2,
 LOCDIF=  1,
 LOCKUP=  1,
 NCYL  =  6,                  !STEWART & STEVENSON SCHEMATIC 1-11-91
 NENG  =  1,
 QMAX  =732,                  !STEWART & STEVENSON SCHEMATIC 1-11-91
 REVM(1) =447,447,447,447,447,
 TCASE(1)=1.0,1.0,
 TQIND =   ,
 NGR   = 7,                   !STEWART & STEVENSON SCHEMATIC 1-11-91
 TRANS= 6.93,0.97,
        4.18,0.97,
        2.24,0.97,
        1.69,0.97,
        1.20,0.97,
        0.90,0.97,
        0.78,0.97,
!AVERAGE NET HORSE POWER= 189.687
 IPOWER =119,
!I/P FROM STEWART & STEVENSON 1-14-91 (O/P NRMMII FORMAT 12-30-94)
          ! ( Speed          Force              HP
  POWER =    0.000000       36592.0       !   0.000000
             0.500000       34000.1       !    45.3334
             1.00000        31408.1       !    83.7550
             1.50000        28816.2       !    115.265
             2.00000        26014.0       !    138.741
             2.50000        23364.9       !    155.766
             3.00000        21209.1       !    169.673
             3.50000        19108.0       !    178.342
             4.00000        17007.0       !    181.408
             4.50000        15248.6       !    182.983
             5.00000        13567.6       !    180.902
             5.50000        12583.8       !    184.562
             6.00000        11163.0       !    178.608
             6.50000        10477.8       !    181.614
             7.00000        9792.50       !    182.793
             7.50000        9107.25       !    182.145
             8.00000        8422.00       !    179.669
             8.50000        7947.88       !    180.152
             9.00000        7581.01       !    181.944
             9.50000        7214.13       !    182.758
            10.0000        6503.00       !    173.413
            10.5000        6293.50       !    176.218
            11.0000        6084.00       !    178.464
            11.5000        5874.50       !    180.151
            12.0000        5665.00       !    181.280
            12.5000        5462.62       !    182.087
            13.0000        5305.83       !    183.935
            13.5000        5245.91       !    188.853
            14.0000        5186.00       !    193.611
            14.5000        5103.75       !    197.345
            15.0000        5021.50       !    200.860
            15.5000        4939.25       !    204.156
            16.0000        4857.00       !    207.232
            16.5000        4737.00       !    208.428
            17.0000        4617.00       !    209.304
```

17.5000	4497.00	!	209.860
18.0000	4377.00	!	210.096
18.5000	4233.38	!	208.847
19.0000	4089.75	!	207.214
19.5000	3946.13	!	205.199
20.0000	3797.00	!	202.507
20.5000	3738.00	!	204.344
21.0000	3679.00	!	206.024
21.5000	3620.00	!	207.547
22.0000	3561.00	!	208.912
22.5000	3488.50	!	209.310
23.0000	3416.00	!	209.515
23.5000	3343.50	!	209.526
24.0000	3271.00	!	209.344
24.5000	3189.00	!	208.348
25.0000	3107.00	!	207.133
25.5000	3025.00	!	205.700
26.0000	2943.00	!	204.048
26.5000	2749.56	!	194.302
27.0000	2727.38	!	196.371
27.5000	2705.19	!	198.380
28.0000	2683.00	!	200.331
28.5000	2654.75	!	201.761
29.0000	2626.50	!	203.116
29.5000	2598.25	!	204.396
30.0000	2570.00	!	205.600
30.5000	2535.25	!	206.200
31.0000	2500.50	!	206.708
31.5000	2465.75	!	207.123
32.0000	2431.00	!	207.445
32.5000	2392.25	!	207.328
33.0000	2353.50	!	207.108
33.5000	2314.75	!	206.784
34.0000	2276.00	!	206.357
34.5000	2233.25	!	205.459
35.0000	2190.50	!	204.447
35.5000	2147.75	!	203.320
36.0000	2105.00	!	202.080
36.5000	2059.58	!	200.466
37.0000	2014.17	!	198.731
37.5000	1949.00	!	194.900
38.0000	1934.00	!	195.979
38.5000	1917.50	!	196.863
39.0000	1901.00	!	197.704
39.5000	1884.50	!	198.501
40.0000	1868.00	!	199.253
40.5000	1849.00	!	199.692
41.0000	1830.00	!	200.080
41.5000	1811.00	!	200.417
42.0000	1792.00	!	200.704
42.5000	1771.50	!	200.770
43.0000	1751.00	!	200.781
43.5000	1730.50	!	200.738
44.0000	1710.00	!	200.640
44.5000	1688.00	!	200.309
45.0000	1666.00	!	199.920
45.5000	1644.00	!	199.472
46.0000	1622.00	!	198.965
46.5000	1598.75	!	198.245
47.0000	1575.50	!	197.463

```
              47.5000          1552.25       !     196.618
              48.0000          1529.00       !     195.712
              48.5000          1504.78       !     194.618
              49.0000          1480.55       !     193.459
              49.5000          1456.33       !     192.235
              50.0000          1441.00       !     192.133
              50.5000          1423.25       !     191.664
              51.0000          1405.50       !     191.148
              51.5000          1387.75       !     190.584
              52.0000          1370.00       !     189.973
              52.5000          1351.00       !     189.140
              53.0000          1332.00       !     188.256
              53.5000          1313.00       !     187.321
              54.0000          1294.00       !     186.336
              54.5000          1274.25       !     185.191
              55.0000          1254.50       !     183.993
              55.5000          1234.75       !     182.743
              56.0000          1215.00       !     181.440
              56.5000          1194.41       !     179.958
              57.0000          1173.82       !     178.421
              57.5000          1015.78       !     155.752
              58.0000          852.000       !     131.776
              58.5000          692.667       !     108.056
              58.7500          613.000       !      96.0367
ACD    =.75,                             !STEWART & STEVENSON SCHEMATIC 1-11-91
CD     =.7,
XBRCOF=.8,
  KOHIND=1,
  NHVALS= 10,  !Letourneau test 20,21 Sept.95 Final Ride * Shock Curve
               !With Final Production on Cab
  HVALS=        0,     2,    4,    6,     8,
               10,    12,   14,   16,   100,
  VOOB(1,1) =100,     50,   35,   22,    17,
              10.5,    5,    3,    2,     2,
  VOOB(1,2) =,
  VOOB(1,3) =,
  KVRIND(1)=1,
  MAXL= 1,
  ABSPWR(1)= 6,
  MAXIPR= 11,  !Letourneau test 20,21 Sept.95 Final Ride & Shock Curve
               !With Final Production on Cab
  RMS =         0,     0,  0.2,   0.4,   0.6,
               1.0,  2.0,  3.0,   4.0,   5.0,
               6.0,
 VRIDE(1,1,1)=100,     60,    45,    35,    30,
                25,  12.0,    10,     8,     6,
               2.0,
  VRIDE(1,2,1)=,
  VRIDE(1,3,1)=,
  ABSPWR(2)=  ,
  VRIDE(1,1,2)=,
  VRIDE(1,2,2)=,
  VRIDE(1,3,2)=,
DRAFT =,
FORDD =,
SAE    =  ,
SAI    =  ,
VFS    =  ,
VSS    =  ,
VSSAXP=  ,
```

```
 WC     =  ,
 NWR    =  ,
 WDAXP =  ,
 WDPTH(1)=  ,
 WRAT(1) =  ,
 WRFORD=  ,
 $END
NOHGT       !1  M1084/M1095, added trl 8March00
     3      !c:\vehicles\nrmmii\m1084trl.obv
NANG        !c:\vehicles\nrmmii\obw.dat
     8      !c:\vehicles\nrmmii\m1084trl.obo
NWDTH       !8March00 increased trl weight
     3
```

CLRMIN INCHES	FOOMAX POUNDS	FOO POUNDS	HOVALS INCHES	AVALS RADIANS	WVALS INCHES
11.44	7448.4	223.4	3.15	1.95	5.88
2.82	17533.9	767.3	15.75	1.95	5.88
-5.60	30647.8	1990.5	33.46	1.95	5.88
11.44	7448.4	226.3	3.15	2.48	5.88
4.23	12983.1	624.3	15.75	2.48	5.88
-9.51	22658.7	2142	33.46	2.48	5.88
10.78	7746.9	292.0	3.15	2.69	5.88
4.79	11525.8	575.3	15.75	2.69	5.88
-8.84	15522.1	1772.3	33.46	2.69	5.88
11.43	3689.7	170.7	3.15	2.86	5.88
8.04	8549.3	719.5	15.75	2.86	5.88
1.56	9069.6	1085.3	33.46	2.86	5.88
13.06	3745.6	171.8	3.15	3.42	5.88
9.97	9132.7	523.4	15.75	3.42	5.88
30.14	1614.5	30.6	33.46	3.42	5.88
13.53	6145.6	167.2	3.15	3.60	5.88
6.21	6521.2	408.4	15.75	3.60	5.88
0.92	15538.3	1051.2	33.46	3.60	5.88
13.93	4181.1	69.3	3.15	3.80	5.88
8.86	9842.8	522	15.75	3.80	5.88
-8.05	16541.9	479.5	33.46	3.80	5.88
14.40	2537.5	31	3.15	4.33	5.88
13.78	4740.4	117.8	15.75	4.33	5.88
10.82	14024.4	643.5	33.46	4.33	5.88
11.71	7278.5	83.2	3.15	1.95	29.88
6.46	26453.8	826.6	15.75	1.95	29.88
-10.56	37389.6	1580.1	33.46	1.95	29.88
11.71	7278.5	84.2	3.15	2.48	29.88
4.85	12850.1	577.5	15.75	2.48	29.88
-9.32	22511.7	1578.1	33.46	2.48	29.88
11.39	6189.9	155.4	3.15	2.69	29.88
7.36	13982.3	684.6	15.75	2.69	29.88
-5.81	15510.2	1536.6	33.46	2.69	29.88
11.86	3688.3	122.3	3.15	2.86	29.88
8.35	8596.5	711.1	15.75	2.86	29.88
4.77	7981.3	924.1	33.46	2.86	29.88
13.01	3750.1	172.7	3.15	3.42	29.88
9.87	9189.9	675.8	15.75	3.42	29.88
-1.09	13181.9	1039.1	33.46	3.42	29.88
12.99	6320.7	196.9	3.15	3.60	29.88
4.44	9528.9	433	15.75	3.60	29.88
31.23	1442.9	26.4	33.46	3.60	29.88
13.01	7282.0	255.8	3.15	3.80	29.88
3.87	10102.2	450.7	15.75	3.80	29.88
-10.03	22347.9	1085.4	33.46	3.80	29.88

```
  12.46    7752.6        39      3.15        4.33      29.88
   4.13   15985.3       468     15.75        4.33      29.88
   1.33    7868.9     729.2     33.46        4.33      29.88
  12.92    7497.9     157.6      3.15        1.95      141.6
   6.60   21201.4     469.7     15.75        1.95      141.6
 -10.56   34850.6    1078.1     33.46        1.95      141.6
  12.92    7497.9     159.1      3.15        2.48      141.6
   7.15   10562.0     514.8     15.75        2.48      141.6
  -0.12   21958.7    1059.2     33.46        2.48      141.6
  14.28    7308.7     187.9      3.15        2.69      141.6
   7.36   13673.3     470.6     15.75        2.69      141.6
   5.46   15140.1    1044.5     33.46        2.69      141.6
  13.10    3725.9     115.1      3.15        2.86      141.6
  10.93    8897.9     376.6     15.75        2.86      141.6
  10.87    8920.4     876.4     33.46        2.86      141.6
  16.21    4831.7     141.5      3.15        3.42      141.6
  10.22    7188.5     278.7     15.75        3.42      141.6
   7.55    6360.2       812     33.46        3.42      141.6
  16.69    4362.9     131.9      3.15        3.60      141.6
   5.13   15101.1     743.8     15.75        3.60      141.6
   2.26   11346.0     674.1     33.46        3.60      141.6
  12.58    5157.6     103.3      3.15        3.80      141.6
  11.22    5795.3     240.4     15.75        3.80      141.6
   2.80   10129.7     623.6     33.46        3.80      141.6
  18.62    2884.2      99.3      3.15        4.33      141.6
  12.63    4291.2     195.6     15.75        4.33      141.6
   4.20    7500.7     507.4     33.46        4.33      141.6
 M1084/M1095,30Dec97 6X6
 $VEHICL
   NUNITS =     2  ! Number of units
   NSUSP  =     3  ! Number of suspension supports
   NVEH1  =     1  ! Vehicle type; 0=tracked, 1=wheeled
   REFHT1 =  41.7 ! Height of hitch from ground
   HTCHFZ =  1910, !est. 10% trl tongue weight V-force on hitch
   SFLAG(1) = 0,1,1, ! Type suspension @supt-i,0=indp,1=bogie
!  Power flags
   IP(1,1)  = 1,1,0,0,0,
   IP(1,2)  = 0,1,0,0,0,
!  Brake flags
   IB(1,1)  = 1,1,1,0,0,
   IB(1,2)  = 0,1,1,0,0,
   EFFRAD(1)=  21,21,21,      !Effective loaded radius of wheels
   ELL(1)   = 253.4, 76.2,-137,   !Horiz. pos. suspension WRT hitch
   BWIDTH(1)=   0,   55.6, 48,!7March00, trl Joe Rouse,
                              !Bogie arm length (wheel to wheel)
   BALMU(1)= 0, 10.0, 10.0,!Bogie max CCW. angle,
                          !(+=CCW.)15"Jounce,6"rebound
   BALMD(1) =  -0,  -10.0,-10.0,!Bogie max CW. angle, (+=CCW.)
   EQUILF(1)=12800, 23208,19100, !Equilibrium force
                              !7March00,trl weight from Joe Rouse AEC
   CGZ1      =   59          ! V-cg, Unit-1 WRT ground
   CGZ2      =   60.1        ! 7March00,trl weight from Joe Rouse AEC
                             ! est. V-cg, Unit-2 WRT grd
   DEE1      =    0          ! H-cg, Unit-1 payload WRT hitch
   ZEE1      =    0          ! V-cg, Unit-1 payload WRT ground
   DEE2      =    0.0        ! H-cg, Unit-2 payload WRT hitch
   ZEE2      =    0.0        ! V-cg, Unit-2 payload WRT ground
   DELTW1    =    0.0        ! Payload weight, Unit-1
   DELTW2    =    0.0        ! Payload weight, Unit-2
   NPTSC1    =      9        ! #Pts, bottom profile, Unit-1
```

```
  XCLC1(1) = 307.6, 308.2, 290.2, 231.0, 129.4, 77.8, 24.8,  2.5, 0,
  YCLC1(1) =  44.9,  37.1,  22.9,  23.0,  25.2, 14.4, 22.5, 32.4, 41.7,
   NPTSC2   =6,              ! #Pts, bottom profile, Unit-2
 XCLC2(1) =0,     -36, -36, -165.5, -165.5, ! X, Bottom profile, Unit-2
   -205.5,                !removed the last point for the ladder(-229.5)
YCLC2(1) =47,     47,  42,     42,      32,  ! Y, Bottom profile, Unit-2
          32,                 !removed the last point for the ladder(20)
SFLAG(4) =,             ! Type suspension front "spridler" (always zero)
   IP(4,1)   =,             ! Power flag, front "spridler"
   IB(4,1)   =,             ! Brake flag, front "spridler"
   ELL(4)    =,             ! H-pos front "spridler" WRT hitch
   ZS(4)     =,             ! V-pos front "spridler" WRT ground
   EFFRAD(4)=,              ! Effective radius front "spridler"
   SFLAG(5) =,              ! Type suspension rear "spridler" (always
zero)
   IP(5,1)   =,             ! Power flag, rear "spridler"
   IB(5,1)   =,             ! Brake flag, rear "spridler"
   ELL(5)    =,             ! H-pos rear "spridler" WRT hitch
   ZS(5)     =,             ! V-pos rear "spridler" WRT ground
   EFFRAD(5)=,              ! Effective radius rear "spridler"
 $END
```

M985/M989 Vehicle File

```
M985 HEMTT 10ton Truck w/M989A1(HEMAT) Trailer
3/07/01 Use this file for JWARS and WARSIM
Added OBSMOD Data 1March01
Changed,1March01:one number in the AXLSP from 60 to 102"
                 TL
Use this file for JWARS and WARSIM
File name:m985m989.v
Date Entered:24JAN.92    By: B. TEMPLE
M985-M989         HEMTT 10ton Truck w/M989A1(HEMAT) Trailer
$VEHICLE
  NAMBLY= 6,
  WGHT(1)=13365,13445,18775,18505,13570,13160,  !(90820 TOTAL WGHT)
  NVUNTS=2,
  VULEN(1)=400.5, 309.5,   !Total length=710
                   !measured tractor from front bumper to the end
                   !measured trailer from end tractor to end trailer
CGH   =69.9,
CGLAT = 0,
CGR   =118,
CL    =  9,
CLRMIN(1)=13,13,13,13,9,9,
EYEHGT=86,
PBF   =64000,
PBHT  =42,
PFA   =48,
WDTH  =96,
  ASHOE(1) =  0,
  AVGC=900,
  AXLSP(1) =60,150,60,102,234,   !1March01
  DFLCT(1,1)= 4.0,4.0,4.0,4.0,1.5,1.5,
  DFLCT(1,2)= ,
  DFLCT(1,3)= ,
  DFLCT(1,4)= ,
  DIAW(1)  = 52.6,52.6,52.6,52.6,39.5,39.5,
  GROUSH(1)=  0,
  ICONST(1)=  0,0,0,0,1,1,
  ID(1)    =  0,0,0,0,0,0,
  IT(1)    =  1,1,2,2,0,0,
  KCTIOP(1)=8*1,
  JVPSI    =  1,
  KTSFLG   =  1,1,1,1,2,2,
  NBOGIE(1)=  0,
  NCHAIN(1)=  0,0,0,0,0,0,
  NFL(1)   =  0,
  NJPSI    =  1,
  NPAD(1)  =  0,
  NVEH(1)  =  1,1,1,1,1,1,
  NWHL(1)  =  2,2,2,2,2,2,
  RDIAM(1) = 20,20,20,20,19.5,19.5,
  RIMW(1)  = 10,10,10,10,11.75,11.75,
  RW(1)    =  0,
  SECTH(1) =13.8,13.8,13.8,13.8,10,10,
  SECTW(1) =16.0,16.0,16.0,16.0,15.2,15.2,
  TIREID(1)='4*16.00R20XL','2*15.0-19.5 TRL',
  TL=606,   !1March01
  TPLY(1)  =28,28,28,28,14,14,
```

```
    TPSI(1,1)=20,20,30,30,85,85,
    TPSI(1,2)=,
    TPSI(1,3)=,
    TPSI(1,4)=,
    TRAKLN(1)= 0,
    TRAKWD(1)= 0,
    VTIRMX=40,12,63,40,
    WT(1)     =77,77,77,77,77,77,
    WTE(1)    =60.5,60.5,60.5,60.5,60.5,60.5,
  CID=  736,
  ICONV1=0,
  CONV1 =  ,  ,
  ICONV2= 0,
  CONV2 =  ,  ,
  IENGIN= 0,
  ENGINE=    ,    ,
    FD(1) =5.45,.95,
    HPNET =403,
    IB(1) =  1,1,1,1,
    IDIESL=  2,
    IP(1) =  1,1,1,1,
    ITVAR =  0,
    JVPSI =  1,
    LOCDIF=  1,
    LOCKUP=  1,
    NCYL  =  8,
    NENG  =  1,
    QMAX  =1250,
    REVM(1) =409,409,409,409,526,526,
    TCASE(1)=   ,
    TQIND =   ,
    NGR   =  8,
    TRANS= 9.81,.95,
           5.37,.95,
           3.69,.95,
           3.67,.95,
           2.66,.95,
           2.02,.95,
           1.38,.95,
           1.00,.95,
    IPOWER= 28,
    POWER=    0,51562,
            1.0,46562,
            2.0,41262,
            3.0,35062,
            4.0,26562,
            5.0,23362,
            6.0,18096,
            7.0,16652,
            8.0,15196,
            9.0,13720,
           10.0,12730,
           11.0,12242,
           13.0, 9760,
           15.0, 8765,
           17.0, 6670,
           20.0, 5880,
           23.0, 5487,
           25.0, 5037,
           28.0, 4510,
```

```
          30.0, 3492,
          35.0, 3287,
          40.0, 3005,
          45.0, 2395,
          50.0, 2322,
          53.0, 2232,
          55.0, 2132,
          60.0, 2082,
          63.0, 2032,
 ACD   =1.0,
 CD    = .7,
 XBRCOF= .8,
   KOHIND=1,
   NHVALS=13,
   HVALS=  0,   7,   7.1, 7.2, 7.5,
           8,   9,    10,  12,  14,
          24,  60,  100,
   VOOB = 60,  60,    20,  11, 7.5,
         5.5,   5,   4.5, 3.5, 2.8,
           2,   2,     2,
   MAXIPR=14,
   MAXL=   1,
   RMS=          0,  .15,  .2,  .3,  .4,
                .5,   .6, .75,   1, 1.5,
                 2,    3,   4,   5,
   VRIDE(1,1,1)=60,   60,  40,  30, 24.5,
                21,   18,  15,  13,   11,
                9.5,   8, 6.5,   6,
    DRAFT =   ,
 FORDD =  ,
 SAE   =  ,
 SAI   =  ,
 VFS   =  ,
 VSS   =  ,
 VSSAXP=  ,
 WC    =  ,
 NWR   =  ,
 WDAXP =  ,
 WDPTH(1)=  ,
 WRAT(1)  =  ,
 WRFORD=  ,
 $END
NOHGT
      3    !used K. Grimes I/P file for the M985, changed weight
NANG       !Combination of files:
      8    !m985.obo
NWDTH      !m989a1.obo !made the trailer fake w/powered units
      3    !obmdcomb < m985.obo m989a1.obo > m985m989.cmb
 CLRMIN    FOOMAX    FOO       HOVALS    AVALS    WVALS
 INCHES    POUNDS    POUNDS    INCHES    RADIANS  INCHES
  14.74     9765.4    404.1      3.15      1.95      5.88
   2.34    44594.2   2563.2     15.75      1.95      5.88
 -12.46    57082.2   5880.9     33.46      1.95      5.88
  14.74     9765.4    411.9      3.15      2.48      5.88
   5.62    30789.3   2191.6     15.75      2.48      5.88
 -12.46    30881.5   3467.1     33.46      2.48      5.88
  14.73     9051.4    293.0      3.15      2.69      5.88
   5.53    20517.5   1735.6     15.75      2.69      5.88
 -12.15    20861.7   2982.6     33.46      2.69      5.88
  14.86     5385.9    353.5      3.15      2.86      5.88
```

5.56	12363.8	1399.6	15.75	2.86	5.88
-10.56	12579.0	1715.2	33.46	2.86	5.88
16.40	5420.7	312.0	3.15	3.42	5.88
9.32	12626.9	639.2	15.75	3.42	5.88
.40	12946.4	1504.6	33.46	3.42	5.88
17.11	6318.0	93.8	3.15	3.60	5.88
8.54	8946.4	645.2	15.75	3.60	5.88
-1.43	21464.1	1549.9	33.46	3.60	5.88
17.53	4812.8	106.6	3.15	3.80	5.88
8.72	11077.0	333.3	15.75	3.80	5.88
-1.93	19343.1	1196.6	33.46	3.80	5.88
17.85	2215.8	13.9	3.15	4.33	5.88
17.12	5603.8	106.6	15.75	4.33	5.88
11.38	9993.6	357.3	33.46	4.33	5.88
15.31	9751.7	285.2	3.15	1.95	29.88
5.25	33927.0	1087.0	15.75	1.95	29.88
-12.46	56429.3	2739.1	33.46	1.95	29.88
15.31	9751.7	290.8	3.15	2.48	29.88
5.66	30763.3	1723.6	15.75	2.48	29.88
-12.46	30861.9	2839.4	33.46	2.48	29.88
14.91	9043.7	245.5	3.15	2.69	29.88
5.64	20441.8	1208.5	15.75	2.69	29.88
-12.00	20831.6	2493.8	33.46	2.69	29.88
15.42	5381.4	254.5	3.15	2.86	29.88
5.61	12364.9	1108.5	15.75	2.86	29.88
-7.24	12440.3	1384.1	33.46	2.86	29.88
16.32	5431.3	314.9	3.15	3.42	29.88
9.39	12729.2	968.9	15.75	3.42	29.88
-.74	12966.1	1629.1	33.46	3.42	29.88
16.21	9199.8	319.6	3.15	3.60	29.88
8.10	21399.0	931.6	15.75	3.60	29.88
-7.85	21624.3	1873.7	33.46	3.60	29.88
16.22	10060.1	395.8	3.15	3.80	29.88
6.51	9931.0	656.4	15.75	3.80	29.88
-5.08	31912.5	1288.3	33.46	3.80	29.88
11.33	13062.1	790.3	3.15	4.33	29.88
4.00	20116.6	638.0	15.75	4.33	29.88
-8.48	21038.2	1267.4	33.46	4.33	29.88
16.06	8386.5	182.0	3.15	1.95	141.60
5.25	25532.7	1146.3	15.75	1.95	141.60
-12.46	58575.8	1781.0	33.46	1.95	141.60
16.06	8386.5	184.7	3.15	2.48	141.60
5.25	20538.6	770.1	15.75	2.48	141.60
-11.27	31657.6	2035.2	33.46	2.48	141.60
16.10	8910.4	206.0	3.15	2.69	141.60
5.52	19742.5	751.5	15.75	2.69	141.60
-3.65	20778.6	1834.3	33.46	2.69	141.60
16.07	5324.9	187.4	3.15	2.86	141.60
7.06	11785.6	768.2	15.75	2.86	141.60
4.47	12319.8	1527.1	33.46	2.86	141.60
15.87	5411.6	230.0	3.15	3.42	141.60
5.93	12730.4	863.5	15.75	3.42	141.60
.29	12937.4	1276.5	33.46	3.42	141.60
15.99	9111.7	248.0	3.15	3.60	141.60
3.58	21177.2	1080.4	15.75	3.60	141.60
-12.09	21645.3	1734.8	33.46	3.60	141.60
15.97	9525.8	266.0	3.15	3.80	141.60
3.10	24153.8	794.6	15.75	3.80	141.60
-18.11	32408.8	1905.2	33.46	3.80	141.60
15.99	7609.5	190.5	3.15	4.33	141.60

```
   2.83   21069.2     465.3     15.75      4.33     141.60
 -18.07   58581.2    2137.0     33.46      4.33     141.60
 M985,HEMTT 28Feb01 changed weight
 $VEHICL
! added the M989A1 trailer to the tractor made the trailer powered
! Data from Keafur Grimes, changed weight 28Feb01
! R. B. Ahlvin WES/MSD 24Nov93
   NUNITS =      1, ! Number of units
   NSUSP  =      2, ! Number of suspension supports
   NVEH1  =      1, ! Vehicle type; 0=tracked, 1=wheeled
   NFL    =       , ! Track type; 0=rigid, 1=flexible
   REFHT1 =  36.48,! Height of hitch from ground
   HTCHFZ =      0,! V-force on hitch
   SFLAG(1) =1,1,  ! Type suspension @supt-i,0=indp,1=bogie
!  Power flags ((IP(i,j), i=1,nsusp) j=1,2)
   IP(1,1)  =1,1,0,0,0,
   IP(1,2)  =1,1,0,0,0,
!  Brake flags ((IB(i,j), i=1,nsusp) j=1,2)
   IB(1,1)  =1,1,0,0,0,
   IB(1,2)  =1,1,0,0,0,
   EFFRAD(1)=26.3,26.3, ! Effective loaded radius wheels/plus track
                        ! thickness WRT ground
   ELL(1)    = 295.44, 85.44,    ! Horizontal pos. suspension WRT hitch
   BWIDTH(1)=      54,     54,    ! Absolute Value Bogie arm length
                                  ! (centerline wheel to centerline wheel)
   BALMU(1) =  5.71,  5.71,      !Bogie max CCW. angle, (+=CCW.)
   BALMD(1) = -5.71, -5.71,      !Bogie max CW. angle, (+=CCW.)
   EQUILF(1)=  26810, 37280,       !28Feb01 Equilibrium force
   CGZ1      = 69,              ! V-cg, Unit-1 WRT ground
   CGZ2      =  0               ! V-cg, Unit-2 WRT ground
   DEE1      =  0               ! H-cg, Unit-1 payload WRT hitch
   ZEE1      =  0               ! V-cg, Unit-1 payload WRT ground
   DEE2      =  0               ! H-cg, Unit-2 payload WRT hitch
   ZEE2      =  0               ! V-cg, Unit-2 payload WRT ground
   DELTW1    =  0               ! Payload weight, Unit-1
   DELTW2    =  0               ! Payload weight, Unit-2
   NPTSC1    = 14,              ! #Pts, bottom profile, Unit-1
   XCLC1(1) = 400.5, 386.46, 325.65, 310.75, 286.36,  !Unit-1
              276.3, 158.16, 115.44, 101.14,  85.75,
               70.8,  65.68,  20.10,   0.00,
   YCLC1(1) = 59.10,  28.22,  28.22,  17.85,  17.85,   !Unit-1
              24.00   24.00,  29.23,  17.85,  17.85,
              17.85,  21.47,  23.47,  35.48,
   NPTSC2    =,           ! #Pts, bottom profile, Unit-2
   XCLC2(1) =,
   YCLC2(1) =,
   SFLAG(4) = 0,       ! Type suspension front "spridler" (always zero)
   IP(4,1)  =,         ! Power flag, front "spridler"
   IB(4,1)  =,         ! Brake flag, front "spridler"
   ELL(4)   =,         ! H-pos front "spridler" WRT hitch
   ZS(4)    =,         ! V-pos centerline front "spridler" WRT ground
   EFFRAD(4)=,         ! Effective radius front "spridler" measured from
                       ! centerline to outer edge of track
   SFLAG(5) = 0,       ! Type suspension rear "spridler" (always zero)
   IP(5,1)  =,         ! Power flag, rear "spridler"
   IB(5,1)  =,         ! Brake flag, rear "spridler"
   ELL(5)   =,         ! H-pos rear "spridler" WRT hitch
   ZS(5)    =,         ! V-pos centerline rear "spridler" WRT ground
   EFFRAD(5)=,         ! Effective radius rear "spridler" measured from
                       ! centerline to outer edge of track
```

```
 $END
 M989A1 HEMAT Trailer, changed weight, 28Feb01 made it a FAKE UNIT
 $VEHICL
! Forced trailer to be powered, then ran combine program for these
! vehicles
! M977/M989A1
! M985/M989A1 !28Feb01 changed weight on tractor and trailer
! R. B. Ahlvin WES/MSD 24Nov93
   NUNITS =   1,    ! Number of units
   NSUSP  =   2,    ! Number of suspension supports
   NVEH1  =   1,    ! Vehicle type; 0=tracked, 1=wheeled
   NFL    =    ,    ! Track type; 0=rigid, 1=flexible
   REFHT1 =  32,    ! Height of hitch from ground
   HTCHFZ =    ,    ! V-force on hitch
   SFLAG(1) = 0,0, ! Type suspension @supt-i,0=independent,1=bogie
!  Power flags ((IP(i,j), i=1,nsusp) j=1,2)
   IP(1,1)  = 1,1,0,0,0,
   IP(1,2)  = 0,0,0,0,0,
!  Brake flags ((IB(i,j), i=1,nsusp) j=1,2)
   IB(1,1)  = 1,1,0,0,0,
   IB(1,2)  = 0,0,0,0,0,
   EFFRAD(1)= 19.7,19.7,   ! Effective loaded radius whls/plus track
                           ! thickness WRT ground
   ELL(1)   = 259,25,      ! Horizontal pos. suspension WRT hitch
   BWIDTH(1)=   0, 0,       ! Absolute Value Bogie arm length
                            ! (centerline wheel to centerline wheel)
   BALMU(1) =       ,              !Bogie max CCW. angle, (+=CCW.)
   BALMD(1) =       ,              !Bogie max CW. angle, (+=CCW.)
   EQUILF(1)= 13570,13160,         !28Feb01,Equilibrium force
   CGZ1     =    69.9,             !est.  V-cg, Unit-1 WRT ground
   CGZ2     =  0             ! V-cg, Unit-2 WRT ground
   DEE1     =  0             ! H-cg, Unit-1 payload WRT hitch
   ZEE1     =  0             ! V-cg, Unit-1 payload WRT ground
   DEE2     =  0             ! H-cg, Unit-2 payload WRT hitch
   ZEE2     =  0             ! V-cg, Unit-2 payload WRT ground
   DELTW1   =  0             ! Payload weight, Unit-1
   DELTW2   =  0             ! Payload weight, Unit-2
   NPTSC1   =  6,            ! #Pts, bottom profile, Unit-1
   XCLC1(1) = 309, 282, 282,  5,  5,  0,!        !Unit-1
   YCLC1(1) =  38,  38,  21, 21, 32, 32,!        !Unit-1
   NPTSC2   =,               ! #Pts, bottom profile, Unit-2
   XCLC2(1) =,
   YCLC2(1) =,
   SFLAG(4) = 0,        ! Type suspension front "spridler" (always zero)
   IP(4,1)  =,          ! Power flag, front "spridler"
   IB(4,1)  =,          ! Brake flag, front "spridler"
   ELL(4)   =,          ! H-pos front "spridler" WRT hitch
   ZS(4)    =,          ! V-pos centerline front "spridler" WRT ground
   EFFRAD(4)=,          ! Effective radius front "spridler" measure from
                        ! centerline to outer edge of track
   SFLAG(5) = 0,        ! Type suspension rear "spridler" (always zero)
   IP(5,1)  =,          ! Power flag, rear "spridler"
   IB(5,1)  =,          ! Brake flag, rear "spridler"
   ELL(5)   =,          ! H-pos rear "spridler" WRT hitch
   ZS(5)    =,          ! V-pos centerline rear "spridler" WRT ground
   EFFRAD(5)=,          ! Effective radius rear "spridler" measure from
                        ! centerline to outer edge of track
 $END
$LFVDAT
! Over-all description:
```

```
 IVTYPE=     1, !1=wheeled, 2=flex-track, 3=gird-track
 IVCONF=     3, !Tractor, if wheeled; 1=4x4, 2=6x6, 3=8x8
                  !if tracked; 1=Normal, 2=Dozer, 4=Comb. 1&2
 GVW   = 90820, !Tractor/trailer Gross vehicle weight {lbs}
 VVCI1 =  41, !Tractor/trailer 1-pass VCI for fine-grained soils {RCI}
! Geometry:
  VLEN   = 400.5,  ! 1March01 Tractor Over-all length {in}
   VWIDTH =   96,  ! Tractor Over-all width {in}
   VAADEG =   43,  ! 1March01 Tractor Departure, App/dep angle{deg}
   VCLR   =   36,  ! Tractor, Frame end clearance
                   ! ("clearance line") {in}
VRR    = 22.3, ! Tractor, Road-wheel radius(+ track-thickness if
               ! tracked){in}
VTL    =  270, ! Tractor, Front-rear grd whl center-line distance{in}
VCGF   =  152, ! Horizontal-distance CG to front wheel center-line {in}
VCGH   = 47.2, ! Vertical-distance CG to front wheel center-line {in}
! Wheeled vehicle additional geometry data
WHLGWS =  234,   ! 1March01 Trailer longest distance between wheels
                 ! greatest span {in}
WBCLR =  21 ! 1March01 Trailer Clearance between wheels of greatest
            ! span {in}
! Tracked vehicle additional data
   TRKLEN =        ! Length of track on ground (one-side) {in}
   TRKWID =        ! Width of one track (one-side) {in}
   TRKD   =        ! Hull depth above end clearance line {in}
   KTPAD  =        ! Track pad code 1=HAS-pads; 0=NO-pads
! Tracked vehicle sprocket/idler configuration for non-dozer
! (i.e. IVCONF=1,4)
RR1 =  , ! Sprocket/idler radius {in}
RR2 =  , ! Horizontal dist. road-wheel ctr. to sprocket/idler ctr. {in}
RR3 =  , ! Vertical dist. road-wheel ctr. to sprocket/idler ctr. {in}
! Swimming/fording characteristics
   VSWIM  =     0, ! Vehicle swim speed (0=NON-SWIMMER) {mph}
   VFORD  =      , ! Vehicle fording speed (pre-set to 5mph)
   DFLOAT =    48, ! Vehicle maximum fording depth {in}
 $ END
```

M911/M747 Vehicle File

```
M911-M747 HET 55 TON PAYLOAD PUSHER AXLE UP 12/90
3/07/01 Use this file for JWARS and WARSIM
Changed 6Mar01: VULEN,AXLSP,IT
File name: LW1M911M747.V
M911-M747     HET 55 TON PAYLOAD PUSHER AXLE UP 12/90
$VEHICLE
  NAMBLY= 7,
  WGHT(1)=19000,32500,32500,4*24250,
CGH   =64.9,
CGLAT = 0,
CGR   =76.5,
CL    =9,
CLRMIN(1)= 3*15,4*9,
EYEHGT=108.,
PBF   =89000,
PBHT  =24.0,
PFA   =84,
VAA   =28,
VDA   =27,
WDTH  =137,
NVUNTS= 2,
NSUSP = 7,
VULEN(1)=291.5,493.16,     ! 6March01, total length of tractor 359.5"
                           ! total length of trailer 514.16"
                           ! measured tractor from front to 5th wheel
                           ! measured trailer from 5th wheel to end trl
  ASHOE(1) =  0,
  AVGC=645,
  AXLSP(1) = 205,60,256,48,48,48,      !6March01
  DFLCT(1,1)= 3*1.9,4*1.4,
  DFLCT(1,2)= 3*3.2,4*1.4,
  DFLCT(1,3)= 3*1.9,4*1.4,
  DFLCT(1,4)= 3*1.9,4*1.4,
  DIAW(1)   =  3*53.8,4*39.7,
  GROUSH(1)=  0,
  ICONST(1)=  3*1,4*1,
  ID(1)     =  0,1,1,4*1,
  IT(1)     =  0,1,1,2,2,3,3,     !6March01
  KTSFLG    =  3*2,4*2,
  NBOGIE(1)=  0,
  NCHAIN(1)=  3*0,4*0,
  NFL(1)    =  0,
  NPAD(1)   =  0,
  NVEH(1)   =  3*1,4*1,
  NWHL(1)   =  2,4,4,4*4,
  RDIAM(1)  =  3*24,4*19.5,
  RIMW(1)   =  3*10,4*11.75,
  RW(1)     =  0,
  SECTH(1)  = 3*12.6,4*9.0,
  SECTW(1)  = 3*14.9,4*15.3,
  TL=665.6,
  TPLY(1)   =18,18,18,4*14,
  TPSI(1,1)=55,55,55,4*60,
  TPSI(1,2)=30,30,30,4*60,
  TPSI(1,3)=55,55,55,4*60,
  TPSI(1,4)=55,55,55,4*60,
```

```
    TRAKLN(1)= 0,
    TRAKWD(1)= 0,
    VTIRMX= 40,12,55,5,
    WT(1)     =72,72,72,4*90.5,
    WTE(1)    =66,64.0,64.0,4*69.4,
  CID=  736,
  ICONV1=0,
  CONV1 =  ,  ,
  ICONV2= 0,
  CONV2 =  ,  ,
  IENGIN= 0,
  ENGINE=    ,    ,
    FD(1) =6.21,.9,
    HPNET =445,
    IB(1) =  3*1,4*1,
    IDIESL=  2,
    IP(1) =  1,1,1,4*0,
    ITVAR =  0,                  !6March01
    LOCDIF=  1,
    LOCKUP=  1,
    NCYL  =  8,
    NENG  =  1,
    QMAX  =1223,
    REVM(1) =394,394,394,4*527,
    TCASE(1)=1.0,
    TQIND =   ,
    NGR   = 10,
    TRANS=10.55,.9,
          6.50,.9,
          5.18,.9,
          4.22,.9,
          3.19,.9,
          2.85,.9,
          2.07,.9,
          2.04,.9,
          1.40,.9,
          1.00,.9,
    IPOWER= 33,
    POWER=     0,61463,
            0.8,54479,
            1.7,46421,
            2.5,39375,
            3.3,32069,
            3.7,30590,
            4.2,28641,
            4.4,27211,
            5.0,24112,
            6.1,20385,
            7.5,14213,
            8.3,13048,
            9.3,12453,
           10.1,11984,
           10.6,11574,
           11.4,9804,
           12.6,9328,
           13.4,9091,
           14.4,8666,
           15.9,7592,
           16.7,7371,
           18.4,5983,
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```
         20.0,5818,
         21.7,5674,
         22.6,5338,
         25.0,5008,
         29.3,4092,
         31.8,3972,
         34.1,3752,
         36.8,3040,
         40.4,2957,
         43.5,2850,
         47.0,2712,
         47.0,0,
 ACD    =1.0,
 CD     =1.0,
 XBRCOF= .8,
   NHVALS=12,
   HVALS=  0,   2, 2.5,   3.0, 3.5,    4, 5.0,    6,    7,   8,   20,   99,
   VOOB =100, 47,   35,    25,   17,   13,    8,    6,    5,   4,    3,    2,
   MAXIPR=12,
   MAXL=    1,
   RMS=         0, .1, .20,.25,.3,.5, .7, 1, 1.50, 2.0, 3,9,
   VRIDE(1,1,1)=100,100,   47, 36,21,13,   9, 8, 7,6.5,6,5,
 DRAFT =   ,
 FORDD =   ,
 SAE   =   ,
 SAI   =   ,
 VFS   =   ,
 VSS   =   ,
 VSSAXP=   ,
 WC    =   ,
 NWR   =   ,
 WDAXP =   ,
 WDPTH(1)=   ,
 WRAT(1) =   ,
 WRFORD=   ,
 $END
NOHGT
      3
 NANG
      8
NWDTH
      3
 CLRMIN    FOOMAX    FOO       HOVALS     AVALS      WVALS
 INCHES    POUNDS    POUNDS    INCHES     RADIANS    INCHES
  12.41   46902.0   11126.0     3.15       1.95       5.88
   4.06  164820.0   14468.0    15.75       1.95       5.88
  -9.88  172298.0   14540.0    33.46       1.95       5.88
  12.41   46902.0   11126.0     3.15       2.48       5.88
   4.06  164820.0   14468.0    15.75       2.48       5.88
  -9.88  172298.0   14540.0    33.46       2.48       5.88
  12.38   41822.0   11160.0     3.15       2.69       5.88
   4.73   76274.0   12622.0    15.75       2.69       5.88
  -9.28   78066.0   14326.0    33.46       2.69       5.88
  12.18   29144.0   11004.0     3.15       2.86       5.88
   7.82   49774.0   11652.0    15.75       2.86       5.88
  -6.49   50346.0   13274.0    33.46       2.86       5.88
  12.29   29166.0   11050.0     3.15       3.42       5.88
   7.60   49284.0   11476.0    15.75       3.42       5.88
   0.27   49286.0   12778.0    33.46       3.42       5.88
  12.86   41980.0   11128.0     3.15       3.60       5.88
```

9.47	41052.0	11474.0	15.75	3.60	5.88
-4.06	74886.0	12868.0	33.46	3.60	5.88
13.18	33456.0	11046.0	3.15	3.80	5.88
9.47	62672.0	11978.0	15.75	3.80	5.88
9.00	62672.0	11998.0	33.46	3.80	5.88
13.18	33456.0	11040.0	3.15	4.33	5.88
9.47	62672.0	11974.0	15.75	4.33	5.88
-4.06	172280.0	14540.0	33.46	4.33	5.88
12.41	46902.0	11126.0	3.15	1.95	29.88
4.06	164820.0	14468.0	15.75	1.95	29.88
-9.88	192298.0	14540.0	33.46	1.95	29.88
12.41	46902.0	11126.0	3.15	2.48	29.88
4.06	174820.0	14468.0	15.75	2.48	29.88
-9.88	192298.0	14540.0	33.46	2.48	29.88
12.38	41822.0	11160.0	3.15	2.69	29.88
4.73	76274.0	12622.0	15.75	2.69	29.88
-9.28	78066.0	14326.0	33.46	2.69	29.88
12.18	29144.0	11004.0	3.15	2.86	29.88
7.82	49774.0	11652.0	15.75	2.86	29.88
-6.49	50346.0	13274.0	33.46	2.86	29.88
12.29	29166.0	11050.0	3.15	3.42	29.88
7.60	49284.0	11476.0	15.75	3.42	29.88
0.27	49286.0	12778.0	33.46	3.42	29.88
12.86	41980.0	11128.0	3.15	3.60	29.88
9.47	41052.0	11474.0	15.75	3.60	29.88
-4.06	74886.0	12868.0	33.46	3.60	29.88
13.18	33456.0	11046.0	3.15	3.80	29.88
9.47	62672.0	11978.0	15.75	3.80	29.88
7.00	62672.0	11998.0	33.46	3.80	29.88
10.18	33456.0	11040.0	3.15	4.33	29.88
6.47	62672.0	11974.0	15.75	4.33	29.88
-3.06	172280.0	14540.0	33.46	4.33	29.88
12.41	46902.0	11126.0	3.15	1.95	141.88
4.06	164820.0	14468.0	15.75	1.95	141.88
-9.88	172298.0	14540.0	33.46	1.95	141.88
12.41	46902.0	11126.0	3.15	2.48	141.88
4.06	170820.0	14468.0	15.75	2.48	141.88
-9.88	192298.0	14540.0	33.46	2.48	141.88
12.38	41822.0	11160.0	3.15	2.69	141.88
4.73	76274.0	12622.0	15.75	2.69	141.88
-9.28	78066.0	14326.0	33.46	2.69	141.88
12.18	29144.0	11004.0	3.15	2.86	141.88
7.82	49774.0	11652.0	15.75	2.86	141.88
-6.49	50346.0	13274.0	33.46	2.86	141.88
12.29	29166.0	11050.0	3.15	3.42	141.88
7.60	49284.0	11476.0	15.75	3.42	141.88
0.27	49286.0	12778.0	33.46	3.42	141.88
12.86	41980.0	11128.0	3.15	3.60	141.88
9.47	41052.0	11474.0	15.75	3.60	141.88
-4.06	74886.0	12868.0	33.46	3.60	141.88
13.18	33456.0	11046.0	3.15	3.80	141.88
9.47	62672.0	11978.0	15.75	3.80	141.88
9.00	82672.0	11998.0	33.46	3.80	141.88
13.18	53456.0	11040.0	3.15	4.33	141.88
9.47	170672.0	11974.0	15.75	4.33	141.88
-9.06	212280.0	14540.0	33.46	4.33	141.88

M1A1 Vehicle File

```
 M1A1 ABRAMS TANK
 3/07/01 - Use for WARSIM and JWARS
 Changed: 5March01
                  HROSUS
                  NSUSP
                  RAID
                  XBRCOF
                  POWER
                  RMS
                  VRIDE
                  HVALS
                  VOOB
                  OBSMOD
 Date entered: 7 Dec '93 RBA & NRMM-mgr
 Date updated: 10 Feb '94 RBA, NRMM-mgr
 File name: HT8M1A1.V
 Description:
 M1A1             ABRAMS TANK
 $VEHICLE
!**Basic information
   NAMBLY= 1
   WGHT(1)=127451  ! PM ofc, 1993
!**Geometric information
   CGH    =  53.04 ! PM ofc, 1991
   CGLAT  =   1.82 ! PM ofc, 1991
   CGR    = 100.55 ! TM55-2350-255-14 '79
   CL     =   17.0 ! JANE'S 1990-91 & PM ofc 1991
! Ground clearance = 19" @ ctr of hull, 17" min. elsewhere, PM ofc
   CLRMIN(1)=    17 ! JANE'S 1990-91 & PM ofc 1991
   VAA    =     22 ! TM55-2350-255-14 '79
   VDA    =     36 ! TM55-2350-255-14 '79
!**Recognition distance information
   EYEHGT =     59 ! TM55-2350-255-14 '79
!**Vegetation performance information
   NVUNTS =      1
   PBF    = 254902 ! estimated as 2*GVW
   PBHT   =   46.8 ! TM55-2350-255-14 '79
   VULEN(1)=311.68 ! FSP83-025, Apr'83
   WDTH   = 143.76 ! TM55-2350-255-14 '79
!**Aerodynamic information
   ACD    =   1.2  ! (worst case rectangular plate)
   PFA    =    78  ! PM ofc, 1991
!**traction assembly information
   NVEH(1)=     0  ! This is a tracked vehicle
   TL     =180.08  ! FSP83-025, Apr'83
   WT(1)  =   112  ! TM55-2350-255-14 '79
   WTE(1) =    87  ! TM55-2350-255-14 '79
!**Track information
   ASHOE(1) =187.5  ! PITCH=7.5 WIDTH=25 25*7.5=187.5 Measured by RBA
   GROUSH(1)= 1.86  ! T-178 track Drawing# 12348368 '93
   NBOGIE(1)=   14  ! TM55-2350-255-14 '79
   NFL(1)   =    1  ! 0=Girderized, 1=Flexible
   NPAD(1)  =    1  ! 0=None, 1=Has Pads
   RW(1)    = 15.6  ! WES, TM55-2350-255-14 '79
   TRAKLN(1)=180.0  ! TM55-2350-255-14 '79
   TRAKWD(1)=   25  ! NRMM-mgr M1A2 Jul'93, Measured by RBA. 15Nov'93
```

```
   IPLOW=0.         ! No plow
!**Wheel/tire information
   ASPECT(1)   =, ! N/A
   AVGC        =, ! N/A
   AXLSP(1)    =, ! N/A
   NJPSI       =, ! N/A
   DFLCT(1,1) =, ! N/A
   DIAW(1)     =, ! N/A
   ICONST(1)   =, ! N/A
   ID(1)       =, ! N/A
   IT(1)       =, ! N/A
   JVPSI       =, ! N/A
   KCTIOP(1)   =, ! N/A
   KTSFLG(1)   =, ! N/A
   NCHAIN(1)   =, ! N/A
   NWHL(1)     =, ! N/A
   RDIAM(1)    =, ! N/A
   RIMW(1)     =, ! N/A
   SECTH(1)    =, ! N/A
   SECTW(1)    =, ! N/A
   TIREID(1)   =, ! N/A
   TPLY(1)     =, ! N/A
   TPSI(1,1)   =, ! N/A
!**Side-slope performance information
! >> defeated for WARSIM project <<
15.6
   HROSUS(1)   =7*37.44, ! 5Mar01 source P. Haley to be derived from
                         ! VEHDYN data
   NSUSP       =7,       ! 5Mar01 source P. Haley to be derived from
                         ! VEHDYN data
   RAID(1)     =1497, 1125, 1145, 1180,! 5Mar01 source P. Haley to be
                                       ! derived from VEHDYN data
             1180, 1180, 353,
!**Powertrain: general information
   IP(1) =  1,
!**Powertrain: engine information
   CID    = 1500 ! WES, Use rated horsepower for turbine engine
   IDIESL =    3 ! 1=Gas,4-stroke diesel, 2=2-stroke diesel,
3=turbine(M1)
   IENGIN =   11
! TARDEC origin unknown
   ENGINE =  800, 1350  1000, 1650   1200, 2000  1400, 2300  1500, 2450
          1500, 3920  1600, 3850,  2000, 3550  2400, 3240  2800, 2910
          2900, 2750
   HPNET =1500  ! gross HP, PM ofc 1991
   NCYL  =   8  ! Correct number for M1 gas turbine (i.e. IDIESL=3)
   NENG  =   1
   QMAX(1)  = 3825  ! Allison SCAAN Jan 16 '91
!**Powertrain: transmission information
  ICONV1 = 19  ! TARDEC, unknown origin
  CONV1 = 1840, 0.0   1800, 0.1  1760, 0.2   1740, 0.3  1740, 0.4
        1740, 0.446 1760, 0.5  1790, 0.548 1790, 0.55 1840, 0.6
        1905, 0.65  1980, 0.7  2060, 0.75  2150. 0.8  2260. 0.85
        2395, 0.9   2470, 0.92 2555, 0.935 2680, 0.95
  ICONV2 = 19  ! TARDEC, unknown origin
  CONV2 = 1.95, 0.0   1.90, 0.1  1.82, 0.2   1.73, 0.3  1.62, 0.4
        1.57, 0.446 1.51, 0.5  1.46, 0.548 1.46, 0.55 1.40, 0.6
        1.33, 0.65  1.27, 0.7  1.20, 0.75  1.14, 0.8  1.06, 0.85
        1.02, 0.9   0.99, 0.92 0.99, 0.935 0.99, 0.95
  ITVAR  = 0, ! 0=shifts automatically, 1 = shifts manually
```

```
  KTROPR = 8*1 ! Sh, P&S, T-snd, T-oth, T-sno, A-snd, A-oth, A-sno
  LOCKUP = 1
  NGR    = 4  ! TM55-2350-255-14 '79
  NTRANG = 1
  TCASE  = 1.0, 1.0, ! Null engine-to-transmission gear
  TQIND  = 300       ! TARDEC, unknown origin
  TRANS(1,1,1) = 5.88, 0.93  ! TM55-2350-255-14 '79
             3.04, 0.94
             1.90, 0.94
             1.28, 0.95
!Powertrain: Final drive information
   FD(1)  = 4.67, 0.98,  ! WES, Allison SCAAN Jan 16 '91
   LOCDIF =  1,
   REVM(1)= 768    ! (11t, 7.5" pitch)
!**Powertrain: Braking information
   IB(1)  =  1
   XBRCOF= 0.81  ! 6Mar01, Based on max tractive force at stall
!**Powertrain: tractive force vs. speed
!  Allison SCAAN data from Charles Raffa TACOM was used from 14.5 MPH TO
MAX
!  speed of vehicle. From Report No. 84-LR(F)-3 Development Test II
(PQT-G)
!  of Automotive Testing; Temperate Phase, M1E1 Tank System
!  16Oct.93 OK by RBA
   IPOWER= 42,    !5Mar01
   POWER= 0.0 103500   1.2 103500   2.5 96500   3.7 84500   5.0 67500
          6.2  51500   7.5  43718   8.7 38772   9.9 35849  11.2 32927
         12.4  31353  13.7  29105  14.5 25772  15.0 24781  16.0 22772
         17.0  20734  18.0  20149  19.0 19396  20.0 18636  21.0 17869
         18.0  17094  23.0  16313  24.0 15528  25.0 14738  26.0 13941
         27.0  13139  28.0  13131  29.0 12774  30.0 12414  31.0 12050
         32.0  11685  33.0  11316  34.0 10945  35.0 10573  36.0 10198
         37.0   9821  38.0   9441  39.0  9059  40.0  8675  41.0  8291
         41.5   6825  41.6   6300
! Ride dynamics data for M1E1 (M1A1) (Driver's position per R.A.)
! Digitized from plots from MSD testing group of APG-1984 data 10Nov'93
  MAXL = 3
  ABSPWR(1)= 6.0, 9.0, 12.0
  MAXIPR = 17
  KVRIND(1)=1
  RMS(1) = 0.00  1.57  1.68  1.86  2.10            !5Mar01
         2.35  2.47  2.52  2.59  2.63
         2.72  2.83  3.03  3.38  3.97
         4.46 10.0
 ! 6-watts
  VRIDE(1,1,1)= 100.0   50.2   37.9   30.8   24.7  !5Mar01
             20.2   18.7   18.1   17.4   16.9
             15.9   14.8   13.3   11.4   9.37
             7.99    7.0
 ! 9-watts
  VRIDE(1,1,2)= 100.0  100.0  100.0  100.0  100.0   !5Mar01
            100.0   50.5   34.2   28.3   25.7
             22.6   19.9   17.1   13.6   10.1
              8.4   10.0
 ! 12-watts
  VRIDE(1,1,3)= 100.0  100.0  100.0  100.0  100.0    ! 5Mar01
            100.0  100.0   54.0   49.8   32.4
             27.0   23.1   19.1   14.8   11.2
              9.4    7.0
 ! Obstacle height-speed  2.5G level
```

```
  KOHIND(1) = 1
! Taken from MSD plot m1a1 shock curve 2.5G 126000 weight
! from G. Gillespie
! Test date and site unknown entered 31 Oct '95
   NHVALS  =  8,
   HVALS   =  0.00  14.4  15  16  17,        ! 5Mar01
           18    20   100,
   VOOB(1,1)= 100   40    20  12   8,        ! 5Mar01
           7    6     2,
!**Water crossing information
  CD     = 1.2 ! TARDEC origin unknown
  DRAFT = 0.0 ! TM55-2350-2555-14 '79
  FORDD =  48 ! w/o kit, PM ofc, 1991
  SAE    = 0.0 ! TARDEC, unknown origin
  SAI    = 0.0 ! TARDEC, unknown origin
  VFS    = 0.0 ! TARDEC, unknown origin
  VSS    = 0.0 ! TARDEC, unknown origin
  VSSAXP= 0.0 ! TARDEC, unknown origin
  WC     = 0.0 ! TARDEC, unknown origin
  WDAXP = 0.0 ! TARDEC, unknown origin
! NRMM-mgr M1A2 Jul'93
 NWR     =  20 ! Tardec Circa '81
WDPTH = 0.000 18.000 22.194 26.389 30.583 34.778 38.972 43.167 47.361
       51.556 55.750 59.944 64.139 68.333 72.528 76.722 80.917 85.111
       89.306 93.500
WRAT = 0.950 0.903 0.855 0.808 0.760 0.713 0.666 0.618 0.570 0.523
        0.480 0.428 0.380 0.333 0.285 0.238 0.111 0.560 0.000 0.000
 WRFORD = 0.0 ! TARDEC Circa '81
 $END
NOHGT        !5Mar01,1 OBSMOD DATA, reran 14Jan99,made no changes to
             !this I/P file
     4       !Reran to omit STEPMN= 1.0000 STEPMX= 2.000
NANG         !c:\vehicles\nrmmii\obsmod\m1a1.obv
     8       !c:\vehicles\nrmmii\obsmod\obt.dat
NWDTH        !c:\vehicles\nrmmii\obsmod\m1a1.obo
     3       !c:\tacom-ob\obsdp < obsdp.inp
```

CLRMIN INCHES	FOOMAX POUNDS	FOO POUNDS	HOVALS INCHES	AVALS RADIANS	WVALS INCHES
28.20	10871.1	641.9	3.15	1.95	5.88
15.37	28154.9	1686.8	15.75	1.95	5.88
-0.64	47131.3	1965.5	33.46	1.95	5.88
-9.99	99999.9	9999.9	45.46	1.95	5.88
28.20	10871.1	680.0	3.15	2.48	5.88
15.37	24149.8	1537.5	15.75	2.48	5.88
6.03	56291.4	2961.5	33.46	2.48	5.88
-0.29	78070.0	3926.4	45.46	2.48	5.88
28.20	10871.1	686.8	3.15	2.69	5.88
15.31	29939.8	1595.7	15.75	2.69	5.88
8.36	41876.1	3271.7	33.46	2.69	5.88
3.65	49963.9	4407.0	45.46	2.69	5.88
28.19	9976.4	713.0	3.15	2.86	5.88
16.46	21753.6	1508.1	15.75	2.86	5.88
13.70	27267.6	2796.6	33.46	2.86	5.88
13.49	34730.3	3742.0	45.46	2.86	5.88
29.76	5910.8	277.8	3.15	3.42	5.88
19.67	9949.9	1346.9	15.75	3.42	5.88
6.56	22431.4	2317.5	33.46	3.42	5.88
4.88	28949.1	3629.6	45.46	3.42	5.88
30.42	5400.8	88.3	3.15	3.60	5.88
22.73	16795.6	2083.6	15.75	3.60	5.88

9.05	19182.7	994.4	33.46	3.60	5.88
-0.16	48259.2	2682.9	45.46	3.60	5.88
31.00	3279.2	75.4	3.15	3.80	5.88
27.42	11345.6	1202.9	15.75	3.80	5.88
14.21	26517.9	2540.7	33.46	3.80	5.88
12.72	21319.9	1496.8	45.46	3.80	5.88
31.00	1479.2	0.3	3.15	4.33	5.88
30.43	3698.8	45.5	15.75	4.33	5.88
29.23	8237.0	271.9	33.46	4.33	5.88
27.86	12195.2	959.3	45.46	4.33	5.88
27.94	4718.6	266.1	3.15	1.95	29.88
15.25	13034.9	898.5	15.75	1.95	29.88
-0.64	27817.7	2690.5	33.46	1.95	29.88
-9.99	99999.9	9999.9	45.46	1.95	29.88
27.94	4718.6	282.2	3.15	2.48	29.88
15.25	19073.9	1366.5	15.75	2.48	29.88
6.03	49748.5	2850.5	33.46	2.48	29.88
3.50	55851.0	4053.9	45.46	2.48	29.88
27.94	4718.6	282.2	3.15	2.69	29.88
15.25	12721.6	1424.8	15.75	2.69	29.88
8.53	41304.3	2953.8	33.46	2.69	29.88
3.98	60671.0	3970.7	45.46	2.69	29.88
27.94	7977.1	385.4	3.15	2.86	29.88
16.82	13064.8	1359.8	15.75	2.86	29.88
13.70	25535.7	2907.6	33.46	2.86	29.88
13.61	28903.0	3746.4	45.46	2.86	29.88
28.40	9945.6	841.0	3.15	3.42	29.88
15.15	9938.9	981.8	15.75	3.42	29.88
5.71	25444.3	2785.6	33.46	3.42	29.88
5.16	28955.0	3565.3	45.46	3.42	29.88
27.83	11629.9	818.6	3.15	3.60	29.88
17.62	17284.0	2405.5	15.75	3.60	29.88
5.30	47740.7	2782.6	33.46	3.60	29.88
-3.05	68377.7	3038.1	45.46	3.60	29.88
28.61	9496.4	316.0	3.15	3.80	29.88
21.95	19682.9	3260.1	15.75	3.80	29.88
12.67	25312.1	1819.2	33.46	3.80	29.88
7.79	25743.0	2543.9	45.46	3.80	29.88
29.28	9262.1	622.2	3.15	4.33	29.88
27.86	12214.6	964.4	15.75	4.33	29.88
24.98	14359.8	1256.1	33.46	4.33	29.88
22.82	20450.6	3497.6	45.46	4.33	29.88
27.85	10372.1	390.8	3.15	1.95	141.60
15.25	20363.2	1645.1	15.75	1.95	141.60
-0.64	33967.3	69475.5	33.46	1.95	141.60
-9.99	99999.9	99999.9	45.46	1.95	141.60
27.85	10372.1	408.1	3.15	2.48	141.60
15.25	26093.3	1889.4	15.75	2.48	141.60
6.03	48962.7	3253.1	33.46	2.48	141.60
4.81	64248.9	4275.7	45.46	2.48	141.60
27.85	10372.1	408.1	3.15	2.69	141.60
15.25	17225.0	1645.2	15.75	2.69	141.60
8.53	47709.2	2696.6	33.46	2.69	141.60
8.53	47592.8	3802.5	45.46	2.69	141.60
27.85	9918.5	484.6	3.15	2.86	141.60
16.82	12731.3	1740.6	15.75	2.86	141.60
13.69	25468.7	3180.8	33.46	2.86	141.60
13.58	28949.7	3863.3	45.46	2.86	141.60
25.71	9949.9	537.0	3.15	3.42	141.60
12.19	12340.9	1923.4	15.75	3.42	141.60

```
  12.27   24259.6    3320.1     33.46      3.42    141.60
  12.01   28954.7    4153.8     45.46      3.42    141.60
  25.88   11649.9     662.1      3.15      3.60    141.60
   7.00   17482.4    2525.1     15.75      3.60    141.60
   3.88   47494.7    2846.0     33.46      3.60    141.60
   3.02   47280.6    4483.2     45.46      3.60    141.60
  25.88    8411.9     400.2      3.15      3.80    141.60
   4.75   26218.9    1963.9     15.75      3.80    141.60
  -6.91   36786.3    3515.6     33.46      3.80    141.60
  -9.99   99999.9    9999.9     45.46      3.80    141.60
  25.88   11094.4     433.4      3.15      4.33    141.60
  11.27   24916.1    3672.0     15.75      4.33    141.60
 -10.51   41128.5    6923.1     33.46      4.33    141.60
 -99.99   99999.9    9999.9     45.46      4.33    141.60
M1A1 ABRAMS TANK (WES Standard)
! Vehicle description:M1A1 ABRAMS TANK
! Project: Standard
! Date entered:09/06/91  Entered by: TEMPLE   Checked by:
! Updates: NRMMII
 $LFVDAT
 ! Over-all description:
   IVTYPE=      2, ! 1=wheeled, 2=flex-track, 3=gird-track
   IVCONF=      1, ! if wheeled; 1=4x4, 2=6x6, 3=8x8
                ! if tracked; 1=Normal, 2=Dozer, 4=Comb. 1&2
   GVW   = 127451, ! Gross vehicle weight {lbs}
   VVCI1 =     26, ! Vehicle 1-pass VCI for fine-grained soils {RCI}
 ! Geometry:
 VLEN   = 304, !8Nov00 measured, Over-all length {in}
 VWIDTH = 144, !Over-all width {in}
 VAADEG =  40, !8Nov00 measured, Approach/departure angle {deg}
 VCLR   =  40, !8Nov00 measured Frame end clearance(clearance line){in}
 VRR    =  15.6, ! Road-wheel radius (+ track-thickness if tracked){in}
 VTL    =   195, ! 8Nov00 calc so wheel would line up Frt-rear grd
                   ! :whl center-line distance{in}
VCGF   =  86.3, !9Nov00, added 7.5 because increased the tl
                !Horizontal-distance CG to front-wheel center-line {in}
VCGH   =  36.5, !Vertical-distance CG to front-wheel center-line {in}
 ! Wheeled vehicle additional geometry data
   WHLGWS =      , ! Distance between wheels of greatest span {in}
   WBCLR  =      , ! Clearance between wheels of greatest span {in}
 ! Tracked vehicle additional data
TRKLEN = 198, ! 8Nov00 tl+3" Length of track on ground (one-side){in}
TRKWID =  25, ! Width of one track (one-side) {in}
TRKD   =   8, ! measured Hull depth above end clearance line {in}
KTPAD  =   1, ! Track pad code 1=HAS-pads; 0=NO-pads
!Tracked vehicle sprocket/idler config. for non-dozer (i.e. IVCONF=1,4)
RR1 = 12.9, ! Sprocket/idler radius {in}
RR2 =   28, !Horizontal dist road-wheel ctr. to sprocket/idler ctr.{in}
RR3 =   26, !Vertical dist road-wheel ctr. to sprocket/idler ctr.{in}
 ! Swimming/fording characteristics
   VSWIM  =  0, ! Vehicle swim speed (0.=NON-SWIMMER) {mph}
   VFORD  =   , ! Vehicle fording speed (pre-set to 5mph)
   DFLOAT = 48, ! Jane's 1998-99 pg.152 Veh maximum fording depth {in}
 $ END
!OBSMOD DATA
 M1A1 ABRAMS TANK (Standard)
 $VEHICL
! R. B. Ahlvin WES/MSD 24Nov93
   NUNITS = 1  ! Number of units
   NSUSP  = 2  ! Number of suspension supports
```

```
   NVEH1   = 0   ! Vehicle type; 0=tracked, 1=wheeled
   NFL     = 1   ! Track type; 0=rigid, 1=flexible
   REFHT1 = 40.0 ! Height of hitch from ground
   HTCHFZ =  0.0 ! V-force on hitch
   SFLAG(1) = 1, 1 ! Type suspension   @ supt-i, 0=independent, 1=bogie
! Power flags ((IP(i,j), i=1,nsusp) j=1,2)
   IP(1,1)  = 1, 1, 1, 1, 1,
   IP(1,2)  = 1, 1, 1, 1, 1,
! Brake flags ((IB(i,j), i=1,nsusp) j=1,2)
   IB(1,1)  = 1, 1, 1, 1, 1,
   IB(1,2)  = 1, 1, 1, 1, 1,
   EFFRAD(1)=   16.50  16.50  !Effective loaded radius of wheels
   ELL(1)   =  215.00  95.00  !Horizontal pos. suspension WRT hitch
   BWIDTH(1)=   60.00  60.00  !Bogie arm length (wheel to wheel)
   BALMU(1) =   26.00  11.00  !Bogie max CCW. angle, (+=CCW.)
15"Jounce,6"rebound
   BALMD(1) =  -11.00 -26.00  !Bogie max CW. angle, (+=CCW.)
   EQUILF(1)=  57750. 68250.  !Equilibrium force
   CGZ1     =   53.00  ! V-cg, Unit-1 WRT ground
   CGZ2     =    0.00  ! V-cg, Unit-2 WRT ground
   DEE1     =  137.00  ! H-cg, Unit-1 payload WRT hitch
   ZEE1     =   51.00  ! V-cg, Unit-1 payload WRT ground
   DEE2     =    0.00  ! H-cg, Unit-2 payload WRT hitch
   ZEE2     =    0.00  ! V-cg, Unit-2 payload WRT ground
   DELTW1   =    0.00  ! Payload weight, Unit-1
   DELTW2   =    0.00  ! Payload weight, Unit-2
   NPTSC1   =       5  ! #Pts, bottom profile, Unit-1
   XCLC1(1) =  315 303  18  13  0  ! X, Bottom profile, Unit-1
   YCLC1(1) =   44  31  34  40 40  ! Y, Bottom profile, Unit-1
   NPTSC2   =      0 ! #Pts, bottom profile, Unit-2
   XCLC2(1) =,       ! X, Bottom profile, Unit-2
   YCLC2(1) =,       ! Y, Bottom profile, Unit-2
   SFLAG(4) =      0 ! Type suspension front "spridler" (always zero)
   IP(4,1)  =      1 ! Power flag, front "spridler"
   IB(4,1)  =      1 ! Brake flag, front "spridler"
   ELL(4)   =  286.8 ! H-pos front "spridler" WRT hitch
   ZS(4)    =  33.25 ! V-pos front "spridler" WRT ground
   EFFRAD(4)=   16.5 ! Effective radius front "spridler"
   SFLAG(5) =      0 ! Type suspension rear "spridler" (always zero)
   IP(5,1)  =      1 ! Power flag, rear "spridler"
   IB(5,1)  =      1 ! Brake flag, rear "spridler"
   ELL(5)   =   34.0 ! H-pos rear "spridler" WRT hitch
   ZS(5)    =   35.5 ! V-pos rear "spridler" WRT ground
   EFFRAD(5)=   16.0 ! Effective radius rear "spridler"
 $END
```

M88A1 Vehicle File

```
M88A1, Recovery Vehicle
3/09/01 Use for WARSIM and JWARS
Description: RECOVERY VEHICLE, Reforger 87
Upgraded TF on 28 April 97 see note by TF
Project: FOR DENSIE BULLOCK
Data: From AMM file D6-16,12
    : Jane's 1990-91 pg.53
    : From GL-87-16
    : From Carl May field sheets Aug.93 Measured data
Date entered for NRMMII:9April 97
File name:c:\vehicles\nrmmii\m88a1.dat
M88A1       Recovery Vehicle
$VEHICLE
  NAMBLY= 1,
  WGHT(1)=112000,       !AMM file D6-16,12; Jane's Logistics 90-91 pg.53
  NVUNTS = 1,
  VULEN(1)=325,         !AMM file D6-16,12; Jane's Logistics 90-91 pg.53
CGH    = 46,            !TR-GL-87-16 Table A1
CGLAT = 0,
CGR    =85.5,           !TR-GL-87-16 Table A1
CL     = 17,            !AMM file D6-16,12; Jane's Logistics 90-91 pg.53
CLRMIN(1)=17,           !AMM file D6-16,12; Jane's Logistics 90-91 pg.53
EYEHGT=114,             !C. May Field Sheets Aug93
PBF    =224000,         !AMM file D6-16,12
PBHT   =44,             !AMM file D6-16,12
PFA    = 98.8,          !calculated
WDTH   =135,            !AMM file D6-16,12; Jane's Logistics 90-91 pg.53
  ASHOE(1)=199,            !calculated
  GROUSH(1)= 1.5,          !AMM file D6-16,12
  NBOGIE(1)= 12,           !AMM file D6-16,12
  NFL(1)    =  1,          !0=Girderized, 1=Flexible, AMM file D6-16,12
  NPAD(1)   =1,            !0=None, 1=HAS PADS, AMM file D6-16,12
  NVEH(1)   =  0,          !0=Tracked, 1=Wheeled
  RW(1)     =17,           !AMM file D6-16,12
  TL        = 180,         !AMM file D6-16,12
  TRAKLN(1)=183,           !AMM file D6-16,12
  TRAKWD(1)=28,            !AMM file D6-16,12
  WT(1)     = 107,         !calculated
  WTE(1)    =  74,         !calculated
  CID=1790,                !TM 9-2350-XXX-20
ICONV1= ,
CONV1 =  ,  ,
ICONV2=  ,
CONV2 =  ,  ,
IENGIN=  ,
ENGINE=    ,    ,
  FD(1) =4.63, .90,    !TR-GL-87-16 Table A1, AMM file D6-16,12
  HPNET =750.4,        !TR-GL-87-16 Table A1,AMM file D6-16,12; Jane's
                       ! Logistics 90-91 pg.53
  IB(1) =1,               !0=NOT Braked, 1=YES Braked
  IDIESL=  1,
  IP(1) =  1,             !0=NOT POWERED 1=POWERED
  ITVAR =  0,             !0=Automatically Shift, 1=Shifts Manually;
  LOCDIF=  1,
  LOCKUP=  1,
  NCYL   = 12,         !AMM file D6-16,12; Jane's Logistics 90-91 pg.53
```

```
   NENG  =  1,
   QMAX  =2480,            !Torque Gross TM 9-2350-XXX-20
   TCASE(1)=1.0,1.0,
   REVM= 905,              !Calculated
   TQIND =   ,
   NGR   = 3,              !TR-GL-87-16 Table A2
   TRANS=  112.30, .90,
             24.50, .90,
              6.80, .90,
! M88A1 Late Production, @ 112K Lbs., (56 tons)
! 24April97, from Bill Criswell, Project Manager,
! M88A2 Enhanced Diagnostics
    IPOWER= 38,  !Detroit Diesel Allison, SCAAN No. 104231
                 ! :Date 8/24/84, tm001124, SIEMERS
!               Speed,        TF,
     POWER=      0.00,      165505,
                 1.00,      117244,
                 1.97,       84000,
                 2.00,       83159,
                 2.18,       78400,
                 2.80,       64327,
                 3.00,       61310,
                 4.00,       46819,
                 4.80,       36468,
                 5.00,       34687,
                 5.98,       30028,
                 6.00,       29961,
                 7.00,       26701,
                 8.00,       23540,
                 8.96,       20665,
                 9.00,       20671,
                10.00,       20449,
                11.00,       19585,
                12.00,       17738,
                12.24,       17193,
                12.80,       14042,
                13.00,       13892,
                14.00,       13160,
                15.00,       12439,
                16.00,       11729,
                17.00,       11030,
                18.00,       10341,
                19.00,        9686,
                19.17,        9577,
                20.00,        9570,
                21.00,        9497,
                22.00,        9397,
                23.00,        9189,
                24.00,        8860,
                25.00,        8438,
                26.00,        7948,
                26.20,        7842,
                26.78,        5600,
 ACD    =.75,
 CD     = .7,
 XBRCOF= .4,     !AMM file D6-16,12
   NHVALS= 12,  !TR-GL-87-16 Table A4
   HVALS=        0,   8,   9,    10,  11,
                12,  13,  14,    15,  16,
                60, 100,
```

```
   VOOB(1,1) = 100, 100,  21,  12.5, 9.5,
                 8, 7.5,   7,   6.5,   6,
                 2,   2,
   KVRIND(1)=  ,   ,   ,
   MAXIPR=16,   !TR-GL-87-16 Table A5
   MAXL=   1,
   RMS=            0, 1.0, 1.2,   1.4, 1.6, 1.8,
                   2, 2.2, 2.4,   2.6, 2.8,
                   3, 3.5,   4,   4.5,   5,
   ABSPWR(1)=  6,
   VRIDE(1,1,1)= 100, 100,  30,  26,    21,  18,
                  16,  14,  13,  12.5,  12,
                  11,  10,   9,     8,   7,
   VRIDE(1,2,1)=,
   VRIDE(1,3,1)=,
   ABSPWR(2)=   ,
   VRIDE(1,1,2)=,
   VRIDE(1,2,2)=,
   VRIDE(1,3,2)=,
  DRAFT =  ,
  FORDD =  ,
  SAE   =  ,
  SAI   =  ,
  VFS   =  ,
  VSS   =  ,
  VSSAXP=  ,
  WC    =  ,
  NWR   =  ,
  WDAXP =  ,
  WDPTH(1)=  ,
  WRAT(1) =  ,
  WRFORD=  ,
  $END= ,
NOHGT     !1 M88A1, Recovery
      4   !c:\vehicles\nrmmii\obsmod\m88a1.obv  !created 10April97
NANG      !c:\vehilces\nrmmii\obsmod\obt.dat
      8   !c:\vehicles\nrmmii\obsmod\m88a1.obo
NWDTH     !c:\tacom-ob\obsdp < obsdp.inp
      3
 CLRMIN    FOOMAX    FOO      HOVALS    AVALS     WVALS
 INCHES    POUNDS    POUNDS   INCHES    RADIANS   INCHES
  21.98    8771.2     400.3     3.15      1.95      5.88
   9.25   32243.9    1578.8    15.75      1.95      5.88
  -0.05   48947.8    2402.5    33.46      1.95      5.88
  -0.37   66959.7    2977.2    45.46      1.95      5.88
  21.98    8771.2     426.0     3.15      2.48      5.88
   9.25   34770.7    1889.4    15.75      2.48      5.88
   7.22   37783.1    2934.6    33.46      2.48      5.88
   7.22   36768.0    2954.4    45.46      2.48      5.88
  21.98    8771.2     438.0     3.15      2.69      5.88
  10.27   32575.1    1801.7    15.75      2.69      5.88
  10.27   26486.3    2601.9    33.46      2.69      5.88
  10.27   21640.0    2729.5    45.46      2.69      5.88
  21.96    8546.8     394.8     3.15      2.86      5.88
  12.99   19613.5    1633.8    15.75      2.86      5.88
  12.99   18245.3    1954.3    33.46      2.86      5.88
  12.99   30871.4    2656.2    45.46      2.86      5.88
  24.14    4715.3     163.0     3.15      3.42      5.88
  13.25   20340.9    1689.7    15.75      3.42      5.88
  10.03   20584.9    2800.1    33.46      3.42      5.88
```

8.94	24136.1	2296.3	45.46	3.42	5.88
25.00	3212.3	123.8	3.15	3.60	5.88
18.73	14089.2	1203.1	15.75	3.60	5.88
9.35	28914.1	2516.0	33.46	3.60	5.88
7.35	35449.8	3295.7	45.46	3.60	5.88
25.00	2381.2	84.8	3.15	3.80	5.88
22.57	8364.0	1172.4	15.75	3.80	5.88
17.74	8026.4	466.6	33.46	3.80	5.88
9.96	28655.6	2421.9	45.46	3.80	5.88
25.00	1558.1	34.0	3.15	4.33	5.88
25.00	3156.2	103.0	15.75	4.33	5.88
23.78	5928.9	344.1	33.46	4.33	5.88
23.01	7453.2	941.3	45.46	4.33	5.88
21.87	8238.5	578.6	3.15	1.95	29.88
9.25	28671.0	2504.0	15.75	1.95	29.88
5.10	24306.9	1010.0	33.46	1.95	29.88
5.19	61595.2	3314.0	45.46	1.95	29.88
21.87	8238.5	614.8	3.15	2.48	29.88
9.25	31053.7	538.7	15.75	2.48	29.88
7.22	25160.2	1553.6	33.46	2.48	29.88
7.22	25156.8	2467.8	45.46	2.48	29.88
21.87	8238.5	634.6	3.15	2.69	29.88
10.27	30984.0	2053.6	15.75	2.69	29.88
10.27	17035.7	1473.2	33.46	2.69	29.88
10.27	22158.3	2120.2	45.46	2.69	29.88
21.95	8546.8	484.2	3.15	2.86	29.88
12.99	13647.0	1292.4	15.75	2.86	29.88
12.99	16896.1	1883.7	33.46	2.86	29.88
12.99	28984.0	2830.4	45.46	2.86	29.88
22.74	8588.2	660.0	3.15	3.42	29.88
11.49	20505.1	1826.4	15.75	3.42	29.88
9.43	20649.4	2495.5	33.46	3.42	29.88
8.03	28892.2	2588.2	45.46	3.42	29.88
22.98	7486.8	852.2	3.15	3.60	29.88
17.02	12660.4	1229.4	15.75	3.60	29.88
8.24	34854.0	1458.8	33.46	3.60	29.88
6.69	35983.7	2567.6	45.46	3.60	29.88
23.51	5808.3	237.8	3.15	3.80	29.88
18.91	13024.1	2148.2	15.75	3.80	29.88
12.35	25270.1	1376.2	33.46	3.80	29.88
4.77	47029.1	5299.3	45.46	3.80	29.88
23.81	3594.8	-93.5	3.15	4.33	29.88
23.01	7451.9	944.5	15.75	4.33	29.88
20.97	10234.9	1954.7	33.46	4.33	29.88
19.51	12241.7	1417.5	45.46	4.33	29.88
21.85	8277.1	312.5	3.15	1.95	141.60
9.25	16766.4	798.4	15.75	1.95	141.60
5.10	42902.1	1759.4	33.46	1.95	141.60
9.47	76363.3	3633.2	45.46	1.95	141.60
21.85	8277.1	327.4	3.15	2.48	141.60
9.25	17830.4	1245.4	15.75	2.48	141.60
7.22	47595.4	2024.5	33.46	2.48	141.60
7.22	47328.6	2951.4	45.46	2.48	141.60
21.85	8277.1	335.4	3.15	2.69	141.60
10.27	25885.6	1388.3	15.75	2.69	141.60
10.27	35773.5	2303.8	33.46	2.69	141.60
10.27	36242.8	3235.0	45.46	2.69	141.60
21.85	8571.8	351.5	3.15	2.86	141.60
12.99	16482.7	1032.5	15.75	2.86	141.60
12.99	20523.4	2320.1	33.46	2.86	141.60

```
  12.99   28984.0    3072.9     45.46       2.86    141.60
  20.41    8583.8     463.9      3.15       3.42    141.60
  11.01   20372.2    1129.5     15.75       3.42    141.60
  10.64   20607.0    2463.3     33.46       3.42    141.60
  10.66   25729.2    3047.2     45.46       3.42    141.60
  20.42    6983.9     443.5      3.15       3.60    141.60
   8.39   18579.0    1965.1     15.75       3.60    141.60
   8.24   35637.6    2775.9     33.46       3.60    141.60
   6.36   35459.7    4518.0     45.46       3.60    141.60
  20.42    8108.0     646.9      3.15       3.80    141.60
   6.12   22135.3    1987.6     15.75       3.80    141.60
   4.03   46261.1    3334.7     33.46       3.80    141.60
   4.67   51949.3    3404.9     45.46       3.80    141.60
  20.42    7220.1     430.8      3.15       4.33    141.60
   7.85   19327.3    1271.1     15.75       4.33    141.60
  14.13   39368.6    4308.8     33.46       4.33    141.60
  12.22   70067.8    6248.8     45.46       4.33    141.60
 M88A1, Recovery Vehicle
  $VEHICL
! R. B. Ahlvin WES/MSD 24Nov93
NUNITS =  1,    ! Number of units
   NSUSP  =  2,    ! Number of suspension supports
   NVEH1  =  0,    ! Vehicle type; 0=tracked, 1=wheeled
   NFL    =  1,    ! Track type; 0=rigid, 1=flexible
   REFHT1 = 33,    ! Height of hitch from ground
   HTCHFZ =  0,    ! V-force on hitch
   SFLAG(1) = 1,1, ! Type suspension @supt-i,0=independent,1=bogie
!  Power flags ((IP(i,j), i=1,nsusp) j=1,2)
   IP(1,1)  = 1,1,1,1,1,
!  Brake flags ((IB(i,j), i=1,nsusp) j=1,2)
   IB(1,1)  = 1,1,1,1,1,
   EFFRAD(1)=16,16, ! Effective loaded radius wheels/plus track
                    ! thickness WRT ground
   ELL(1)    = 213,61,   ! Horizontal pos. suspension WRT hitch
   BWIDTH(1)=40.8,40,    ! Bogie arm length (centerline wheel to
                         ! centerline wheel)
   BALMU(1) = 11, 11,              !Bogie max CCW. angle, (+=CCW.)
   BALMD(1) =-11,-11,              !Bogie max CW. angle, (+=CCW.)
   EQUILF(1)= 52400, 59600,        !Equilibrium force
   CGZ1      =   46,         ! V-cg, Unit-1 WRT ground
   CGZ2      =  0            ! V-cg, Unit-2 WRT ground
   DEE1      =  0            ! H-cg, Unit-1 payload WRT hitch
   ZEE1      =  0            ! V-cg, Unit-1 payload WRT ground
   DEE2      =  0            ! H-cg, Unit-2 payload WRT hitch
   ZEE2      =  0            ! V-cg, Unit-2 payload WRT ground
   DELTW1    =  0            ! Payload weight, Unit-1
   DELTW2    =  0            ! Payload weight, Unit-2
   NPTSC1    =  8,           ! #Pts, bottom profile, Unit-1
   XCLC1(1) =260, 290, 291, 130, 10, -18,        !Unit-1
              -3, -31,
   YCLC1(1) = 96,  37,  25,  48, 25,  48,       !Unit-1
              82,  117,
   NPTSC2    = 0,            ! #Pts, bottom profile, Unit-2
   XCLC2(1) =,
   YCLC2(1) =,
   SFLAG(4) = 0,       ! Type suspension front "spridler" (always zero)
   IP(4,1)  =1,1,      ! Power flag, front "spridler"
   IB(4,1)  =1,1,      ! Brake flag, front "spridler"
   ELL(4)    = 271,    ! H-position front "spridler" WRT hitch
   ZS(4)     = 25,     ! V-position front "spridler" WRT ground
```

```
  EFFRAD(4)=18,         ! Effective radius front "spridler"
  SFLAG(5) = 0,         ! Type suspension rear "spridler" (always zero)
  IP(5,1)  =1,1,        ! Power flag, rear "spridler"
  IB(5,1)  =1,1,        ! Brake flag, rear "spridler"
  ELL(5)   =0,          ! H-position rear "spridler" WRT hitch
  ZS(5)    =33,         ! V-position rear "spridler" WRT ground
  EFFRAD(5)=19,         ! Effective radius rear "spridler"
$END
```

AVLB Vehicle File

```
 AVLB based on M60A1 chassis, NRMM file and WES TR gl-84-11
 3/07/01 Use for WARSIM and JWARS
 Changes 7Mar01:
VULEN,CGR,PBF,PBHT,PFA,WDTH,GROUSH,TL,WT,WTE,HPNET,OBSMOD
 Project: WARSIM; JWARS
 Date entered:10/98
 File name: avlbx.v
 Description: armored vehicle launched bridge
 AVLB         based on M60A1 chassis
 $VEHICLE
   NAMBLY= 1,
   WGHT(1)=123000,            !WES TR
   NVUNTS = 1,
VULEN(1)=444, !7March01, scaled from Southwest Mobile Sys. Corp picture
 CGH   =69.0,                 !WES TR
 CGLAT = 0,
 CGR   =95,                   !7Mar01
 CL    =15,                   !WES TR
 CLRMIN(1)=15,                !WES TR
 EYEHGT=69,                   !unchanged from m60
 PBF   =123000,               !7Mar01
 PBHT = 56,     !LSB 3/14/01 101 wouldn't run, this is valid data point
 PFA   =154.7,                !7Mar01 calculated
 WDTH  =155,                  !7Mar01, Bridger wid=155",AMM file,
                              !M60A1 wid.=143" Jane's A&A 1990-91 pg.149
   ASHOE(1) =194,             !WES TR
   AVGC=    ,
   GROUSH(1)=1.55,            !7Mar01
   ICONST(1)=    ,  ,
   NBOGIE(1)= 12,             !WES TR
   NFL(1)    =  1,            !WES TR
   NPAD(1)   =  1,            !unchanged from m60
   NVEH(1)   =  0,
   RW(1)     = 15,            !WES TR
   TL=167,                    !7Mar01 WES TR
   TRAKLN(1)=171,             !WES TR
   TRAKWD(1)=28,              !WES TR
   WT(1)     =110             !7Mar01, calculated
   WTE(1)    = 82,            !7Mar01, calculated
   CID=1791,
   ICONV1= ,
   CONV1 =  ,  ,
   ICONV2=  ,
   CONV2 =  ,  ,
   IENGIN=  ,
   ENGINE=    ,    ,
   FD(1) =5.08,.98,           !m60 drive-line, unchanged from m60
   HPNET =750,                !7Mar01 WES TR
   IB(1) =  1,
   IDIESL=  1,
   IP(1) =  1,
   ITVAR =  0,
   LOCDIF=  0,
   LOCKUP=  0,
   NCYL  = 12,
   NENG  =  1,
```

```
    QMAX   =1710,
    REVM(1) =    ,   ,
    TCASE(1)=1.0,1.0,
    TQIND =900,
    NGR    =  2,                  !m60 drive-line, unchanged from m60
    TRANS= 3.497,.98,
           1.256,.98,
    IPOWER= 17,                   !WES TR, same as m60
    POWER= 0   ,72790,
           1.4,62800,
           2.3,52850,
           3.5,42910,
           4.5,38000,
           5.5,33020,
           6.8,28100,
           8. ,23200,
       10.,18900,
          12.0,14600,
       14.,12700,
          16. ,10800,
          20. , 9100,
          24. , 7100,
          26. , 6700,
          28. , 6000,
          30. , 5200,
  ACD    = .75,
  CD     = .7,
  XBRCOF= .4,
    KOHIND=   ,   ,   ,
    NHVALS= 0,
    NHVALS=8,                  ! WES TR
    HVALS=         0,   6,   8, 10, 12, 14, 60, 100,
    VOOB(1,1) =30.1, 30, 25, 13,  8,  6,  2,   2,
    VOOB(1,2) =    ,   ,   ,    ,   ,   ,   ,   ,   ,   ,   ,
    VOOB(1,3) =    ,   ,   ,    ,   ,   ,   ,   ,   ,   ,   ,
    KVRIND(1)=   ,   ,   ,
    MAXIPR=10,                 ! WES TR
    MAXL=   1,
    RMS=              0, .5,  1, 1.2, 1.5,  2, 2.5, 3, 5, 9,
    ABSPWR(1)= 6,
    VRIDE(1,1,1)=30.1, 30, 27,  21,  14, 12,  10, 8, 8, 8,
    VRIDE(1,2,1)=,
    VRIDE(1,3,1)=,
    ABSPWR(2)=  ,
    VRIDE(1,1,2)=,
    VRIDE(1,2,2)=,
    VRIDE(1,3,2)=,
  DRAFT =   ,
  FORDD =   ,
  SAE   =   ,
  SAI   =   ,
  VFS   =   ,
  VSS   =   ,
  VSSAXP=   ,
  WC    =   ,
  NWR   =   ,
  WDAXP =   ,
  WDPTH(1)=   ,
  WRAT(1) =   ,
  WRFORD=   ,
```

```
 $END
NOHGT       !1 AVLB, (M60A1 chassis), 8Mar01
      4     !c:\vehicles\nrmmii\obsmod\avlb.obv
NANG        !c:\vehicles\nrmmii\obsmod\obt.dat
      8     !c:\vehicles\nrmmii\obsmod\avlb.obo
NWDTH
      3
```

CLRMIN INCHES	FOOMAX POUNDS	FOO POUNDS	HOVALS INCHES	AVALS RADIANS	WVALS INCHES
27.08	9309.8	407.0	3.15	1.95	5.88
17.34	45940.1	2819.0	15.75	1.95	5.88
10.09	62430.3	3628.3	33.46	1.95	5.88
1.60	104360.2	5368.7	45.46	1.95	5.88
27.08	9309.8	433.0	3.15	2.48	5.88
16.50	46243.2	2775.6	15.75	2.48	5.88
9.51	35513.8	3282.9	33.46	2.48	5.88
3.52	58089.1	4692.3	45.46	2.48	5.88
27.08	9309.8	442.4	3.15	2.69	5.88
17.47	34175.1	2682.0	15.75	2.69	5.88
13.05	25825.6	2889.1	33.46	2.69	5.88
11.87	40990.0	4315.7	45.46	2.69	5.88
26.95	8895.9	487.7	3.15	2.86	5.88
19.57	19087.6	1833.0	15.75	2.86	5.88
18.12	24581.3	2821.0	33.46	2.86	5.88
17.73	33903.4	3690.5	45.46	2.86	5.88
29.02	6617.8	586.9	3.15	3.42	5.88
17.09	21997.1	1905.3	15.75	3.42	5.88
3.60	22890.6	2741.5	33.46	3.42	5.88
1.05	33903.4	3465.6	45.46	3.42	5.88
30.00	3983.9	116.5	3.15	3.60	5.88
23.07	15328.7	1491.5	15.75	3.60	5.88
6.91	37755.8	4563.2	33.46	3.60	5.88
-8.88	41045.2	4436.0	45.46	3.60	5.88
30.00	3319.0	124.2	3.15	3.80	5.88
27.13	11698.2	1202.5	15.75	3.80	5.88
16.79	28138.5	2702.3	33.46	3.80	5.88
11.00	51244.8	4461.6	45.46	3.80	5.88
30.00	1568.6	20.7	3.15	4.33	5.88
30.00	3315.5	69.6	15.75	4.33	5.88
28.74	7704.7	582.3	33.46	4.33	5.88
27.95	6506.1	-138.9	45.46	4.33	5.88
27.18	9932.2	423.3	3.15	1.95	29.88
20.49	14399.8	1065.8	15.75	1.95	29.88
11.68	36767.6	2908.6	33.46	1.95	29.88
1.60	101701.1	5836.0	45.46	1.95	29.88
27.18	9932.2	451.5	3.15	2.48	29.88
16.72	23402.3	1664.6	15.75	2.48	29.88
11.86	52272.4	4044.3	33.46	2.48	29.88
3.52	66152.4	5570.4	45.46	2.48	29.88
27.18	9932.2	451.5	3.15	2.69	29.88
17.47	15631.8	1041.6	15.75	2.69	29.88
13.18	35048.0	3609.8	33.46	2.69	29.88
12.46	41361.3	4490.7	45.46	2.69	29.88
26.93	8897.5	656.5	3.15	2.86	29.88
19.95	16225.7	1382.9	15.75	2.86	29.88
18.34	24613.8	3042.7	33.46	2.86	29.88
17.68	33903.4	3859.3	45.46	2.86	29.88
27.89	9097.1	733.8	3.15	3.42	29.88
13.77	22443.4	2312.1	15.75	3.42	29.88
1.99	22801.5	3042.3	33.46	3.42	29.88

1.13	33903.4	3736.1	45.46	3.42	29.88
27.41	11257.5	578.7	3.15	3.60	29.88
17.51	29312.8	2146.2	15.75	3.60	29.88
2.90	39521.8	3810.8	33.46	3.60	29.88
-19.95	43817.2	4252.6	45.46	3.60	29.88
28.23	7448.6	477.1	3.15	3.80	29.88
22.50	15306.1	545.4	15.75	3.80	29.88
7.57	37257.5	1667.2	33.46	3.80	29.88
4.74	60145.4	5707.2	45.46	3.80	29.88
28.72	7969.8	397.0	3.15	4.33	29.88
27.89	6537.4	-134.5	15.75	4.33	29.88
26.09	14545.3	1065.7	33.46	4.33	29.88
25.99	15568.5	1912.7	45.46	4.33	29.88
27.09	10118.4	397.7	3.15	1.95	141.60
17.95	21121.3	949.8	15.75	1.95	141.60
9.95	32875.0	3424.4	33.46	1.95	141.60
1.60	101608.2	5605.6	45.46	1.95	141.60
27.09	10118.4	417.1	3.15	2.48	141.60
16.54	40553.9	2004.3	15.75	2.48	141.60
10.38	53213.1	4345.9	33.46	2.48	141.60
3.52	59034.5	5089.8	45.46	2.48	141.60
27.09	10118.4	417.1	3.15	2.69	141.60
17.76	37706.2	2027.0	15.75	2.69	141.60
13.11	39229.5	4012.9	33.46	2.69	141.60
12.46	41362.5	4617.8	45.46	2.69	141.60
27.00	9074.2	412.2	3.15	2.86	141.60
19.76	22382.9	2067.5	15.75	2.86	141.60
18.34	24613.8	3379.4	33.46	2.86	141.60
17.68	33903.4	3973.1	45.46	2.86	141.60
25.35	9081.7	503.8	3.15	3.42	141.60
18.60	22184.9	1767.3	15.75	3.42	141.60
17.77	24534.4	3799.5	33.46	3.42	141.60
17.89	33903.4	4381.5	45.46	3.42	141.60
25.45	8103.4	244.7	3.15	3.60	141.60
14.75	30705.7	1402.9	15.75	3.60	141.60
1.91	38743.3	3918.5	33.46	3.60	141.60
0.76	42934.4	5230.7	45.46	3.60	141.60
25.65	7703.6	246.8	3.15	3.80	141.60
12.33	42262.9	1987.9	15.75	3.80	141.60
-11.29	57073.8	2817.2	33.46	3.80	141.60
-19.25	63580.5	6775.2	45.46	3.80	141.60
25.57	10019.4	567.6	3.15	4.33	141.60
16.91	20878.5	813.9	15.75	4.33	141.60
-12.77	33804.4	2673.8	33.46	4.33	141.60
-36.66	99554.9	7010.4	45.46	4.33	141.60

LAV3 Vehicle File

```
 LAVIII, 14March01, 5Jan00
 Use this file for JWARS and WARSIM
 Project: Ronnie Gilmore, 5Jan2000, FSCS
 Changed:14Mar01,changed vulen, cgh in the nrmmii file
 Changed obsmod file:19Mar01,ell(1)(2),bottom profile, weight
 Date entered:1-05-2000
 File name :c:\gilmoroo\fscs\vehs\laviii.dat  !5Jan00
 LAVIII, 14March01, 5Jan00
 $VEHICLE
   NAMBLY= 4,
   WGHT(1)=9155.93,9737.14,9982.98,10535.95, !5Jan00,Lynn Martin, TACOM
                                             ! fax sheet
   NVUNTS =   1,
   VULEN(1)= 272.3,              !14March01,from drawing, 5Jan00
 CGH    = 48,                    !14Mar01,Lynn Martin, TACOM fax sheet
 CGLAT = 0,
 CGR    =71.14,                  !5Jan00,Lynn Martin, TACOM fax sheet
 CL     =16.97,                  !5Jan00,Lynn Martin, TACOM fax sheet
 CLRMIN(1)=4*16.97,              !5Jan00,Lynn Martin, TACOM fax sheet
 EYEHGT=70.07,                   !5Jan00,Lynn Martin, TACOM fax sheet
 PBF    =78824,                  !5Jan00,Lynn Martin, TACOM fax sheet
 PBHT  =50,
 PFA    =60,                     !5Jan00,Lynn Martin, TACOM fax sheet
 WDTH  =104.5,                   !5Jan00,Lynn Martin, TACOM fax sheet
   AVGC=45.4,                    !5Jan00,Lynn Martin, TACOM fax sheet
   AXLSP(1) =48.03,55.91,48.03,  !5Jan00,Lynn Martin, TACOM fax sheet
   DFLCT(1,1)=1.38,1.46,1.50,1.56,          !primary    5Jan00
   DFLCT(1,2)=1.80,1.85,1.90,1.95,          !secondary  5Jan00
   DFLCT(1,3)=2.16,2.28,2.34,2.45,          !cc         5Jan00
   DFLCT(1,4)=3.01,3.17,3.23,3.43,          !sand       5Jan00
   DIAW(1)   = 4*44.49,          !5Jan00,Lynn Martin, TACOM fax sheet
   ICONST(1)= 4*0,                          !5Jan00, no change
   ID(1)     = 4*0,                         !5Jan00, no change
   IT(1)     = 4*0,                         !5Jan00, no change
   KCTIOP(1)= 0,0,0,0,0,0,0,0,   !5Jan00, no change,17June99,changed
   KTSFLG   =1,                  !5Jan00, no change, 9Feb99,changed
   NCHAIN(1)= 4*0,               !5Jan00, no change
   NJPSI     =  4,               !5Jan00, no change,17June99,changed
   NVEH(1)   = 4*1,              !5Jan00, no change
   NWHL(1)   =4*2,               !5Jan00, no change
   RDIAM(1)  =4*20,              !5Jan00,Lynn Martin, TACOM fax sheet
   RIMW(1)   = 4*6.5,            !5Jan00, no change
   RW(1)     =   ,  ,
   SECTH(1) = 4*12.24,           !5Jan00,Lynn Martin, TACOM fax sheet
   SECTW(1) = 4*12.2,            !5Jan00,Lynn Martin, TACOM fax sheet
   TL=151.97,                    !5Jan00,Lynn Martin, TACOM fax sheet
TIREID(1)='11.00R 16XL ','11.00R 16XL ','11.00R 16XL ','11.00R 16XL '
   TPLY(1)   =4*18,              !5Jan00,Lynn Martin, TACOM fax sheet
   TPSI(1,1)=4*53,               !5Jan00, Primary
   TPSI(1,2)=4*30,               !5Jan00, Secondary
   TPSI(1,3)=4*25,               !5Jan00, CC
   TPSI(1,4)=4*20,                          !5Jan00, Sand
   VTIRMX(1)= 60,35,20,7,                   !5Jan00
   WT(1) = 90.55,90.55,89.76,89.76, !5Jan00, Martin, TACOM fax sheet
   WTE(1) = 78.35,78.35,77.56,77.56,!5Jan00, Martin, TACOM fax sheet
 CID=  440,                    !5Jan00,Lynn Martin, TACOM fax sheet
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 ICONV1= ,
 CONV1 =  ,  ,
 ICONV2=  ,
 CONV2 =  ,  ,
 IENGIN= 9,                    !5Jan00,Lynn Martin, TACOM fax sheet
 ENGINE= 1000,784.8,
         1440,780.3,
         1600,768.2,
         1800,752.1,
         2000,740.8,
         2200,726.9,
         2400,676.9,
         2600,629.0,
         2840,  0.0,
   FD(1) = 9.16, .9,           !5Jan00,Lynn Martin, TACOM fax sheet
   HPNET =311.4,               !5Jan00,Lynn Martin, TACOM fax sheet
   IB(1) = 4*1,                !5Jan00, no change
   IDIESL=  1,                 !5Jan00,Lynn Martin, TACOM fax sheet
   IP(1) = 4*1,                !5Jan00, no change
   ITVAR =  0,                 !5Jan00, no change
   JVPSI =  3,                 !5Jan00
   LOCDIF=  1,
   LOCKUP=  1,                 !5Jan00, no change
   NCYL  =  6,                 !5Jan00, no change
   NENG  =  1,                 !5Jan00, no change
   QMAX  =586,
REVM(1)=473.34,473.34,473.34,473.34,!5Jan00, Martin, TACOM fax sheet
TCASE(1)=1.314,0.9,                !5Jan00, Martin, TACOM fax sheet
   TQIND =   ,
   NGR   =  6,
   TRANS=4.59,0.96,              !5Jan00,Lynn Martin, TACOM fax sheet
         2.25,0.96,
         1.54,0.96,
         1.00,0.96,
         0.75,0.96,
         0.65,0.96,
KTROPR=8*0,              ! 13Jan00, added to give both speed ranges
NTRANG=2,                ! 13Jan00, added to allow 2 x mission ranges
   IPOWER(1)= 47,
   POWER(1,1,1)= 0    ,39293, !5Jan00,Lynn Martin, TACOM fax sheet
                 1    ,36764,
                 2    ,31574,
                 2.53 ,28700,
                 3    ,26363,
                 3.36 ,24600,
                 4    ,21408,
                 4.39 ,19541,
                 5    ,14359,
                 6    ,13150,
                 7    ,11960,
                 8    , 9903,
                 9    , 9704,
                10    , 9502,
                11    , 8798,
                12    , 6735,
                13    , 6645,
                14    , 6561,
                15    , 6433,
                16    , 6085,
                16.83 , 5789,
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            18     , 4419,
            19     , 4372,
            20     , 4336,
            21     , 4303,
            22     , 4261,
            23     , 4201,
            24     , 4067,
            25     , 3895,
            26     , 3754,
            27     , 3210,
            28     , 3191,
            29     , 3167,
            30     , 3141,
            31     , 3093,
            32     , 3015,
            33     , 2915,
            34     , 2831,
            35     , 2752,
            36     , 2634,
            37     , 2569,
            38     , 2490,
            39     , 2425,
            40     , 2364,
            41     , 2304,
            42     , 1703,
            42.63  , 1225,
IPOWER(2)= 41,
POWER(1,1,2)= 0     ,25777, !5Jan00,Lynn Martin, TACOM fax sheet
              1.2   ,24600,
              2     ,23204,
              4     ,18506,
              6     ,14249,
              6.69  , 9946,
              8     , 9216,
              10    , 8198,
              12    , 7153,
              12.18, 6499,
              14    , 6347,
              16    , 6056,
              17.31, 5604,
              18    , 4433,
              20    , 4353,
              22    , 4276,
              24    , 4062,
              25.66, 3798,
              26    , 2930,
              28    , 2887,
              30    , 2852,
              32    , 2823,
              34    , 2787,
              36    , 2706,
              38    , 2562,
              39.77, 2454,
              40    , 2116,
              42    , 2100,
              44    , 2080,
              46    , 2058,
              48    , 2006,
              50    , 1927,
              52    , 1852,
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                54   , 1748,
                56   , 1697,
                58   , 1630,
                60   , 1577,
                62   , 1524,
                62.89, 1501,
                64   , 1125,
                64.98,  804,
 ACD    = 1,                       !5Jan00,Lynn Martin, TACOM fax sheet
 CD     = .8,                      !5Jan00, no change
 XBRCOF= .49,                      !5Jan00,Lynn Martin, TACOM fax sheet
   KOHIND= 1,
   NHVALS=   15,                   !5Jan00,Lynn Martin, TACOM fax sheet
   HVALS=       0.0,    1.0,    2.0,    4.0,    6.0,
                8.0,   10.0,   12.0,   14.0,   16.0,
               18.0,   20.0,   22.0,   24.0,   30.0,
   VOOB(1,1)=  64.98,   64.98,  64.98, 64.98, 64.98,
              64.98,   26.49,  14.77, 10.44,  8.54,
               7.36,    6.50,   5.88,  5.37,  3.50,
   VOOB(1,2) =    ,
   VOOB(1,3) =    ,
   KVRIND(1)= 1,
   MAXL=   1,
   ABSPWR(1)= 6,
   MAXIPR= 14,                 !5Jan00,Lynn Martin, TACOM fax sheet
   RMS=           0.00,  0.25,   0.50,  0.74,  1.00,
                  1.25,  1.50,   1.75,  2.00,  2.50,
                  3.00,  4.00,   5.00,  7.50,
   VRIDE        = 64.98, 64.98,  64.98, 64.98, 39.00,
                22.00, 16.50,  14.90, 14.00, 12.50,
                11.20,  8.80,   6.30,  1.00,
 DRAFT =  68.9,                !5Jan00,Lynn Martin, TACOM fax sheet
 FORDD =  68.9,                !5Jan00,Lynn Martin, TACOM fax sheet
 SAE   =  55,                  !5Jan00,Lynn Martin, TACOM fax sheet
 SAI   =  55,                  !5Jan00,Lynn Martin, TACOM fax sheet
 VFS   =   6.2,                !5Jan00,Lynn Martin, TACOM fax sheet
 VSS   =   0.0,                !5Jan00,Lynn Martin, TACOM fax sheet
 VSSAXP=  10.0,                !5Jan00,Lynn Martin, TACOM fax sheet
 WC    =  18000,               !5Jan00,Lynn Martin, TACOM fax sheet
 NWR   =  ,
 WDAXP =  57.2,                !5Jan00,Lynn Martin, TACOM fax sheet
 WDPTH(1)=  ,
 WRAT(1) =  ,
 WRFORD=  ,
 $END
NOHGT      !1  LAVIII,19March01, 5Jan00
    3      !C:\vehicles\nrmmii\obsmod\laviii.obv
NANG       !C:\vehicles\nrmmii\obsmod\obw.dat
    8      !C:\vehicles\nrmmii\obsmod\laviii.obo
NWDTH      !data from Lynn Martin, TACOM fax sheet's
    3      !3/19/01 changed bottom profile, ell(1)((2)weight
 CLRMIN    FOOMAX    FOO      HOVALS    AVALS     WVALS
 INCHES    POUNDS    POUNDS   INCHES    RADIANS   INCHES
  16.85     5914.5    380.3     3.15      1.95      5.88
   4.38    27133.0   1719.0    15.75      1.95      5.88
  -9.22    32492.0   1716.6    33.46      1.95      5.88
  16.85     5914.5    392.4     3.15      2.48      5.88
   5.46    20335.3   1263.6    15.75      2.48      5.88
  -6.07    15936.7   1710.3    33.46      2.48      5.88
  16.85     5108.7    342.5     3.15      2.69      5.88
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7.32	12958.8	1031.7	15.75	2.69	5.88
2.35	13005.7	1395.1	33.46	2.69	5.88
16.85	3003.4	336.7	3.15	2.86	5.88
9.14	6347.7	639.3	15.75	2.86	5.88
8.91	10863.4	1140.7	33.46	2.86	5.88
18.14	3047.5	411.5	3.15	3.42	5.88
7.13	6432.3	428.4	15.75	3.42	5.88
-4.76	9236.9	1075.6	33.46	3.42	5.88
18.82	3946.5	150.9	3.15	3.60	5.88
9.95	5682.5	743.0	15.75	3.60	5.88
-10.04	14942.5	1248.8	33.46	3.60	5.88
19.36	2769.0	134.5	3.15	3.80	5.88
11.95	8783.1	825.8	15.75	3.80	5.88
3.68	11790.6	790.8	33.46	3.80	5.88
20.00	1772.9	40.5	3.15	4.33	5.88
18.62	4344.0	90.8	15.75	4.33	5.88
14.97	8777.5	450.1	33.46	4.33	5.88
16.85	5045.8	300.0	3.15	1.95	29.88
4.81	15676.9	738.0	15.75	1.95	29.88
-8.46	39242.0	1353.0	33.46	1.95	29.88
16.85	5045.8	308.6	3.15	2.48	29.88
8.43	11572.6	787.2	15.75	2.48	29.88
-4.44	21615.9	1864.9	33.46	2.48	29.88
16.85	5109.0	217.6	3.15	2.69	29.88
9.55	10775.5	771.5	15.75	2.69	29.88
2.71	14402.0	1654.7	33.46	2.69	29.88
16.85	2985.3	117.8	3.15	2.86	29.88
11.72	6077.8	575.3	15.75	2.86	29.88
9.63	10863.4	1196.8	33.46	2.86	29.88
17.87	3054.3	352.1	3.15	3.42	29.88
4.11	6431.2	482.7	15.75	3.42	29.88
-3.98	9473.2	1179.6	33.46	3.42	29.88
17.89	5229.3	330.5	3.15	3.60	29.88
6.96	8341.9	508.8	15.75	3.60	29.88
-14.89	15089.6	1321.4	33.46	3.60	29.88
17.88	4682.2	287.4	3.15	3.80	29.88
9.14	8812.3	586.6	15.75	3.80	29.88
-12.30	22425.6	1337.1	33.46	3.80	29.88
15.69	8227.2	861.1	3.15	4.33	29.88
9.14	23284.1	1353.6	15.75	4.33	29.88
-0.06	44435.0	2044.7	33.46	4.33	29.88
16.85	5577.6	125.4	3.15	1.95	141.60
4.81	20120.3	840.7	15.75	1.95	141.60
-8.46	30354.2	2103.3	33.46	1.95	141.60
16.85	5577.6	125.4	3.15	2.48	141.60
8.25	12675.7	905.4	15.75	2.48	141.60
-4.94	22691.8	1852.5	33.46	2.48	141.60
16.85	5182.9	169.3	3.15	2.69	141.60
9.71	10908.4	802.6	15.75	2.69	141.60
2.48	15091.7	1620.2	33.46	2.69	141.60
16.85	3049.7	186.0	3.15	2.86	141.60
11.72	6427.4	739.3	15.75	2.86	141.60
9.63	8941.8	1242.2	33.46	2.86	141.60
16.30	3047.4	199.6	3.15	3.42	141.60
11.17	6762.2	719.5	15.75	3.42	141.60
9.72	8943.3	1223.6	33.46	3.42	141.60
16.28	5192.4	205.8	3.15	3.60	141.60
4.28	8022.2	765.4	15.75	3.60	141.60
1.59	14972.2	1479.8	33.46	3.60	141.60
16.16	4682.8	238.0	3.15	3.80	141.60

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   3.94    8739.9     869.4     15.75      3.80    141.60
 -11.59   22693.9    1809.5     33.46      3.80    141.60
  16.16    4808.7     267.5      3.15      4.33    141.60
  -1.43   20110.1     950.4     15.75      4.33    141.60
 -25.67   32685.8    2029.8     33.46      4.33    141.60
LAVIII, 19Mar01,5Jan00
 $VEHICL
! R. B. Ahlvin WES/MSD 24Nov93
NUNITS =    1,  !5Jan00,Lynn Martin TACOM fax sheet's
                !Number of units
   NSUSP  =    2,  !5Jan00,Lynn Martin TACOM fax sheet's
                   !Number of suspension supports
   NVEH1  =    1,  !5Jan00,Lynn Martin TACOM fax sheet's
                   !Vehicle type; 0=tracked, 1=wheeled
   NFL    =    0,  !5Jan00,Lynn Martin TACOM fax sheet's
                   !Track type; 0=rigid, 1=flexible
   REFHT1 =   25,  !5Jan00,Lynn Martin TACOM fax sheet's
                   !Height of hitch from ground
   HTCHFZ =    0,  !5Jan00,Lynn Martin TACOM fax sheet's
                   !V-force on hitch
   SFLAG(1) = 1,1, !5Jan00,Lynn Martin TACOM fax sheet's
                   !Type suspension @supt-i,0=indp,1=bogie
!  Power flags ((IP(i,j), i=1,nsusp) j=1,2)
   IP(1,1)  = 1,1,0,0,0,  !5Jan00,Lynn Martin TACOM fax sheet's
   IP(1,2)  = 1,1,0,0,0,
!  Brake flags ((IB(i,j), i=1,nsusp) j=1,2)
   IB(1,1)  = 1,1,0,0,0,  !5Jan00,Lynn Martin TACOM fax sheet's
   IB(1,2)  = 1,1,0,0,0,
   EFFRAD(1)= 22.0,22.0,  !5Jan00,Lynn Martin TACOM fax sheet's
          !Effective loaded radius whls/plus track thickness WRT grd
   ELL(1)   =174,71,      !19Mar01 data from drawing
                          !Horizontal pos. suspension WRT hitch
   BWIDTH(1)= 48.0,48.0,  !5Jan00,Lynn Martin TACOM fax sheet's,
                          !Absolute Value Bogie arm length (centerline
                                  !wheel to centerline wheel)
   BALMU(1) = 22.6,  11.8,       !5Jan00,Lynn Martin TACOM fax sheet
                                 !Bogie max CCW. angle, (+=CCW.)
   BALMD(1) =-11.8, -22.6,       !5Jan00,Lynn Martin TACOM fax sheet
                                  !Bogie max CW. angle, (+=CCW.)
EQUILF(1)= 18893, 20519,  !19Mar01,Equilibrium force
   CGZ1   =  48, !5Jan00,Lynn Martin TACOM fax sheet V-cg,Unit-1 WRT grd
   CGZ2     =  0             ! V-cg, Unit-2 WRT ground
   DEE1     =  0             ! H-cg, Unit-1 payload WRT hitch
   ZEE1     =  0             ! V-cg, Unit-1 payload WRT ground
   DEE2     =  0             ! H-cg, Unit-2 payload WRT hitch
   ZEE2     =  0             ! V-cg, Unit-2 payload WRT ground
   DELTW1   =  0             ! Payload weight, Unit-1
   DELTW2   =  0             ! Payload weight, Unit-2
   NPTSC1   =  16,            ! #Pts, bottom profile, Unit-1
XCLC1(1) = 260,  260,   257,   257,  231,   !19Mar01, data from drawing
           231,  222.5, 218.9,  26.6, 25,
             0,   -2,    -6,    -6,   -4, -9.5,
YCLC1(1) = 54.9, 47,    45,    40,   28,    !19Mar01, data from drawing
             23,   23,    20,    20,   24,
             25,   46,    46,    50,   50,  86,
   NPTSC2   =,               ! #Pts, bottom profile, Unit-2
   XCLC2(1) =,
   YCLC2(1) =,
   SFLAG(4) = 0,       ! Type suspension front "spridler" (always zero)
   IP(4,1)  =,         ! Power flag, front "spridler"
```

```
   IB(4,1)   =,          ! Brake flag, front "spridler"
   ELL(4)    =,          ! H-pos front "spridler" WRT hitch
   ZS(4)     =,          ! V-pos centerline front "spridler" WRT ground
   EFFRAD(4)=,           ! Effective radius front "spridler" measure from
                         ! centerline to outer edge of track
   SFLAG(5) = 0,         ! Type suspension rear "spridler" (always zero)
   IP(5,1)   =,          ! Power flag, rear "spridler"
   IB(5,1)   =,          ! Brake flag, rear "spridler"
   ELL(5)    =,          ! H-pos rear "spridler" WRT hitch
   ZS(5)     =,          ! V-pos centerline rear "spridler" WRT ground
   EFFRAD(5)=,           ! Effective radius rear "spridler" measure from
                         ! centerline to outer edge of track
 $END
$LFVDAT
! Over-all description:
   IVTYPE=  1,       ! 1=wheeled, 2=flex-track, 3=gird-track
   IVCONF=  3,       ! if wheeled; 1=4x4, 2=6x6, 3=8x8
                     ! if tracked; 1=Normal, 2=Dozer, 4=Comb. 1&2
   GVW   =39412,     ! Gross vehicle weight {lbs}
   VVCI1 =  31.58, ! Vehicle 1-pass VCI for fine-grained soils {RCI}
! Geometry: Vegetation
VLEN   =272.3,   ! Over-all length {in}
VWIDTH =104.3,   ! Over-all width {in}
VAADEG =  36.1, ! Approach/departure angle {deg}
VCLR   =  24.2, ! Frame end clearance ("clearance line") {in}
VRR    =   19,  ! Road-wheel radius (+ track-thickness if tracked) {in}
VTL    =  152.0,! Front-rear ground wheel center-line distance {in}
VCGF   = 80.83, ! Horizontal distance CG to front-wheel center-line{in}
VCGH   = 20.7,   ! Vertical distance CG to front-wheel center-line {in}
! Wheeled vehicle additional geometry data
   WHLGWS =  56,    ! Distance between wheels of greatest span {in}
   WBCLR  =  20.6, ! Clearance between wheels of greatest span {in}
! Tracked vehicle additional data
   TRKLEN =       , ! Length of track on ground (one-side) {in}
   TRKWID =       , ! Width of one track (one-side) {in}
   TRKD   =       , ! Hull depth above end clearance line {in}
   KTPAD  =       , ! Track pad code 1=HAS-pads; 0=NO-pads
! Tracked vehicle sprocket/idler configuration for non-dozer
! (i.e. IVCONF=1,4)
RR1 =  , ! Sprocket/idler radius {in}
RR2 =  , ! Horizontal dist. road-wheel ctr. to sprocket/idler ctr. {in}
RR3 =  , ! Vertical dist. road-wheel ctr. to sprocket/idler ctr. {in}
! Swimming/fording characteristics
VSWIM  = 10, ! Lynn Martin, swim speed (0=NON-SWIMMER) {mph}
VFORD  = 6.2, ! Lynn Martin, fording speed (pre-set to 5mph)
DFLOAT = 68.9 ! Lynn Martin, used PBH, Vehicle maximum fording
              ! depth {in}
 $ END
```

M113A2 Vehicle File

```
M113A2
3/07/01 Use this file for WARSIM and JWARS
Changed: 7March01, VULEN,FD,POWER,OBSMOD
File Name:AT5M113A2.V
M113A2
$VEHICLE
  NAMBLY =    1,
  WGHT(1)=25000,
  NVUNTS =    1,
VULEN  =  192,    !7March01
CGH   =38.5,
CGLAT = 0,
CGR   =53,
CL    =16,
CLRMIN(1)=16,
EYEHGT=84,
PBF   =50000,
PBHT  =30,
PFA   =70,
WDTH  =105.8,
  ASHOE(1) = 90,
  GROUSH(1)=1.6,
  NBOGIE(1)= 10,
  NFL(1)    =  1,
  NPAD(1)   =  1,
  NVEH(1)   =  0,
  RW(1)     =14.5,
  TL=105,
  TRAKLN(1)=109,
  TRAKWD(1)=15,
  WT(1)     =85,
  WTE(1)    =70,
CID=  318,
ICONV1=0,
ICONV2=0,
IENGIN=0,
FD(1) =3.93,0.95, ! corrected 12Dec94 per Hutto, United Defense
                  ! Scans-July94
  HPNET =212,
  IB(1) =  1,
  IDIESL=  2,
  IP(1) =  1,
  ITVAR =  0,
  LOCDIF=  1,
  LOCKUP=  1,
  NCYL  =  6,
  NENG  =  1,
  QMAX  =435,
  REVM  =1056, ! ( 10t, 6" pitch )
  TCASE(1)=1.0,1.0,
  NGR   =  3,
  TRANS=3.81,0.95,
        1.94,0.95,
        1.00,0.95,
  NTRANG=  1,
 IPOWER=87,
```

```
! DATA SOURCE- UNITED DEFENSE SCANS-JULY 1994 (PER T. HUTTO)
! TR M-76-5
!      SPEED,MPH        TF LBS.         HORSEPOWER
POWER= 0.000000   ,    21450.0 ,       !   0.000000
       0.500000   ,    20048.0 ,       !  26.7306
       1.00000    ,    18517.4  ,      !  49.3796
       1.50000    ,    16861.4  ,      !  67.4457
       2.00000    ,    15129.3  ,      !  80.6895
       2.50000    ,    13593.3  ,      !  90.6221
       3.00000    ,    12222.0  ,      !  97.7757
       3.50000    ,    11056.4  ,      ! 103.193
       4.00000    ,    10062.8  ,      ! 107.337
       4.50000    ,    9133.33  ,      ! 109.600
       5.00000    ,    8325.00  ,      ! 111.000
       5.50000    ,    7600.00  ,      ! 111.467
       6.50000    ,    7185.71  ,      ! 124.552
       7.00000    ,    7010.53  ,      ! 130.863
       7.50000    ,    6846.05  ,      ! 136.921
       8.00000    ,    6636.36  ,      ! 141.576
       8.50000    ,    6405.59  ,      ! 145.193
       9.00000    ,    6158.88  ,      ! 147.813
       9.50000    ,    5914.29  ,      ! 149.829
      10.0000     ,    5662.50   ,     ! 151.000
      10.5000     ,    5350.00   ,     ! 149.800
      11.0000     ,    4534.21   ,     ! 133.004
      11.5000     ,    3582.86   ,     ! 109.874
      13.5000     ,    3553.97   ,     ! 127.943
      14.0000     ,    3511.67   ,     ! 131.102
      14.5000     ,    3470.00   ,     ! 134.173
      15.0000     ,    3428.33   ,     ! 137.133
      15.5000     ,    3363.67   ,     ! 139.032
      16.0000     ,    3297.00   ,     ! 140.672
      16.5000     ,    3230.33   ,     ! 142.135
      17.0000     ,    3164.07   ,     ! 143.438
      17.5000     ,    3097.85   ,     ! 144.566
      18.0000     ,    3031.62   ,     ! 145.518
      18.5000     ,    2965.00   ,     ! 146.273
      19.0000     ,    2898.33   ,     ! 146.849
      19.5000     ,    2831.67   ,     ! 147.247
      20.0000     ,    2750.50   ,     ! 146.693
      20.5000     ,    2667.72   ,     ! 145.835
      21.0000     ,    2584.93   ,     ! 144.756
      21.5000     ,    2311.00   ,     ! 132.497
      23.5000     ,    1817.81   ,     ! 113.916
      24.0000     ,    1800.68   ,     ! 115.244
      24.5000     ,    1783.56   ,     ! 116.526
      25.0000     ,    1766.44   ,     ! 117.763
      25.5000     ,    1749.32   ,     ! 118.953
      26.0000     ,    1732.19   ,     ! 120.099
      26.5000     ,    1717.53   ,     ! 121.372
      27.0000     ,    1704.64   ,     ! 122.734
      27.5000     ,    1691.75   ,     ! 124.062
      28.0000     ,    1678.87   ,     ! 125.355
      28.5000     ,    1665.98   ,     ! 126.614
      29.0000     ,    1653.09   ,     ! 127.839
      29.5000     ,   1633.68   ,     ! 128.516
      30.0000     ,   1612.20   ,     ! 128.976
      30.5000     ,   1590.72   ,     ! 129.379
      31.0000     ,   1569.24   ,     ! 129.724
      31.5000     ,   1547.77   ,     ! 130.012
```

```
        32.0000     ,   1526.29    ,    ! 130.243
        32.5000     ,   1508.85    ,    ! 130.767
        33.0000     ,   1491.67    ,    ! 131.267
        33.5000     ,   1474.48   ,     ! 131.721
        34.0000     ,   1457.30   ,     ! 132.129
        34.5000     ,   1440.12   ,     ! 132.491
        35.0000     ,   1422.42   ,     ! 132.759
        35.5000     ,   1400.94   ,     ! 132.623
        36.0000     ,   1379.47   ,     ! 132.429
        36.5000     ,   1357.99   ,     ! 132.178
        37.0000     ,   1336.51   ,     ! 131.869
        37.5000     ,   1315.03   ,     ! 131.503
        38.0000     ,   1292.29   ,     ! 130.952
        38.5000     ,   1266.61   ,     ! 130.039
        39.0000     ,   1240.92   ,     ! 129.056
        39.5000     ,   1215.24   ,     ! 128.005
        40.0000     ,   1189.55   ,     ! 126.886
        40.5000     ,   1163.87   ,     ! 125.698
        41.0000     ,   1110.62   ,     ! 121.427
        41.5000     ,   1025.00   ,     ! 113.433
        42.0000     ,   939.383   ,     ! 105.211
        42.5000     ,   746.052   ,     !  84.5526
        42.8000     ,   575.000   ,     !  65.6267
 ACD   =1.1,
 CD    = .7,
 XBRCOF= .6,
   NHVALS=11,
   HVALS= 0, 8, 9, 10, 11, 12, 13, 14, 15, 16, 60,
   VOOB = 100, 100, 26, 13, 8, 5.8, 4.5, 3.7, 3, 2.4, 2,
   MAXIPR=19,
   MAXL   =  1,
   ABSPWR =6.0,
   RMS=            0,  .4,  .6,  .8, 1.0, 1.2, 1.4, 1.6, 1.8, 2.0,
                 2.2, 2.4, 2.6, 2.8, 3.0, 3.5, 4.0, 4.5, 5.0,
   VRIDE(1,1,1)=100, 100,  40,  30,  26,  23,  19,  17,  16,  14,
                  13,  12,11.5,10.9,10.4, 9.5, 8.9, 8.2,   8,
 DRAFT =,
 FORDD =,
 SAE   =,
 SAI   =,
 VFS   =,
 VSS   =,
 VSSAXP=,
 WC    =,
 NWR   =,
 WDAXP =,
 WDPTH(1)=,
 WRAT(1) =,
 WRFORD  =,
 $END
NOHGT    !1 M113A2, ADP Data from K. Grimes M113a1,changed weight
      4  !c:\vehicles\nrmmii\obsmod\m113a2.obv
NANG     !c:\vehicles\nrmmii\obsmod\obt.dat
      8  !c:\vehicles\nrmmii\obsmod\m113a2.obo
NWDTH
      3
 CLRMIN    FOOMAX    FOO       HOVALS    AVALS     WVALS
 INCHES    POUNDS    POUNDS    INCHES    RADIANS   INCHES
  17.03    2623.3      99.3      3.15      1.95      5.88
   6.50    7913.2     495.9     15.75      1.95      5.88
```

-11.27	22322.9	1376.5	33.46	1.95	5.88
-2.85	99999.9	9999.9	45.46	1.95	5.88
17.03	2623.3	105.5	3.15	2.48	5.88
6.53	6450.8	542.0	15.75	2.48	5.88
1.86	14396.2	1335.6	33.46	2.48	5.88
2.25	15099.5	1722.0	45.46	2.48	5.88
17.03	2623.3	105.5	3.15	2.69	5.88
6.32	5178.7	420.3	15.75	2.69	5.88
5.38	9056.4	1151.4	33.46	2.69	5.88
4.75	10959.3	1358.4	45.46	2.69	5.88
17.02	1823.1	90.2	3.15	2.86	5.88
9.86	4893.8	449.6	15.75	2.86	5.88
8.55	6890.9	849.8	33.46	2.86	5.88
8.55	6890.9	1022.6	45.46	2.86	5.88
18.26	1864.6	237.9	3.15	3.42	5.88
5.00	4869.9	471.2	15.75	3.42	5.88
3.04	6890.9	823.5	33.46	3.42	5.88
3.14	6890.9	1023.6	45.46	3.42	5.88
19.37	1262.6	70.0	3.15	3.60	5.88
10.26	5054.8	71.7	15.75	3.60	5.88
0.58	8925.8	819.6	33.46	3.60	5.88
-0.27	10835.6	1005.7	45.46	3.60	5.88
19.87	914.5	27.8	3.15	3.80	5.88
16.08	2884.6	-14.5	15.75	3.80	5.88
8.16	9320.6	281.0	33.46	3.80	5.88
-4.01	12744.6	693.9	45.46	3.80	5.88
20.00	650.1	24.2	3.15	4.33	5.88
19.32	1374.9	107.6	15.75	4.33	5.88
18.07	1914.7	-7.3	33.46	4.33	5.88
16.17	4146.5	295.1	45.46	4.33	5.88
17.15	1817.7	63.3	3.15	1.95	29.88
9.80	5261.6	217.5	15.75	1.95	29.88
-10.14	19206.2	1271.1	33.46	1.95	29.88
-12.29	19089.4	1126.3	45.46	1.95	29.88
17.15	1817.7	65.6	3.15	2.48	29.88
6.56	7548.8	513.7	15.75	2.48	29.88
1.95	14245.9	1674.2	33.46	2.48	29.88
3.01	14662.1	1809.8	45.46	2.48	29.88
17.15	1817.7	68.0	3.15	2.69	29.88
6.74	7764.0	752.1	15.75	2.69	29.88
5.57	8619.6	1256.0	33.46	2.69	29.88
4.95	10959.3	1454.1	45.46	2.69	29.88
17.11	1771.9	131.7	3.15	2.86	29.88
9.94	4491.0	529.6	15.75	2.86	29.88
8.67	6890.9	895.3	33.46	2.86	29.88
8.67	6890.9	1039.3	45.46	2.86	29.88
16.64	1824.4	200.6	3.15	3.42	29.88
4.84	4830.1	574.8	15.75	3.42	29.88
3.20	6890.9	880.6	33.46	3.42	29.88
3.34	6890.9	1062.3	45.46	3.42	29.88
17.77	2398.5	278.0	3.15	3.60	29.88
4.53	8178.1	707.0	15.75	3.60	29.88
-0.78	8999.6	1056.0	33.46	3.60	29.88
-1.48	10959.3	1166.0	45.46	3.60	29.88
16.89	3502.8	544.4	3.15	3.80	29.88
10.37	7489.0	439.2	15.75	3.80	29.88
-3.43	13679.5	1130.0	33.46	3.80	29.88
-6.09	51920.2	222.7	45.46	3.80	29.88
18.38	2155.6	85.2	3.15	4.33	29.88
16.16	4150.2	296.5	15.75	4.33	29.88

12.47	5242.6	758.4	33.46	4.33	29.88
10.32	4179.6	982.4	45.46	4.33	29.88
17.14	1867.1	66.1	3.15	1.95	141.60
9.43	4972.4	363.9	15.75	1.95	141.60
-7.80	19206.8	992.1	33.46	1.95	141.60
-10.61	19089.4	1020.1	45.46	1.95	141.60
17.14	1867.1	67.6	3.15	2.48	141.60
6.60	9113.5	474.4	15.75	2.48	141.60
2.39	14245.9	1338.9	33.46	2.48	141.60
3.01	14662.1	1419.6	45.46	2.48	141.60
17.14	1867.1	67.6	3.15	2.69	141.60
6.46	7876.5	677.6	15.75	2.69	141.60
5.71	8619.6	1021.7	33.46	2.69	141.60
4.95	10959.3	1226.9	45.46	2.69	141.60
17.03	1861.5	113.4	3.15	2.86	141.60
9.98	4833.2	472.3	15.75	2.86	141.60
8.67	6890.9	784.9	33.46	2.86	141.60
8.67	6890.9	922.7	45.46	2.86	141.60
17.04	1860.8	166.4	3.15	3.42	141.60
9.97	5160.3	601.0	15.75	3.42	141.60
8.59	6890.9	891.2	33.46	3.42	141.60
8.75	6890.9	984.6	45.46	3.42	141.60
17.15	2054.5	60.5	3.15	3.60	141.60
8.35	8225.1	475.4	15.75	3.60	141.60
5.60	9011.2	1177.5	33.46	3.60	141.60
5.24	10959.3	1404.6	45.46	3.60	141.60
17.15	2610.4	175.8	3.15	3.80	141.60
5.09	9704.4	696.1	15.75	3.80	141.60
2.77	13743.3	1055.6	33.46	3.80	141.60
2.15	14698.3	1671.0	45.46	3.80	141.60
17.15	2539.0	113.6	3.15	4.33	141.60
6.52	10304.1	565.5	15.75	4.33	141.60
-8.41	21212.2	1200.3	33.46	4.33	141.60
-9.99	99999.9	9999.9	45.46	4.33	141.60

M923 Vehicle File

```
M923, 6X6, 5TON TRUCK
Chassis Model: M939
Description:10 TIRES BIAS DUAL ON REAR WITH AUTOMATIC TRANSMISSION
Changed: THIS FILE HAD 225 HPNET I CHANGED IT ON 1-12-95 TO 240 HPNET
         PER THE TM 9-2320-272-10 TO 36A12-1C-441 SEPT.1982
Project: UPDATE FOR NRMMII
Date entered:8/20/91                    By: TEMPLE
File name:c:\vehicles\nrmmii\M923.DAT
MODEL:NRMMII
Description:
M923
$VEHICLE
  NAMBLY= 3,
  WGHT(1)=11020,10665,10815,
  NVUNTS =   1,
  VULEN(1)=305,  ! JANE'S 1990-91 pg.564
CGH   =51.1,
CGLAT = 0,
CGR   =86.5,
CL    =11.5,
CLRMIN(1)=11.5,11.5,11.5,
EYEHGT=92,
PBF   =32500,
PBHT  =34.2,
PFA   =48,
WDTH  =98,
  ASHOE(1) =   ,  ,
  AVGC=325,
  AXLSP(1) =152,54,
  DFLCT(1,1)=2.1,1.2,1.2,
  DFLCT(1,2)=,
  DFLCT(1,3)=,
  DFLCT(1,4)=,
  DIAW(1)  =43.6,43.6,43.6,
  GROUSH(1)=   ,  ,
  ICONST(1)=1,1,1,
  ID(1)    =0,1,1,    !0=not duals, 1=duals
  IT(1)    =0,1,1,    !0=not tandem,
  KCTIOP(1)=8*1,
  KTSFLG   =2,2,2,
  NBOGIE(1)=   ,  ,
  NCHAIN(1)=0,0,0,
  NFL(1)   =   ,  ,
  NJPSI    =1,
  NPAD(1)  =   ,  ,
  NVEH(1)  =1,1,1,
  NWHL(1)  =2,4,4,
  RDIAM(1) =20,20,20,
  RIMW(1)  =8,8,8,
  RW(1)    =   ,  ,
  SECTH(1) =9,9,9,
  SECTW(1) =11.5,11.5,11.5,
  TL=206,
  TIREID(1)='11.00X20     ',' 11.00X20    ','11.00X20     ',
  TPLY(1)  =12,12,12,
  TPSI(1,1)=40,40,40,
```

```
    TPSI(1,2)=,
    TPSI(1,3)=,
    TPSI(1,4)=,
    TRAKLN(1)=  ,  ,
    TRAKWD(1)=  ,  ,
    VTIRMX(1)=40,
    WT(1)    = 74,72,72,
    WTE(1)   =62,46.5,46.5,
  CID=  855,
  ICONV1= ,
  CONV1 =  ,  ,
  ICONV2=  ,
  CONV2 =  ,  ,
  IENGIN=  ,
  ENGINE=    ,    ,
    FD(1) =6.44,.90,
    HPNET=240,! (changed by NAP 1-12-95)TM 9-2320-272-10 TO 36A12-1C-441
              ! SEP.1982
    IB(1) =1,1,1,
    IDIESL=  1,
    IP(1) =1,1,1,
    ITVAR =  0,
    JVPSI =  1,
    LOCDIF=  1,
    LOCKUP=  1,
    NCYL  =  6,
    NENG  =  1,
    QMAX  =658,
    REVM(1) =486,476,476,
    TCASE(1)=1.0,1.0,
    TQIND =    ,
    NGR   = 10,
    TRANS= 7.46,.90,
           4.17,.90,
           3.96,.90,
           3.05,.90,
           2.92,.90,
           2.27,.90,
           1.79,.90,
           1.22,.90,
           0.93,.90,
           0.73,.90,
    IPOWER=33 ,
    POWER=   0,30567,
             1,26856,
           1.5,24291,
             2,21642,
           2.5,19291,
             3,17158,
           3.5,15234,
             4,13564,
           4.5,12263,
             5,11479,
           5.5,9416,
             6,8790,
           6.5,8233,
             7,7722,
           7.5,7228,
             8,6882,
           8.5,6692,
```

```
           9,6383,
         9.5,6055,
          10,5756,
          11,5008,
          13,4430,
          15,3715,
          17,3382,
          19,2923,
          21,2736,
          25,2160,
          29,1960,
          35,1550,
          40,1437,
          44,1225,
          50,1147,
          55,1050,
ACD    =.75,
CD     = .7,
XBRCOF= .8,
  KOHIND= 1,
  NHVALS=14,
  HVALS=         0,   5,    6,   7,    8,
                 9,  10,   11,  12,  13,
                14,  15,   16, 100,
  VOOB(1,1) =100, 100, 30.2,  14,    5,
               4.8, 4.4,  4.3, 4.2, 4.1,
                 4, 3.9,  3.8,   2,
  VOOB(1,2) =    ,
  VOOB(1,3) =    ,
  KVRIND(1)= 1,
  MAXIPR=18,
  MAXL=   1,
  RMS=             0,  .4,   .5,  .6,  .8,
                   1, 1.2,  1.4,   2, 2.2,
                 2.4, 2.6,  2.8,   3, 3.5,
                   4, 4.5,    5,
  ABSPWR(1)= 6,
  VRIDE(1,1,1)=100, 100, 19.8, 14.1, 10.6,
                 9.1, 8.4,    8,    8,  7.9,
                 7.9, 7.8,  7.8,  7.7,  7.6,
                 7.5, 7.3,  7.2,
  VRIDE(1,2,1)=,
  VRIDE(1,3,1)=,
  ABSPWR(2)=  ,
  VRIDE(1,1,2)=,
  VRIDE(1,2,2)=,
  VRIDE(1,3,2)=,
DRAFT =  ,
FORDD =30,
SAE   =34,
SAI   =34,
VFS   = 5,
VSS   =  ,
VSSAXP=  ,
WC    =  ,
NWR   =  ,
WDAXP =  ,
WDPTH(1)=  ,
WRAT(1) =  ,
WRFORD=  ,
```

```
 $END
NOHGT        !Obsmod data from K. Grimes
      3
NANG
      8
WDTH
      3
```

CLRMIN INCHES	FOOMAX POUNDS	FOO POUNDS	HOVALS INCHES	AVALS RADIANS	WVALS INCHES
11.61	7067.6	1417.6	3.15	1.95	5.88
-1.25	21225.4	2442.1	15.75	1.95	5.88
-11.94	31158.5	4122.2	33.46	1.95	5.88
11.61	7067.6	1419.0	3.15	2.48	5.88
1.55	18869.7	2231.0	15.75	2.48	5.88
-11.66	18888.8	2982.6	33.46	2.48	5.88
11.40	6581.2	1468.5	3.15	2.69	5.88
5.03	13308.3	2030.0	15.75	2.69	5.88
-11.59	13311.8	2568.2	33.46	2.69	5.88
11.61	4439.5	1420.8	3.15	2.86	5.88
6.02	8609.9	1727.5	15.75	2.86	5.88
-1.48	8348.3	2029.6	33.46	2.86	5.88
12.98	4459.1	1396.1	3.15	3.42	5.88
9.29	8746.9	1557.7	15.75	3.42	5.88
-0.47	8826.6	1833.5	33.46	3.42	5.88
13.45	6222.7	1409.1	3.15	3.60	5.88
8.92	6736.1	1630.2	15.75	3.60	5.88
-0.74	13760.8	2068.9	33.46	3.60	5.88
14.13	4698.1	1316.7	3.15	3.80	5.88
8.84	9843.5	1783.9	15.75	3.80	5.88
0.03	14430.4	1917.6	33.46	3.80	5.88
14.50	3309.2	1332.8	3.15	4.33	5.88
13.70	6249.2	1376.4	15.75	4.33	5.88
11.80	10003.6	1577.9	33.46	4.33	5.88
11.68	7540.7	1497.2	3.15	1.95	29.88
5.79	21225.4	1955.4	15.75	1.95	29.88
-12.03	31119.2	3505.2	33.46	1.95	29.88
11.68	7540.7	1501.5	3.15	2.48	29.88
6.17	15823.0	1795.2	15.75	2.48	29.88
-11.93	18825.2	2666.9	33.46	2.48	29.88
11.40	6581.2	1453.0	3.15	2.69	29.88
5.98	13285.5	1751.0	15.75	2.69	29.88
-8.78	13188.9	2349.8	33.46	2.69	29.88
12.00	4433.6	1383.3	3.15	2.86	29.88
5.97	8608.2	1714.2	15.75	2.86	29.88
1.47	7231.1	1926.5	33.46	2.86	29.88
12.97	4459.5	1394.1	3.15	3.42	29.88
9.27	8758.0	1674.0	15.75	3.42	29.88
-1.40	8824.8	1800.2	33.46	3.42	29.88
12.93	6637.3	1408.8	3.15	3.60	29.88
8.00	6476.3	1523.1	15.75	3.60	29.88
-9.06	13852.1	2291.7	33.46	3.60	29.88
12.76	6863.6	1458.3	3.15	3.80	29.88
8.82	9667.8	1595.0	15.75	3.80	29.88
-7.14	19492.6	2114.2	33.46	3.80	29.88
12.33	9927.0	2047.8	3.15	4.33	29.88
8.38	15404.2	1667.8	15.75	4.33	29.88
-7.00	25000.0	2000.0	33.46	4.33	29.88
13.12	7433.6	1417.6	3.15	1.95	141.60
7.42	19157.3	1690.2	15.75	1.95	141.60
-5.59	25843.1	2081.6	33.46	1.95	141.60

```
  13.12    7433.6    1419.4      3.15       2.48     141.60
   8.30   12105.9    1922.9     15.75       2.48     141.60
  -5.46   19542.8    2187.6     33.46       2.48     141.60
  12.94    6574.1    1392.8      3.15       2.69     141.60
   8.47   12196.6    1612.0     15.75       2.69     141.60
   1.11   13817.7    2071.4     33.46       2.69     141.60
  13.01    4440.6    1391.3      3.15       2.86     141.60
   9.54    8761.3    1555.1     15.75       2.86     141.60
   9.13    8832.9    1884.0     33.46       2.86     141.60
  12.52    4446.2    1360.1      3.15       3.42     141.60
   5.06    8760.9    1533.8     15.75       3.42     141.60
   3.53    8833.0    1832.4     33.46       3.42     141.60
  12.58    6589.4    1399.0      3.15       3.60     141.60
   5.06   12529.0    1767.1     15.75       3.60     141.60
 -12.14   13835.9    1986.1     33.46       3.60     141.60
  12.50    6700.9    1369.3      3.15       3.80     141.60
   5.02   11442.3    1712.6     15.75       3.80     141.60
 -21.26   19609.2    2345.9     33.46       3.80     141.60
  12.35    6830.2    1385.2      3.15       4.33     141.60
   4.79   19366.6    1802.6     15.75       4.33     141.60
 -20.72   30092.0    2274.2     33.46       4.33     141.60
!Linear-Feature I/P
 M923, 6X6 5 TON TRUCK
! Vehicle description:M923, 6X6 5 TON TRUCK
!
 $LFVDAT
! Over-all description:
   IVTYPE=      1, ! 1=wheeled, 2=flex-track, 3=gird-track
   IVCONF=      2, ! if wheeled; 1=4x4, 2=6x6, 3=8x8
                   ! if tracked; 1=Normal, 2=Dozer, 4=Comb. 1&2
   GVW   =  32500, ! Gross vehicle weight {lbs}
   VVCI1 =     31, ! Vehicle 1-pass VCI for fine-grained soils {RCI}
! Geometry:
VLEN   =   305, ! Over-all length {in}
VWIDTH =    98, ! Over-all width {in}
VAADEG =    34, ! Approach/departure angle {deg}
VCLR   =  20.5, ! Frame end clearance ("clearance line") {in}
VRR    =  20.6, ! Road-wheel radius (+ track-thickness if tracked) {in}
VTL    =   206, ! Front-rear ground wheel center-line distance {in}
VCGF   = 119.5, !Horizontal distance CG to front wheel center-line {in}
VCGH   =  30.5, !Vertical distance CG to front wheel center-line {in}
! Wheeled vehicle additional geometry data
   WHLGWS =   152, ! Distance between wheels of greatest span {in}
   WBCLR  =  20.5, ! Clearance between wheels of greatest span {in}
! Tracked vehicle additional data
   TRKLEN =      , ! Length of track on ground (one-side) {in}
   TRKWID =      , ! Width of one track (one-side) {in}
   TRKD   =      , ! Hull depth above end clearance line {in}
   KTPAD  =      , ! Track pad code 1=HAS-pads; 0=NO-pads
! Tracked vehicle sprocket/idler configuration for non-dozer
! (i.e. IVCONF=1,4)
RR1 =  , ! Sprocket/idler radius {in}
RR2 =  , ! Horizontal dist. road-wheel ctr. to sprocket/idler ctr. {in}
RR3 =  , ! Vertical dist. road-wheel ctr. to sprocket/idler ctr. {in}
! Swimming/fording characteristics
   VSWIM  =     0, ! Vehicle swim speed (0=NON-SWIMMER) {mph}
   VFORD  =      , ! Vehicle fording speed (pre-set to 5mph)
   DFLOAT =    30, ! Vehicle maximum fording depth {in}
 $ END
!Obsmod Data I/P
```

```
M923 6X6  11.00X20 TIRES by K. Grimes
 1 2 1 0
  28.00    0.00
 0 1 0
 1 0 1 1 0 0
 1 0 1 1 0 0
  21.80  21.80
 262.00  84.00
    .00  54.00
   0.00  11.00
   0.00 -11.00
10955.0 21545.
  51.10   0.00
 144.00  51.10    0.       0.
   0.00   0.00
 9 0
 319.00  36.70 268.00  36.70 263.00  16.50 258.00  21.50 111.00  21.50
 100.00  14.50  57.00  14.50  53.00  36.50   0.00  36.50
```

M923/M1061 Vehicle File

```
M923,w/m1061a1, 5TON TRUCK, 6X6
Project: UPDATE FOR NRMMII
Date entered:8/20/91 By: TEMPLE: trailer added 9/10/98 AMSAA
File name:m9231061.v : trailer good for WARSIM only, 45" obstacles
always avoided
Description:
M923-M1061
$VEHICLE
  NAMBLY= 5,
  WGHT(1)=11020,10665,10815,7925,7925,
  nsusp=5,
  NVUNTS =   2,
  VULEN(1)=323,242,
CGH    =51.1,
CGLAT = 0,
CGR    =86.5,
CL     =11.5,
CLRMIN(1)=11.5,11.5,11.5,14.2,14.2, ! trailer dims scaled from drawing
EYEHGT=92,
PBF    =32500,
PBHT   =34.2,
PFA    =48,
WDTH   =98,
ASHOE(1) =    ,  ,
AVGC=325,
AXLSP(1) =152,54,172.2,34, !7Sept00, trailer dims scaled from drawings
  DFLCT(1,1)=2.1,1.2,1.2,1.2,1.2      ! same tires as truck
  DFLCT(1,2)=2.1,1.2,1.2,1.2,1.2
  DFLCT(1,3)=2.1,1.2,1.2,1.2,1.2
  DFLCT(1,4)=2.1,1.2,1.2,1.2,1.2
  DIAW(1)   =43.6,43.6,43.6,43.6,43.6   ! same tires as truck
  GROUSH(1)=    ,  ,
  ICONST(1)=1,1,1,1,1,
  ID(1)     =0,1,1,0,0,
  IT(1)     =0,1,1,0,0,
  KCTIOP(1)=8*1,
  KTSFLG    =2,2,2,2,2,
  NBOGIE(1)=    ,  ,
  NCHAIN(1)=0,0,0,0,0,
  NFL(1)    =   ,  ,
  NJPSI     =  1,
  NPAD(1)   =   ,  ,
  NVEH(1)   =1,1,1,1,1,
  NWHL(1)   =2,4,4,2,2,
  RDIAM(1)  =20,20,20,20,20,
  RIMW(1)   =8,8,8,8,8,
  RW(1)     =   ,  ,
  SECTH(1)  =9,9,9,9,9,
  SECTW(1)  =11.5,11.5,11.5,11.5,11.5,
  TL=412.20,                         !7Sept00
  TIREID(1)='11.00X20',' 11.00X20','11.00X20',
  TPLY(1)   =12,12,12,12,12,
  TPSI(1,1)=40,40,40,40,40,
  TPSI(1,2)=40,40,40,40,40,
  TPSI(1,3)=40,40,40,40,40,
  TPSI(1,4)=40,40,40,40,40,
```

```
    TRAKLN(1)=  ,  ,
    TRAKWD(1)=  ,  ,
    VTIRMX(1)=40,12,75,40,
    WT(1)     = 74,72,72,72,72,
    WTE(1)    =62,46.5,46.5,46.5,46.5,
  CID=  855,
  ICONV1= ,
  CONV1 =  ,  ,
  ICONV2=  ,
  CONV2 =  ,  ,
  IENGIN=  ,
  ENGINE=    ,    ,
    FD(1) =6.44,.90,
    HPNET =225,
    IB(1) =1,1,1,
    IDIESL=  1,
    IP(1) =1,1,1,
    ITVAR =  0,
    JVPSI =  1,
    LOCDIF=  1,
    LOCKUP=  1,
    NCYL  =  6,
    NENG  =  1,
    QMAX  =658,
    REVM(1) =486,476,476,476,476,
    TCASE(1)=1.0,1.0,
    TQIND =   ,
    NGR   = 10,
    TRANS= 7.46,.90,
           4.17,.90,
           3.96,.90,
           3.05,.90,
           2.92,.90,
           2.27,.90,
           1.79,.90,
           1.22,.90,
           0.93,.90,
           0.73,.90,
    IPOWER=33 ,
    POWER=   0,30567,
             1,26856,
           1.5,24291,
             2,21642,
           2.5,19291,
             3,17158,
           3.5,15234,
             4,13564,
           4.5,12263,
             5,11479,
           5.5,9416,
             6,8790,
           6.5,8233,
             7,7722,
           7.5,7228,
             8,6882,
           8.5,6692,
             9,6383,
           9.5,6055,
            10,5756,
            11,5008,
```

```
          13,4430,
          15,3715,
          17,3382,
          19,2923,
          21,2736,
          25,2160,
          29,1960,
          35,1550,
          40,1437,
          44,1225,
          50,1147,
          55,1050,
 ACD   =.75,
 CD    = .7,
 XBRCOF= .8,
   KOHIND= 1,
   NHVALS=14,
   HVALS=  0,5,6,7,8,9,10,11,12,13,14,15,16,100,
   VOOB(1,1) =  100,100,30.2,14,5,4.8,4.4,4.3,4.2,4.1,4,3.9,3.8,2,
   VOOB(1,2) =   ,   ,   ,   ,   ,   ,   ,   ,   ,   ,   ,
   VOOB(1,3) =   ,   ,   ,   ,   ,   ,   ,   ,   ,   ,   ,
   KVRIND(1)= 1,
   MAXIPR=18,
   MAXL=   1,
   RMS= 0,.4,.5,.6,.8,1,1.2,1.4,2,2.2,2.4,2.6,2.8,3,3.5,4,4.5,5,
   ABSPWR(1)= 6,
VRIDE(1,1,1)=100,100,19.8,14.1,10.6,9.1,8.4,8,8,7.9,7.9,7.8,7.8,7.7,7.6,
7.5,7.3,7.2,
   VRIDE(1,2,1)=,
   VRIDE(1,3,1)=,
   ABSPWR(2)=  ,
   VRIDE(1,1,2)=,
   VRIDE(1,2,2)=,
   VRIDE(1,3,2)=,
 DRAFT =  ,
 FORDD =30,
 SAE   =34,
 SAI   =34,
 VFS   = 5,
 VSS   =  ,
 VSSAXP=  ,
 WC    =  ,
 NWR   =  ,
 WDAXP =  ,
 WDPTH(1)=  ,
 WRAT(1) =  ,
 WRFORD=  ,
 $END
NOHGT
      3
NANG
      8
WDTH
      3
 CLRMIN    FOOMAX    FOO       HOVALS    AVALS     WVALS
 INCHES    POUNDS    POUNDS    INCHES    RADIANS   INCHES
  11.61    7067.6    1417.6      3.15      1.95      5.88
  -1.25   21225.4    2442.1     15.75      1.95      5.88
 -11.94   31158.5    4122.2     33.46      1.95      5.88
  11.61    7067.6    1419.0      3.15      2.48      5.88
```

1.55	18869.7	2231.0	15.75	2.48	5.88
-11.66	18888.8	2982.6	33.46	2.48	5.88
11.40	6581.2	1468.5	3.15	2.69	5.88
5.03	13308.3	2030.0	15.75	2.69	5.88
-11.59	13311.8	2568.2	33.46	2.69	5.88
11.61	4439.5	1420.8	3.15	2.86	5.88
6.02	8609.9	1727.5	15.75	2.86	5.88
-1.48	8348.3	2029.6	33.46	2.86	5.88
12.98	4459.1	1396.1	3.15	3.42	5.88
9.29	8746.9	1557.7	15.75	3.42	5.88
-0.47	8826.6	1833.5	33.46	3.42	5.88
13.45	6222.7	1409.1	3.15	3.60	5.88
8.92	6736.1	1630.2	15.75	3.60	5.88
-0.74	13760.8	2068.9	33.46	3.60	5.88
14.13	4698.1	1316.7	3.15	3.80	5.88
8.84	9843.5	1783.9	15.75	3.80	5.88
0.03	14430.4	1917.6	33.46	3.80	5.88
14.50	3309.2	1332.8	3.15	4.33	5.88
13.70	6249.2	1376.4	15.75	4.33	5.88
11.80	10003.6	1577.9	33.46	4.33	5.88
11.68	7540.7	1497.2	3.15	1.95	29.88
5.79	21225.4	1955.4	15.75	1.95	29.88
-12.03	31119.2	3505.2	33.46	1.95	29.88
11.68	7540.7	1501.5	3.15	2.48	29.88
6.17	15823.0	1795.2	15.75	2.48	29.88
-11.93	18825.2	2666.9	33.46	2.48	29.88
11.40	6581.2	1453.0	3.15	2.69	29.88
5.98	13285.5	1751.0	15.75	2.69	29.88
-8.78	13188.9	2349.8	33.46	2.69	29.88
12.00	4433.6	1383.3	3.15	2.86	29.88
5.97	8608.2	1714.2	15.75	2.86	29.88
1.47	7231.1	1926.5	33.46	2.86	29.88
12.97	4459.5	1394.1	3.15	3.42	29.88
9.27	8758.0	1674.0	15.75	3.42	29.88
-1.40	8824.8	1800.2	33.46	3.42	29.88
12.93	6637.3	1408.8	3.15	3.60	29.88
8.00	6476.3	1523.1	15.75	3.60	29.88
-9.06	13852.1	2291.7	33.46	3.60	29.88
12.76	6863.6	1458.3	3.15	3.80	29.88
8.82	9667.8	1595.0	15.75	3.80	29.88
-7.14	19492.6	2114.2	33.46	3.80	29.88
12.33	9927.0	2047.8	3.15	4.33	29.88
8.38	15404.2	1667.8	15.75	4.33	29.88
-7.00	25000.0	2000.0	33.46	4.33	29.88
13.12	7433.6	1417.6	3.15	1.95	141.60
7.42	19157.3	1690.2	15.75	1.95	141.60
-5.59	25843.1	2081.6	33.46	1.95	141.60
13.12	7433.6	1419.4	3.15	2.48	141.60
8.30	12105.9	1922.9	15.75	2.48	141.60
-5.46	19542.8	2187.6	33.46	2.48	141.60
12.94	6574.1	1392.8	3.15	2.69	141.60
8.47	12196.6	1612.0	15.75	2.69	141.60
1.11	13817.7	2071.4	33.46	2.69	141.60
13.01	4440.6	1391.3	3.15	2.86	141.60
9.54	8761.3	1555.1	15.75	2.86	141.60
9.13	8832.9	1884.0	33.46	2.86	141.60
12.52	4446.2	1360.1	3.15	3.42	141.60
5.06	8760.9	1533.8	15.75	3.42	141.60
3.53	8833.0	1832.4	33.46	3.42	141.60
12.58	6589.4	1399.0	3.15	3.60	141.60

5.06	12529.0	1767.1	15.75	3.60	141.60
-12.14	13835.9	1986.1	33.46	3.60	141.60
12.50	6700.9	1369.3	3.15	3.80	141.60
5.02	11442.3	1712.6	15.75	3.80	141.60
-21.26	19609.2	2345.9	33.46	3.80	141.60
12.35	6830.2	1385.2	3.15	4.33	141.60
4.79	19366.6	1802.6	15.75	4.33	141.60
-20.72	30092.0	2274.2	33.46	4.33	141.60

Appendix C
Final Capacities

Wheeled Vehicles - High Mobility Class: M1084 Capacities, vehicles/hr

Table 1
Plains

Scenario	Road Type	Normal	Fog	Limited	Blackout
Dry-Normal	Primary	1128	862	564	300
	Secondary	824	792	564	300
	Trail	541	492	488	300
Wet-Slippery	Primary	1128	701	512	300
	Secondary	824	681	498	300
	Trail	405	390	357	300
Snow	Primary	1128	652	479	300
	Secondary	752	636	468	300
	Trail	705	540	400	300

Table 2
Hills

Scenario	Road Type	Normal	Fog	Limited	Blackout
Dry-Normal	Primary	1128	857	564	300
	Secondary	735	733	564	300
	Trail	433	414	357	300
Wet-Slippery	Primary	1128	694	507	300
	Secondary	735	669	491	300
	Trail	340	333	297	300
Snow	Primary	1041	645	473	300
	Secondary	653	625	459	300
	Trail	598	506	377	300

Table 3
Mountains

Scenario	Road Type	Normal	Fog	Limited	Blackout
Dry-Normal	Primary	934	846	564	300
	Secondary	612	565	560	300
	Trail	333	328	297	300
Wet-Slippery	Primary	934	679	497	300
	Secondary	612	560	476	300
	Trail	270	268	256	300
Snow	Primary	801	626	460	300
	Secondary	576	512	443	300
	Trail	427	335	311	300

Wheeled Vehicles - Medium Mobility Class: M985
Capacities, vehicles/hr

Table 4
Plains

Scenario	Road Type	Normal	Fog	Limited	Blackout
Dry-Normal	Primary	1085	795	542	276
	Secondary	768	745	542	276
	Trail	463	435	422	276
Wet-Slippery	Primary	1085	648	472	276
	Secondary	768	628	459	276
	Trail	381	369	351	276
Snow	Primary	1049	591	433	276
	Secondary	679	576	423	276
	Trail	326	326	326	276

Table 5
Hills

Scenario	Road Type	Normal	Fog	Limited	Blackout
Dry-Normal	Primary	1039	791	542	276
	Secondary	655	651	542	276
	Trail	406	392	354	276
Wet-Slippery	Primary	1039	642	468	276
	Secondary	655	618	452	276
	Trail	341	331	306	276
Snow	Primary	890	584	429	276
	Secondary	594	538	415	276
	Trail	326	326	326	276

Table 6
Mountains

Scenario	Road Type	Normal	Fog	Limited	Blackout
Dry-Normal	Primary	824	780	542	276
	Secondary	549	475	468	276
	Trail	333	326	296	276
Wet-Slippery	Primary	824	626	458	276
	Secondary	549	472	439	276
	Trail	268	263	248	276
Snow	Primary	746	566	416	276
	Secondary	519	452	399	276
	Trail	311	311	309	276

Wheeled Vehicles - Low Mobility Class: M917
Capacities, vehicles/hr

Table 7
Plains

Scenario	Road Type	Normal	Fog	Limited	Blackout
Dry-Normal	Primary	1011	696	504	288
	Secondary	617	534	493	288
	Trail	326	318	285	288
Wet-Slippery	Primary	1011	560	411	288
	Secondary	617	512	395	288
	Trail	219	218	216	288
Snow	Primary	899	505	374	288
	Secondary	564	473	361	288
	Trail	464	415	310	288

Table 8
Hills

Scenario	Road Type	Normal	Fog	Limited	Blackout
Dry-Normal	Primary	894	691	501	288
	Secondary	544	468	467	289
	Trail	273	269	255	288
Wet-Slippery	Primary	864	553	407	288
	Secondary	544	467	386	289
	Trail	194	194	192	288
Snow	Primary	801	498	369	288
	Secondary	483	413	351	289
	Trail	385	311	282	288

Table 9
Mountains

Scenario	Road Type	Normal	Fog	Limited	Blackout
Dry-Normal	Primary	660	629	492	288
	Secondary	428	373	337	288
	Trail	222	219	214	289
Wet-Slippery	Primary	660	534	392	288
	Secondary	428	340	333	288
	Trail	152	151	150	248
Snow	Primary	593	474	352	288
	Secondary	391	314	310	288
	Trail	267	233	206	247

Tows - High Mobility Class: M1084/M1095
Capacities, vehicles/hr

Table 10
Plains

Scenario	Road Type	Normal	Fog	Limited	Blackout
Dry-Normal	Primary	957	816	535	268
	Secondary	590	529	504	268
	Trail	294	295	282	268
Wet-Slippery	Primary	957	663	485	268
	Secondary	590	520	471	268
	Trail	230	231	228	268
Snow	Primary	783	616	452	268
	Secondary	522	453	435	268
	Trail	496	390	378	268

Table 11
Hills

Scenario	Road Type	Normal	Fog	Limited	Blackout
Dry-Normal	Primary	799	751	535	268
	Secondary	505	454	425	268
	Trail	247	248	241	268
Wet-Slippery	Primary	799	657	480	268
	Secondary	505	426	425	268
	Trail	191	194	192	268
Snow	Primary	715	609	448	268
	Secondary	421	360	343	268
	Trail	348	294	253	268

Table 12
Mountains

Scenario	Road Type	Normal	Fog	Limited	Blackout
Dry-Normal	Primary	611	572	536	268
	Secondary	370	351	301	268
	Trail	193	193	191	268
Wet-Slippery	Primary	611	559	470	268
	Secondary	370	333	288	268
	Trail	136	136	135	217
Snow	Primary	567	504	435	268
	Secondary	336	307	271	268
	Trail	226	212	197	268

Tows - Medium Mobility Class: M985/M989
Capacities, vehicles/hr

Table 13
Plains

Scenario	Road Type	Normal	Fog	Limited	Blackout
Dry-Normal	Primary	790	620	450	235
	Secondary	519	437	419	235
	Trail	306	299	272	235
Wet-Slippery	Primary	790	498	366	235
	Secondary	519	427	352	235
	Trail	216	214	209	235
Snow	Primary	738	463	343	235
	Secondary	484	408	332	235
	Trail	455	367	276	235

Table 14
Hills

Scenario	Road Type	Normal	Fog	Limited	Blackout
Dry-Normal	Primary	740	615	445	235
	Secondary	452	392	391	235
	Trail	251	247	235	235
Wet-Slippery	Primary	740	491	362	235
	Secondary	452	391	344	235
	Trail	175	174	171	235
Snow	Primary	660	457	338	235
	Secondary	422	375	323	235
	Trail	364	282	251	235

Table 15
Mountains

Scenario	Road Type	Normal	Fog	Limited	Blackout
Dry-Normal	Primary	550	476	438	235
	Secondary	380	341	309	235
	Trail	185	183	179	235
Wet-Slippery	Primary	550	459	350	235
	Secondary	380	312	307	235
	Trail	124	123	122	189
Snow	Primary	510	424	324	235
	Secondary	358	298	294	235
	Trail	241	209	185	201

Tows - Low Mobility Class: M911/M747
Capacities, vehicles/hr

Table 16
Plains

Scenario	Road Type	Normal	Fog	Limited	Blackout
Dry-Normal	Primary	503	469	414	209
	Secondary	268	265	241	209
	Trail	128	128	128	196
Wet-Slippery	Primary	503	434	413	209
	Secondary	268	259	240	209
	Trail	73	73	73	130
Snow	Primary	425	372	362	209
	Secondary	231	226	214	209
	Trail	197	192	185	209

Table 17
Hills

Scenario	Road Type	Normal	Fog	Limited	Blackout
Dry-Normal	Primary	457	433	357	209
	Secondary	211	210	203	209
	Trail	106	106	106	168
Wet-Slippery	Primary	457	397	356	209
	Secondary	211	208	203	209
	Trail	73	73	73	130
Snow	Primary	374	335	295	209
	Secondary	190	188	184	209
	Trail	148	145	142	188

Table 18
Mountains

Scenario	Road Type	Normal	Fog	Limited	Blackout
Dry-Normal	Primary	317	306	261	209
	Secondary	176	175	171	209
	Trail	86	85	85	143
Wet-Slippery	Primary	317	290	260	209
	Secondary	176	174	171	209
	Trail	73	73	73	130
Snow	Primary	266	248	225	209
	Secondary	160	158	156	209
	Trail	95	94	94	145

Tracked Vehicles - High Mobility Class: M1A1
Capacities, vehicles/hr

Table 19
Plains

Scenario	Road Type	Normal	Fog	Limited	Blackout
Dry-Normal	Primary	1123	627	442	298
	Secondary	790	619	437	298
	Trail	621	587	458	298
Wet-Slippery	Primary	1123	519	374	298
	Secondary	790	503	364	298
	Trail	514	469	418	298
Snow	Primary	1085	505	364	298
	Secondary	772	493	356	298
	Trail	644	430	314	298

Table 20
Hills

Scenario	Road Type	Normal	Fog	Limited	Blackout
Dry-Normal	Primary	1044	624	441	298
	Secondary	712	613	434	298
	Trail	541	471	451	298
Wet-Slippery	Primary	1044	514	373	298
	Secondary	712	498	359	298
	Trail	462	416	410	298
Snow	Primary	1012	500	361	298
	Secondary	692	485	351	298
	Trail	572	409	301	298

Table 21
Mountains

Scenario	Road Type	Normal	Fog	Limited	Blackout
Dry-Normal	Primary	862	617	436	298
	Secondary	618	575	428	298
	Trail	456	393	388	298
Wet-Slippery	Primary	862	503	363	298
	Secondary	618	481	349	298
	Trail	398	346	345	298
Snow	Primary	802	487	353	298
	Secondary	606	470	341	298
	Trail	449	361	273	283

Tracked Vehicles - Medium Mobility Class: M88A1
Capacities, vehicles/hr

Table 22
Plains

Scenario	Road Type	Normal	Fog	Limited	Blackout
Dry-Normal	Primary	750	732	539	295
	Secondary	472	472	461	295
	Trail	376	376	350	295
Wet-Slippery	Primary	750	732	539	295
	Secondary	472	472	461	295
	Trail	336	336	324	295
Snow	Primary	722	722	560	295
	Secondary	447	447	439	295
	Trail	391	378	350	295

Table 23
Hills

Scenario	Road Type	Normal	Fog	Limited	Blackout
Dry-Normal	Primary	696	695	533	295
	Secondary	416	411	405	295
	Trail	345	345	318	295
Wet-Slippery	Primary	696	695	533	295
	Secondary	416	411	405	295
	Trail	278	278	269	295
Snow	Primary	648	648	557	295
	Secondary	404	403	381	295
	Trail	352	344	316	295

Table 24
Mountains

Scenario	Road Type	Normal	Fog	Limited	Blackout
Dry-Normal	Primary	501	501	489	295
	Secondary	382	378	353	295
	Trail	263	263	254	295
Wet-Slippery	Primary	501	501	489	295
	Secondary	382	378	353	295
	Trail	226	226	222	295
Snow	Primary	476	476	468	295
	Secondary	377	376	350	295
	Trail	266	262	244	295

Tracked Vehicles - Low Mobility Class: AVLB Capacities, vehicles/hr

Table 25
Plains

Scenario	Road Type	Normal	Fog	Limited	Blackout
Dry-Normal	Primary	591	515	375	267
	Secondary	418	384	363	267
	Trail	315	301	286	267
Wet-Slippery	Primary	591	515	375	267
	Secondary	418	384	363	267
	Trail	264	261	248	267
Snow	Primary	558	530	385	267
	Secondary	402	368	358	267
	Trail	345	345	295	267

Table 26
Hills

Scenario	Road Type	Normal	Fog	Limited	Blackout
Dry-Normal	Primary	537	508	373	267
	Secondary	375	335	334	267
	Trail	277	269	244	267
Wet-Slippery	Primary	537	508	373	267
	Secondary	375	335	334	267
	Trail	233	231	218	267
Snow	Primary	500	480	380	267
	Secondary	360	321	321	267
	Trail	294	294	250	267

Table 27
Mountains

Scenario	Road Type	Normal	Fog	Limited	Blackout
Dry-Normal	Primary	432	404	362	267
	Secondary	328	293	285	267
	Trail	225	221	208	267
Wet-Slippery	Primary	432	404	362	267
	Secondary	328	293	285	267
	Trail	194	193	187	267
Snow	Primary	417	387	373	267
	Secondary	317	292	277	267
	Trail	225	225	193	267

Amphibious Wheeled Vehicles: LAV3 Capacities, vehicles/hr

Table 28
Plains

Scenario	Road Type	Normal	Fog	Limited	Blackout
Dry-Normal	Primary	1147	609	439	310
	Secondary	829	592	428	310
	Trail	555	519	445	310
Wet-Slippery	Primary	1147	587	426	310
	Secondary	829	569	413	310
	Trail	450	430	428	310
Snow	Primary	1147	542	395	310
	Secondary	801	526	386	310
	Trail	751	455	335	310

Table 29
Hills

Scenario	Road Type	Normal	Fog	Limited	Blackout
Dry-Normal	Primary	1147	603	436	310
	Secondary	769	584	422	310
	Trail	456	431	426	310
Wet-Slippery	Primary	1147	582	421	310
	Secondary	769	562	403	310
	Trail	377	338	331	310
Snow	Primary	1128	537	391	310
	Secondary	715	515	379	310
	Trail	598	427	317	310

Table 30
Mountains

Scenario	Road Type	Normal	Fog	Limited	Blackout
Dry-Normal	Primary	994	591	428	310
	Secondary	605	535	413	310
	Trail	382	343	329	310
Wet-Slippery	Primary	994	569	413	310
	Secondary	605	534	396	310
	Trail	311	301	272	310
Snow	Primary	842	517	380	310
	Secondary	588	491	367	310
	Trail	459	367	281	305

Amphibious Tracked Vehicles: M113A2
Capacities, vehicles/hr

Table 31
Plains

Scenario	Road Type	Normal	Fog	Limited	Blackout
Dry-Normal	Primary	757	727	551	335
	Secondary	634	618	541	335
	Trail	461	424	407	335
Wet-Slippery	Primary	757	680	496	335
	Secondary	634	616	481	335
	Trail	357	352	331	335
Snow	Primary	675	670	505	335
	Secondary	573	551	495	335
	Trail	536	486	416	335

Table 32
Hills

Scenario	Road Type	Normal	Fog	Limited	Blackout
Dry-Normal	Primary	722	692	548	335
	Secondary	590	559	535	335
	Trail	383	368	331	335
Wet-Slippery	Primary	722	675	491	335
	Secondary	590	559	474	335
	Trail	337	334	317	335
Snow	Primary	663	649	502	335
	Secondary	518	482	483	335
	Trail	401	334	315	335

Table 33
Mountains

Scenario	Road Type	Normal	Fog	Limited	Blackout
Dry-Normal	Primary	646	637	540	335
	Secondary	441	393	353	335
	Trail	339	332	309	335
Wet-Slippery	Primary	646	636	480	335
	Secondary	441	371	351	335
	Trail	301	298	287	335
Snow	Primary	602	583	490	335
	Secondary	405	364	342	335
	Trail	329	300	278	335

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14. ABSTRACT

The Mobility Systems Branch (MSB) has a long history of providing Tactical Decision Aids (TDA) for military planning systems and ground movement algorithms for Modeling and Simulation (M&S). These TDA and M&S algorithms are based on the NATO Reference Mobility Model (NRMM), which is an Army Model and Simulation Office (AMSO) standard for ground vehicle movement. There is currently a need to characterize vehicle pass rates in M&S as well as for planning and operations in the Army and Department of Defense (DoD). In particular, the theater-level Joint Warfare Simulations (JWARS) model has a requirement to represent ground movement in terms of a vehicular pass rate through an area. These pass rates are assigned to edges which are connected by nodes to form a movement network. Each edge may be required to represent several roads as a result of the large terrain areas that a theater-level model must accommodate. The MSB was tasked to provide vehicle pass rates and software to aggregate the roads provided in the Compact Terrain Data Base (CTDB) into a simpler network.

(Continued)

15. SUBJECT TERMS

Classical thinning	Logistics	Road profiles
Infrastructure	Movement	Theater level modeling and simulation
	Road capacity	Transportation network

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14. ABSTRACT

The purpose of this report was to present the methodology and results of a process which categorizes the transportation network and the derivation of the associated pass rates for convoys of vehicles. The first part of the report describes the process of deriving the pass rates and average speeds for vehicle convoys. Then the methodology for categorizing and aggregating the transportation network is presented. This software has been developed to generate the movement network for JWARS.

Based on the results of this investigation, the following conclusions can be drawn:

a. An overall methodology to represent ground vehicle movement across a theater has been developed based on the NRMM.
b. A network aggregation methodology was developed to simplify representation of movement and retain capacity characteristics within a theater of operations.
c. Estimates of pass rates were generated based on readily available data for a synthetic natural environment.