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DREDGED MATERIAL RESEARCH PROGRAM

TECHNICAL REPORT D-77-1

LOW-GROUND-PRESSURE CONSTRUCTION EQUIPMENT FOR USE IN DREDGED MATERIAL CONTAINMENT AREA OPERATION AND MAINTENANCE - EQUIPMENT INVENTORY

by

Charles E. Green, Adam A. Rula

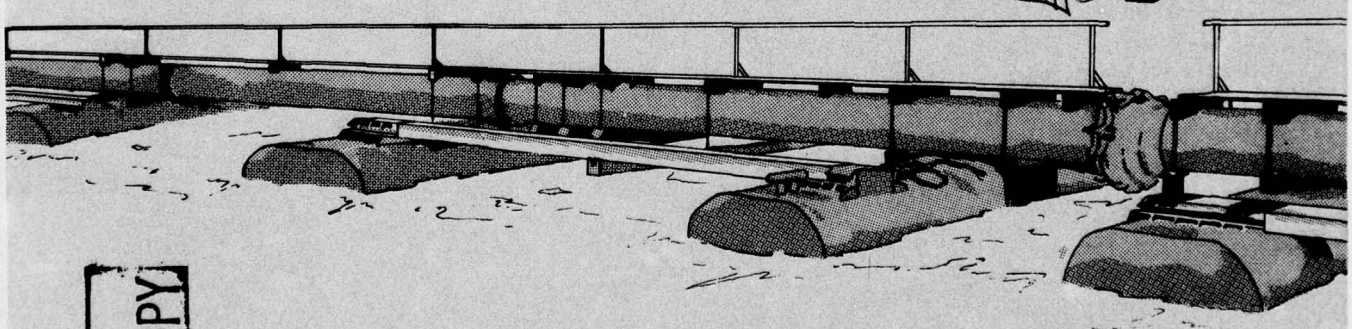
Mobility and Environmental Systems Laboratory
U. S. Army Engineer Waterways Experiment Station
P. O. Box 631, Vicksburg, Miss. 39180

April 1977
Final Report

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Under DMRP Work Unit No. 2C09A

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SUBJECT: Transmittal of Technical Report D-77-1

TO: All Report Recipients

1. The technical report transmitted herewith represents the results of one of the research efforts (work units) initiated to date as part of Task 2C (Containment Area Operations) of the Corps of Engineers Dredged Material Research Program (DMRP). Task 2C is included as part of the Disposal Operations Project (DOP) of the DMRP, which among other considerations includes research into various ways of improving the efficiency and acceptability of facilities for confining dredged material on land.

2. Confining dredged material on land is a relatively recent disposal alternative to which practically no specific design or construction improvement investigations, much less applied research, have been addressed. Being a form of waste product disposal, dredged material placement on land has seldom been evaluated on other than purely economic grounds with an emphasis nearly always on lowest possible cost. There has been a dramatic increase in the last several years in the amount of land disposal necessitated by confining dredged material; hence increased attention is being directed toward improving the design, construction, and management of these containment areas.

3. DMRP work units have investigated or are currently investigating improved facility design, construction, and management for increasing facility storage capacities with both economic and environmental protection benefits. Work in and around containment areas usually requires special equipment because of the soft dredged material and foundation conditions usually associated with such areas. Consequently the total picture would be incomplete without an assessment of vehicles or equipment that can perform productive work in containment areas. To this end, the investigation reported herein was accomplished by the U. S. Army Engineer Waterways Experiment Station's Mobility and Environmental Systems Laboratory. This is the first of three studies that will provide guidance for the selection of equipment for use in and around containment areas.

4. Sixty vehicles were evaluated analytically to determine their capabilities for operating in and around confined dredged material disposal areas. The results discuss the state-of-the-art vehicles that are commercially available or have undergone recent military testing and that can operate in soft soils. The vehicles are divided into six payload classes that indirectly reflect the size of the job that the vehicles or equipment may be expected to perform. Vehicle performance is expressed in terms of "go," "no go," and traction capability on five selected soil strengths to cover the range of soil strengths measured in several dredged material disposal areas. Pertinent data are presented in catalog form for each of the vehicles. Data presented include photographs or drawings, manufacturer, general vehicle data under which performance data can be found, mechanical data that include dimensions or description of major components of the vehicle, and miscellaneous data under which such information as cost (1974) and primary uses are found. The limitations of the method used to compute vehicle performance are also discussed.

5. Caution should be exercised in selecting vehicles for use in borderline situations. The performance of the vehicles was determined analytically and the vehicles have not been field evaluated in dredged material containment areas. A second phase of the vehicle performance study (now underway) is evaluating the performance of various vehicles and identifying in more detail the operational environment and functions under which they must perform. A third report in this series will provide detailed guidance on the selection of equipment to be used in and around confined disposal areas.

JOHN L. CANNON
Colonel, Corps of Engineers
Commander and Director

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Sixty vehicles were evaluated to determine their capabilities for operating in and around confined dredged material disposal areas. The results represent the state of the art of vehicles that are commercially available or have undergone recent military testing and that can operate in soft soils. The vehicles were divided into six payload classes that indirectly reflect the size of the job that the vehicle or equipment may be expected to perform. Vehicle performance was expressed in terms of go-no go and (Continued)

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20. ABSTRACT (Continued).

traction capability on five selected soil strengths that cover the range of soil strengths measured in several dredged material disposal containment areas that are believed representative of many operational environments.

The soils data revealed that the operational environment of confined dredged material disposal areas can be highly variable within a given site in terms of type of material, profile strength, presence of surface and subsurface water, and vegetal cover. These factors combine to present a very harsh operational environment for vehicles or equipment.

A comparison of the computed soil strength requirements for the vehicles operating in fine-grained soils with measured soil strength data indicated that commercially available vehicles in the six categories considered can operate in all except the lowest soil strength units established.

It is suggested that before the concept of using low-ground-pressure construction equipment for dredged material containment area operations can be applied with a higher level of confidence, other studies should be conducted to identify specific missions or jobs to be performed. These should identify measures of performance, evaluate current automotive and mobility technology and focus on subject problems by modification and refinement as required, describe the operational environment in engineering terms, validate performance predictions, and develop an analytical framework to account for the pertinent construction equipment-operational environment interactions. This technological base can then be used to prepare sound equipment performance criteria and/or specifications, evaluate testable specifications in quantitative terms, and design new equipment with confidence.

Appendix A presents the methods used for computing soft-soil vehicle performance in some detail, with appropriate examples. Appendix B presents the effects of vehicle buoyancy in soft soil on the determination of the minimum soil strength required for travel. These appendixes were reproduced in microfiche and are enclosed in an envelope in the back cover of this report.

Appendix C presents pertinent vehicle data in catalog form: several photographs or drawings, manufacturer, general vehicle data under which performance data can be found, mechanical data that include dimensions or description of major components of the vehicle, and miscellaneous data under which such information as cost (1974) and primary use is found. The limitations of the methods used to compute vehicle performance are discussed.

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PREFACE

The study reported herein was performed by personnel of the Mobility Systems Division (MSD), Mobility and Environmental Systems Laboratory (MESL), U. S. Army Engineer Waterways Experiment Station (WES), for the Office of Dredged Material Research (ODMR),* WES, as part of the overall Dredged Material Research Program sponsored by Office, Chief of Engineers, under Task 2C, "Containment Area Operations," of the Disposal Operations Project (DOP).

The study was performed during January-June 1974 under the direct supervision of Mr. Edgar S. Rush, Chief, Mobility Investigations Branch (MIB), MSD, and under the general supervision of Messrs. Adam A. Rula, Chief, MSD, and Woodland G. Shockley, Chief, MESL. The study plan was developed and executed by Mr. Charles E. Green, MIB, in cooperation with supervisory personnel of MSD. Messrs. Green and Rula prepared the report.

The study was conducted under the direction of Dr. John Harrison, Chief, EEL; Mr. Charles C. Calhoun, Jr., Manager, DOP; and Mr. Newton C. Baker, Manager, Task 2C. The study was monitored by Mr. Dale A. Goss, EEL.

Directors of WES during the study and preparation and publication of the report were COL G. H. Hilt, CE, and COL J. L. Cannon, CE. Technical Director was Mr. F. R. Brown.

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* ODMR became part of the Environmental Effects Laboratory (EEL) in July 1974.

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CONVERSION FACTORS, U. S. CUSTOMARY TO METRIC (SI)
UNITS OF MEASUREMENT

U. S. customary units of measurement used in this report can be converted to metric (SI) units as follows:

Multiply	By	To Obtain
inches	2.54	centimetres
feet	0.3048	metres
miles (U. S. statute)	1.6093	kilometres
square inches	6.4516	square centimetres
cubic feet	0.0283	cubic metres
cubic yards	0.7646	cubic metres
pounds (mass)	0.45359	kilograms
tons (2000 lb)	0.90718	metric tons
pounds (force)	4.448222	newtons
kips	4448.222	newtons
pounds per square inch	6.8948	kilopascals
pounds per cubic foot	0.2714	meganewtons per cubic metre
miles per hour (U. S. statute)	1.609344	kilometres per hour
horsepower	9809.50	watts
degrees	0.01745329	radians

LOW-GROUND-PRESSURE CONSTRUCTION EQUIPMENT FOR USE IN DREDGED MATERIAL CONTAINMENT AREA OPERATION AND MAINTENANCE — EQUIPMENT INVENTORY

PART I: INTRODUCTION

Background

1. The U. S. Army Engineer Waterways Experiment Station (WES) is conducting a comprehensive, nationwide research program on the disposal of dredged material for the Office, Chief of Engineers. The objectives of the Dredged Material Research Program (DMRP) are to provide definitive information on the environmental effects of dredging and dredged material disposal operations in all environmental situations and to develop technically satisfactory, environmentally compatible, and economically feasible dredging and disposal alternatives, including consideration of dredged material as a manageable resource.

2. In recent years, the Corps of Engineers has dredged or contracted for the dredging of an annual average of 380,000,000 cu yd* of sediment from the Nation's waterways and harbors. In over 200 active dredging projects, confined disposal facilities built on land, in marshes, or in shallow water are relied upon in whole or in part for the disposal of dredged material. The total annual quantity of dredged material being placed in confined disposal areas solely from maintenance dredging activities is about 67,000,000 cu yd.

3. The primary function of a dredged material containment facility is to retain the solids from the dredged inflow. The constituents and consistency of the dredged material may vary widely, depending on the source materials and dredging techniques or equipment employed. The materials most commonly dredged for maintaining navigable waterways and harbors are fine-grained soils (clay and silt) and coarse-grained soils

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* A table of factors for converting U. S. customary units of measurement to metric (SI) units is presented on page 4.

(sand); in industrial areas, the dredged material may also contain various amounts of industrial waste.

4. Generally, containment areas are in low-lying, wet environments that have a poor potential for industrial development. Such environments provide challenging problems that require unique engineering solutions in the design and construction of containment areas. Also, the high water content of fine-grained material pumped into the containment areas makes operating and maintaining the areas very difficult. The investigation of the use of low-ground-pressure construction equipment for dredged material containment area operation and maintenance is one phase of the DMRP.

Purpose

5. The overall purpose of this study was to determine whether low-ground-pressure vehicles, commercial and/or military, have the potential for improving current methods of operation and maintenance of confined dredged material containment areas and their associated facilities.

6. The specific purposes were to inventory available low-ground-pressure vehicles; prepare a catalog of selected vehicles that have the potential for performing useful tasks in dredged material containment areas, together with relevant vehicle data; and assess, using techniques previously developed by the Mobility and Environmental Systems Laboratory, the capabilities of the selected vehicles.

Scope

7. A limited field data-collection program (Part II) was conducted to determine the magnitude of the stress level that the environment of dredged material containment areas may produce on ground-crawling equipment operating in these areas. Five dredged material containment areas were sampled and the soil characteristics described by the

cone index/rating cone index (CI/RCI*) system, which has been used for many years in soil trafficability work for military purposes. A literature search, personal contact with vehicle manufacturers, and expected operational environments established the limits of the vehicle inventory. A vehicle catalog was compiled that included commercially available vehicles and some standard and experimental military vehicles that have the potential for operating in dredged material environments. It does not include major equipment modifications or prototype equipment development. Each vehicle was described by a photograph, a listing of vehicle data, its cost (1974), availability, and potential uses. Vehicle performance was assessed (Part III) on the basis of a vehicle's ability to complete a prescribed number of passes in straight-line travel and to develop excess traction (drawbar pull) for arbitrarily selected soil strengths covering the lower range of soil strengths (CI <30) measured in the dredged material containment areas. The pertinent vehicle and soil characteristics were used to assess the soft-soil performance capabilities of each vehicle by using elements of the U. S. Army Materiel Command ground mobility analytical model, called AMC-71.[1,2]

8. A description of AMC-71 and the methods used for computing soft-soil vehicle performance are presented in some detail, along with appropriate examples, in Appendix A. Appendix B discusses the effects of vehicle buoyancy in soft soil on the determination of the minimum soil strength required for travel. (Appendixes A and B were reproduced in microfiche and are enclosed in the back cover of this report.) The vehicle catalog is presented in Appendix C.

Definitions

9. Certain definitions used in this report are defined below.

   a. Critical layer. The layer of soil that is most pertinent to establishing relations between soil strength and vehicle performance. For a 50-pass performance in fine-grained soil and remoldable sand, it is usually the 6- to 12-in. layer; however, it varies with weight and type of

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* For convenience, symbols and unusual abbreviations are listed and defined in the Notation (Appendix D).

vehicle and with soil strength profile. For 1-pass performance, it is usually closer to the surface.

b. Fine-grained soil. A soil of which more than 50 percent of the grains by weight will pass a No. 200 sieve (smaller than 0.74 mm in diameter).

c. Coarse-grained soil. A soil of which more than 50 percent of the grains by weight will be retained on a No. 200 sieve.

d. Sand. A coarse-grained soil with the greater percentage of the coarse portion (larger than 0.74 mm) passing the No. 4 sieve (4.76 mm).

e. Remoldable sand. A sand that contains some fines and is slow-draining when wet. Such sand behaves similarly to wet, fine-grained soil under vehicular traffic.

f. Cone index (CI). An index of the shearing resistance of a medium as measured at any depth by a cone penetrometer. The resistance of the medium to penetration by a 30-deg cone with a 0.5-sq-in. circular base is expressed in pounds of force on the handle per square inch of the base area. In the basic WES-VCI system, the CI is considered as an index only and no direct meaning is assigned to its dimensions.

g. Remolding index (RI). A ratio that expresses the proportion of original strength of a medium that will remain under a moving vehicle. The ratio is determined from CI measurements made before and after remolding a 6-in.-long sample with special apparatus.

h. Rating cone index (RCI). The product of the measured CI and the RI of the same layer.

i. Mobility index (MI). A dimensionless number that results from a consideration of certain vehicle characteristics.

j. Vehicle cone index (VCI). The minimum soil strength in the critical soil layer in terms of RCI for fine-grained soils and CI for coarse-grained soils required for a specified number of passes of a vehicle, usually 1 pass or 50 passes.

k. VCI_{50}. Experimentally determined minimum RCI of the critical layer required for a vehicle to complete 50 passes in a fine-grained soil. VCI_{50} can also be computed for a given vehicle by first calculating an MI from selected vehicle characteristics and then converting the MI to VCI_{50} by means of a curve or table.

l. VCI_1. Experimentally determined minimum CI or RCI of the critical layer required for a vehicle to complete one pass. VCI_1 can also be computed for a given vehicle by

first calculating an MI from selected vehicle characteristics and then converting the MI to VCI_1 by means of a curve or table. The 1-pass critical layer for most vehicles is usually the 0- to 6-in. layer.

PART II: COLLECTION OF DATA FROM REPRESENTATIVE DREDGED MATERIAL CONTAINMENT AREAS

10. Pertinent data, as discussed below, were collected at five dredged material containment areas that had a high probability of offering a range in operational difficulty (see paragraph 7). The areas were selected by personnel of the Environmental Effects Laboratory, WES, as being representative of Corps of Engineers dredged material containment areas presenting significant problems for vehicular traffic. Criteria for selection were primarily type and consistency of dredged material. The five areas are in three Corps of Engineers Districts--three in the Mobile District and one each in the Savannah and the Norfolk Districts.

Data Collected and Procedures Used

11. Sufficient data were collected to describe the areas for mobility purposes. The surface condition was described in terms of the presence or absence of surface water and vegetation cover. Photographs were taken to show the surface conditions at the time of the data collection.

12. Schematic maps of the areas were prepared delineating boundaries of surface water and soil class (fine- or coarse-grained soil). Air photo and field reconnaissance techniques were used in establishing map unit boundaries and locating sites for sampling.

13. Each site was delineated on the basis of soil class and the soil strength range that might be encountered in the area. Ten sets of cone penetrometer readings were made in the vicinity of each site. Each set of readings consisted of cone index measurements made at the surface (in the case of surface free water, surface readings were made at the soil surface), at 1-in. vertical increments to a depth of 6 in., then at 3-in. vertical increments to a depth of 18 in., and finally at 6-in. vertical increments to a depth of 36 in. Representative bulk samples were taken from the 0- to 12-in. depth at each site for

laboratory determination of soil type according to the Unified Soil Classification System (USCS).[3]

14. In the field, it was discovered that the strength profiles of dredged material were highly variable because of type of material, surface cover, and surface water and groundwater conditions. Because of the variation in soil strength profiles and the abundance of surface water or groundwater available for potential mixing with the soil by the running gear of the vehicle, assumptions 3.a.1 and 3.a.2 (paragraph 3, Appendix A) are invalid. Therefore, CI (instead of RCI) is used in this study to describe soil strength regardless of class of soil material.

Description of Areas

15. The dredged material containment areas are described and soil conditions are discussed in the following paragraphs. The soil data are listed in Table 1.

Mobile District

16. The three dredged material containment areas that were visited in the Mobile District are identified as Blakeley Island, Pinto Island, and McDuffie Island areas. Their general location is shown on the map in Figure 1.

17. Blakeley Island area. This area is approximately 2 miles northeast of Mobile on the east side of the Mobile River and north of the Cochrane Bridge. Six sites were selected for sampling in this area. Their locations and surface water and soil class boundaries are given in Figure 2. At the time of the visit (May 1974), the containment area was bare of vegetation, and approximately 40 percent was covered with surface water. General views of the area are given in Figure 3.

18. About 15 percent of the area (southwest section) was identified as coarse-grained soil composed of a poorly graded sand (SP), and the remainder as fine-grained soil composed of fat clay (CH) and silty clay (MH). The CI measurements for the two SP sites (1 and 4) gave two widely different averages (see Table 1). Site 4 was representative of a wet SP material, but the CI of site 1 was extremely low. At the time

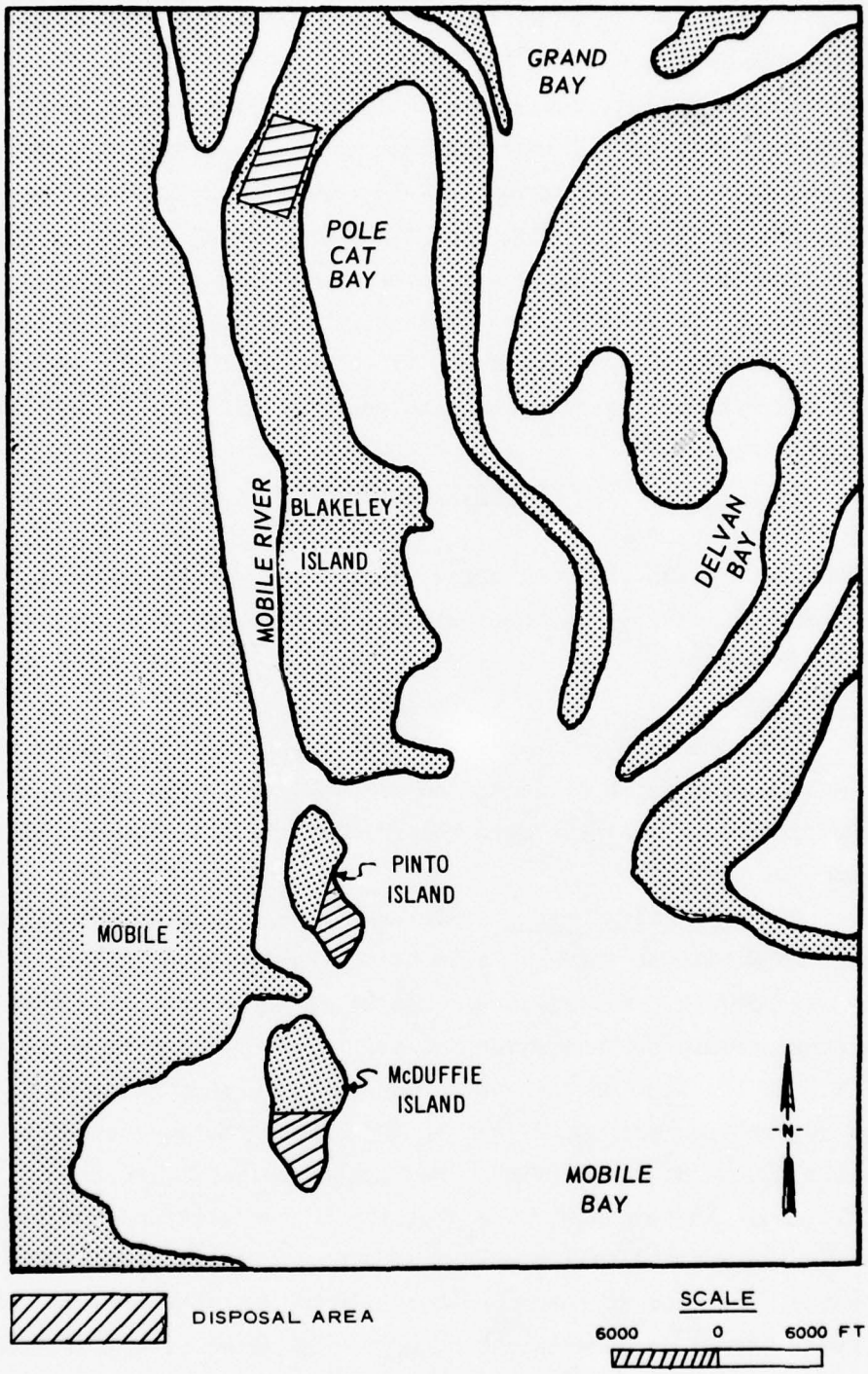


Figure 1. Vicinity map of the dredged material containment areas near Mobile, Alabama

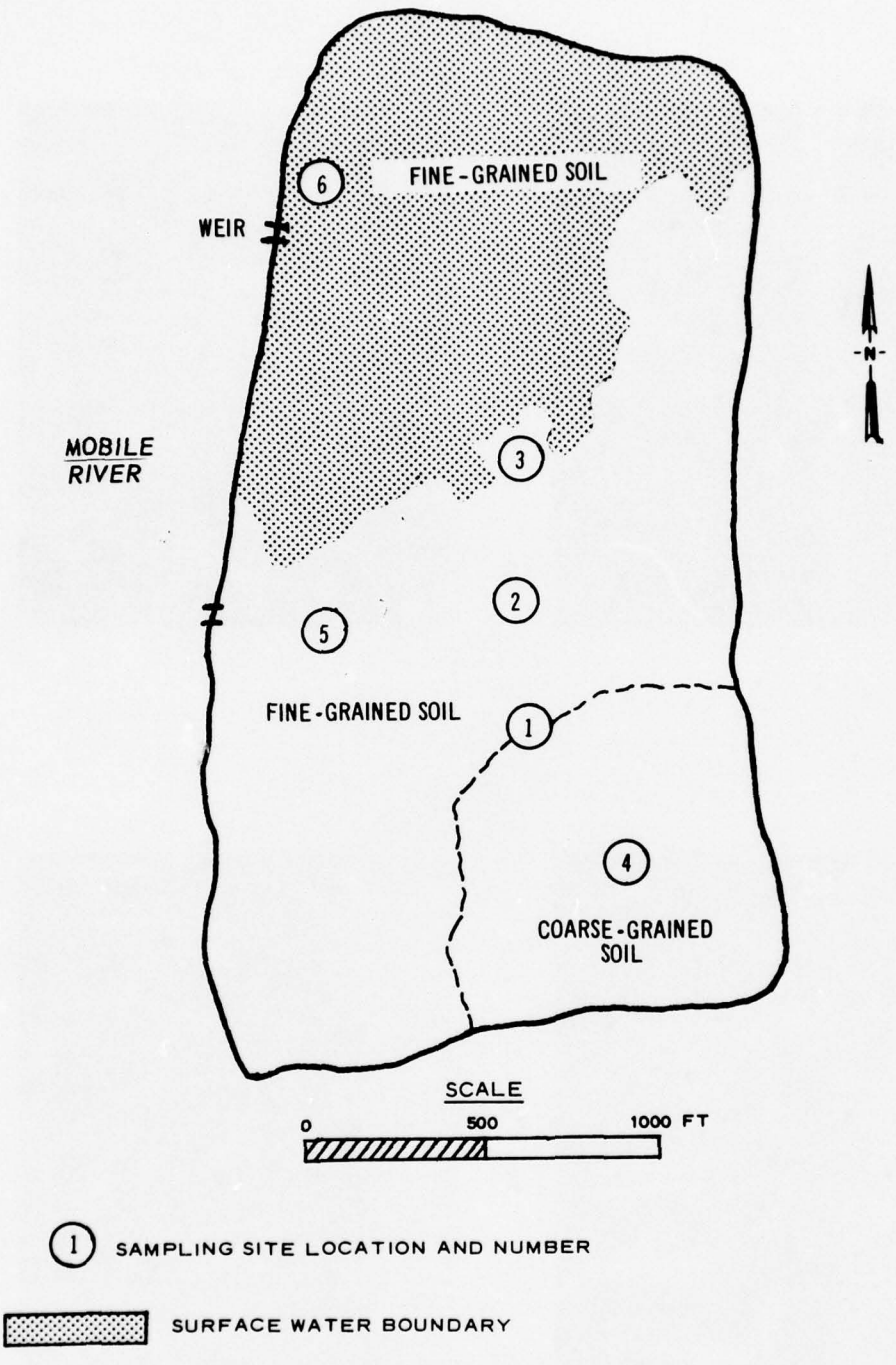
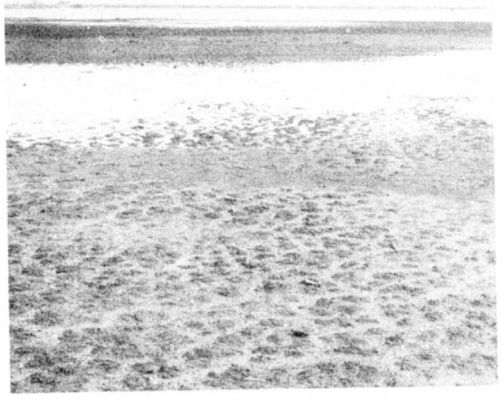


Figure 2. Schematic map of Blakeley Island area



a. Site 2



b. Site 3



c. Site 5



d. Site 6

Figure 3. General views of Blakeley Island area

of sampling, site 1 was apparently in a near-quick condition, because air and water percolated to the surface after the penetrometer was removed from the soil. The average CI of the fine-grained soils in the 0- to 6-in. layer ranged from 8 to 24, while the CI for the 6- to 12-in. layer decreased, ranging from 2 to 18. The strongest site (site 5) was on a shallow ridge, and the material was drier than at the other sites.

19. CI profiles for the Blakeley Island area are given in Figure 4. The CI for site 4 increased fairly rapidly with depth. The CI for site 1 remained relatively the same as depth increased. The profiles for sites 2, 3, and 6 are similar except that small differences in the surface layer (0- to 6-in. depth) indicate slight differences in moisture conditions. The profile for site 5 indicates that the material had undergone some consolidation; also, the soil in the upper 3 in. was much drier than at the other sites as indicated by the higher average CI.

20. Pinto Island area. This area is approximately 1 mile east of Mobile on the west side of Mobile Bay and south of the Bankhead Tunnel. A schematic map of the area showing the location of four sampling sites and soil class boundaries is given in Figure 5. At the time of the visit (May 1974), the area was free of vegetation except for a few scattered small trees about 10 ft tall intermingled with patches of marsh grass approximately 3 ft tall; there was very little surface water present except for a few scattered puddles throughout the area. General views of the area are given in Figure 6.

21. About 25 percent of the area (north-central section) was identified as coarse-grained soil and 75 percent as fine-grained soil. Site 1 was a poorly graded sand (SP), and the other three sites were fat clays (CH). The SP site was much stronger than the CH sites; the average CI in the 0- to 6-in. layer of SP soil was 63, while it ranged from 5 to 14 in the CH soils.

22. CI profiles are presented in Figure 7. The coarse-grained soil strength (site 1) increased rapidly to a depth of 5 in., decreased slightly to a depth of about 30 in., and then increased again. The profiles for the clay soils (sites 2, 3, and 4) are quite similar, with different surface strengths depicting differences in surface moisture conditions.

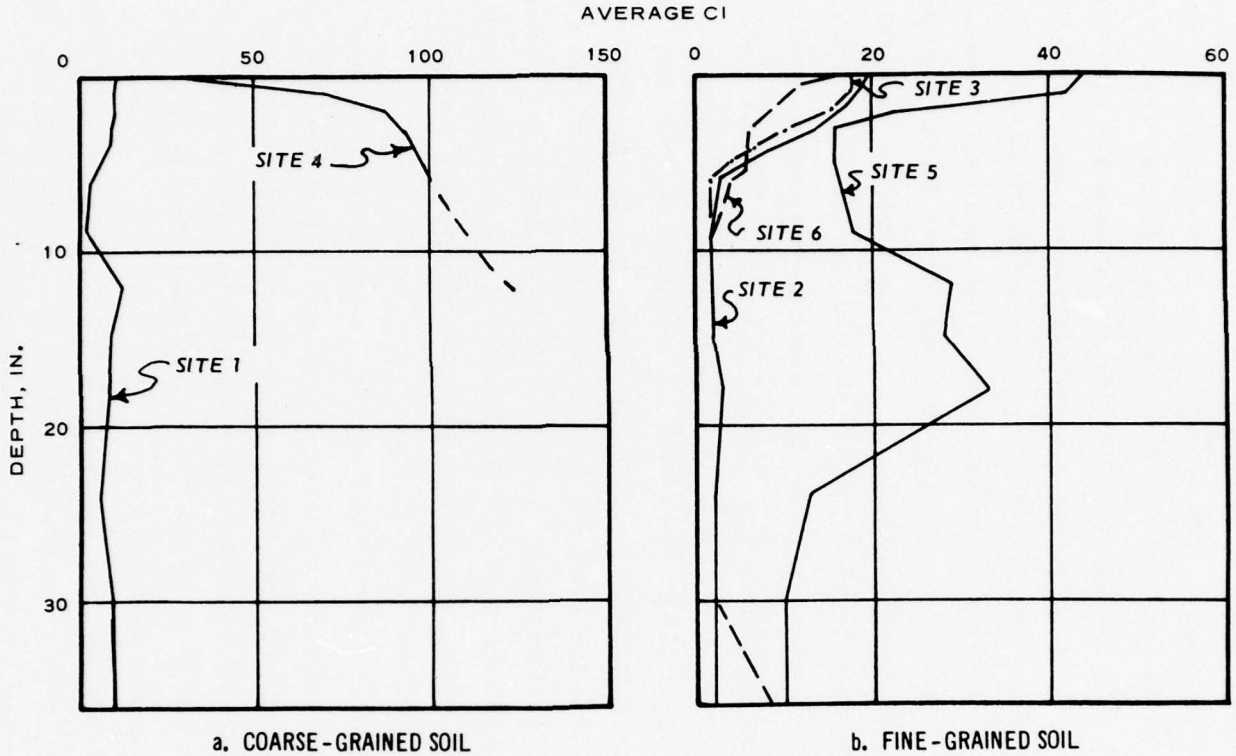


Figure 4. CI profiles for Blakeley Island area

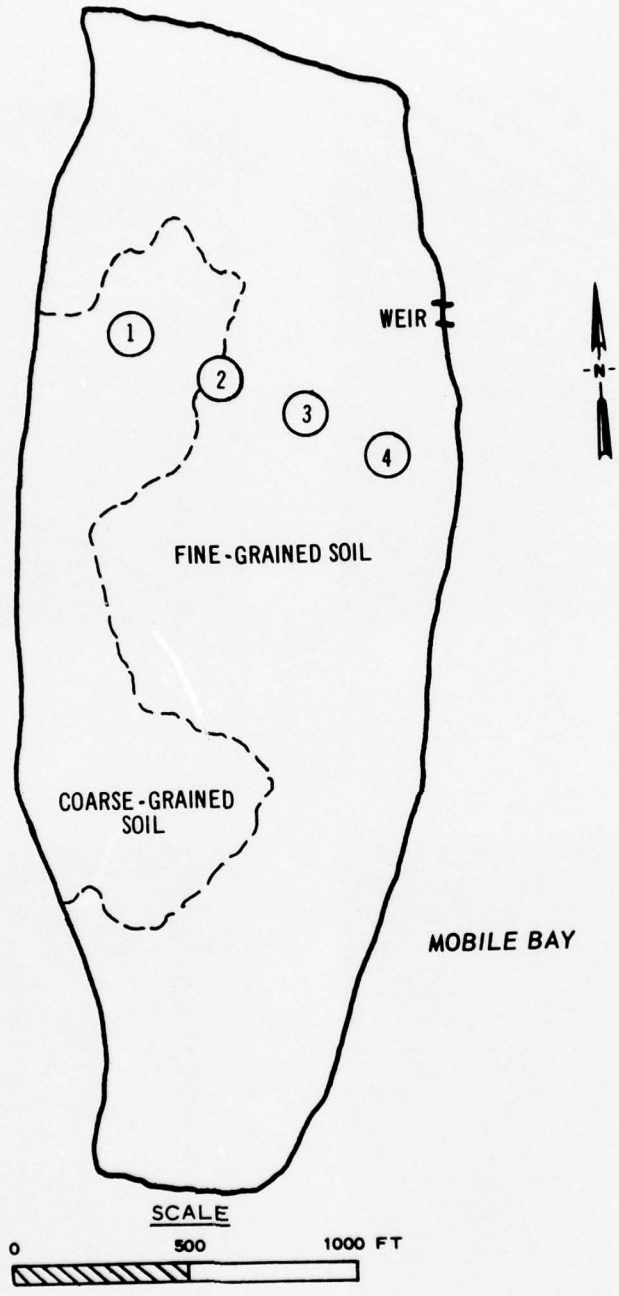


Figure 5. Schematic map of Pinto Island area



a. Site 1



b. Site 2



c. Site 3



d. Site 4

Figure 6. General views of Pinto Island area

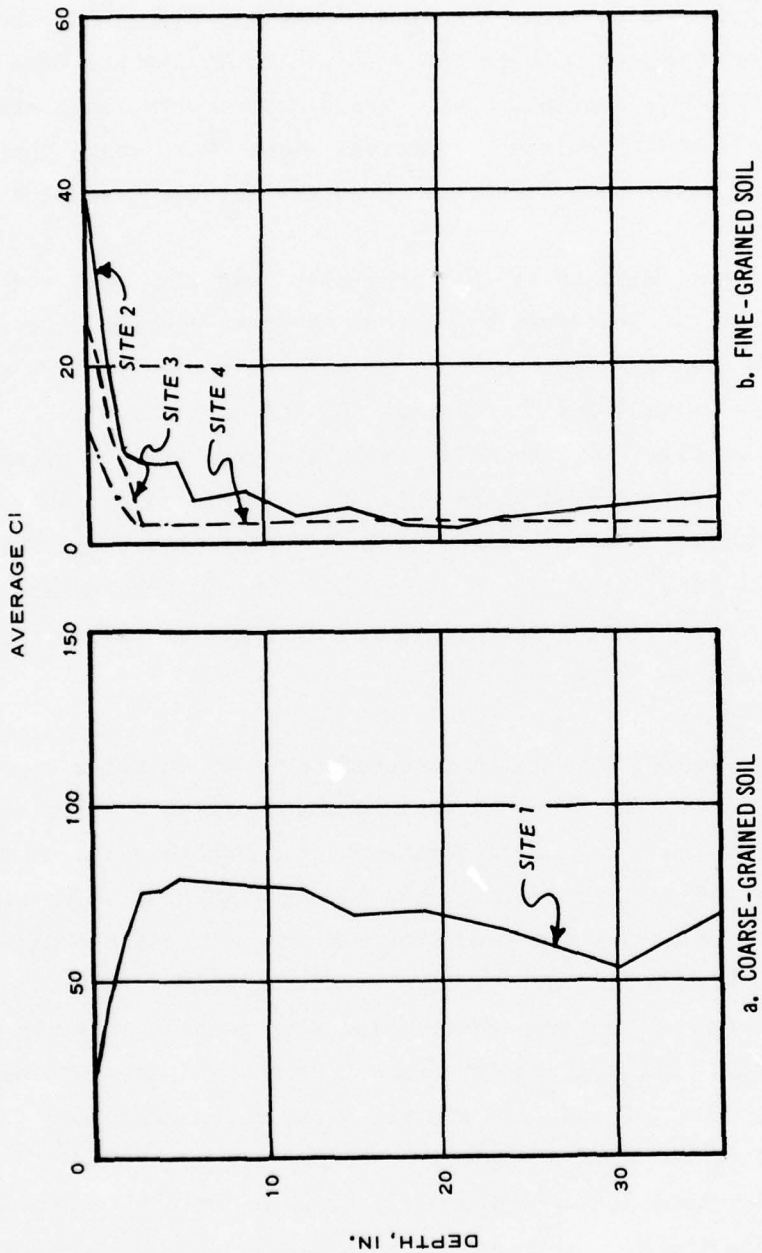


Figure 7. CI profiles for Pinto Island area

23. McDuffie Island area. This area is approximately 1 mile southeast of Mobile on the east side of Garrows Bend and the west side of Mobile Bay. A schematic map of the area showing the location of the three sites selected for sampling is presented in Figure 8. The whole containment area appeared to be fine-grained soil. At the time of sampling (May 1974), the entire area was almost covered with marsh grass about 3 ft tall and a few scattered trees about 10 ft tall; there was little surface water present except for a few scattered puddles throughout the area.

24. The soil data in Table 1 show that lean clay (CL) and fat clay (CH) were present. The surface layer of the lean clay at site 3 was much stronger than the surface layers of fat clay at sites 1 and 2, as shown by the average 0- to 6-in. CI readings (40 versus 5 and 7).

25. CI profiles for the McDuffie Island area (Figure 9) show that three distinct surface conditions existed, as depicted by the 0- to 6-in. CI readings. Site 1 had the weakest surface layer and the softest subsurface material; site 3, the strongest. The underlying material at all sites was soft. At about 30 in., the strength of the soil of site 3 began to increase rapidly.

Savannah District

26. One dredged material containment area was sampled in the Savannah District. The area, known as Barnwell Island, is in South Carolina, approximately 2 miles northeast of Savannah on the north side of the Savannah River, as shown on the map in Figure 10. Ten sites were selected for sampling; their locations and the soil class boundaries are identified in Figure 11. At the time of sampling (May 1974), approximately 40 percent of the area was covered with patches of marsh grass about 4 ft tall. The only surface water present was in small meandering drainageways. Some of the area contained large desiccation cracks. General views of the area are given in Figure 12.

27. The schematic map (Figure 11) shows a strip of coarse-grained soil (SP) along the western boundary established by the Savannah River. The remaining area, about 80 percent of the total area, is fine-grained soil consisting of silty clay (MH) and fat clay (CH). There was more

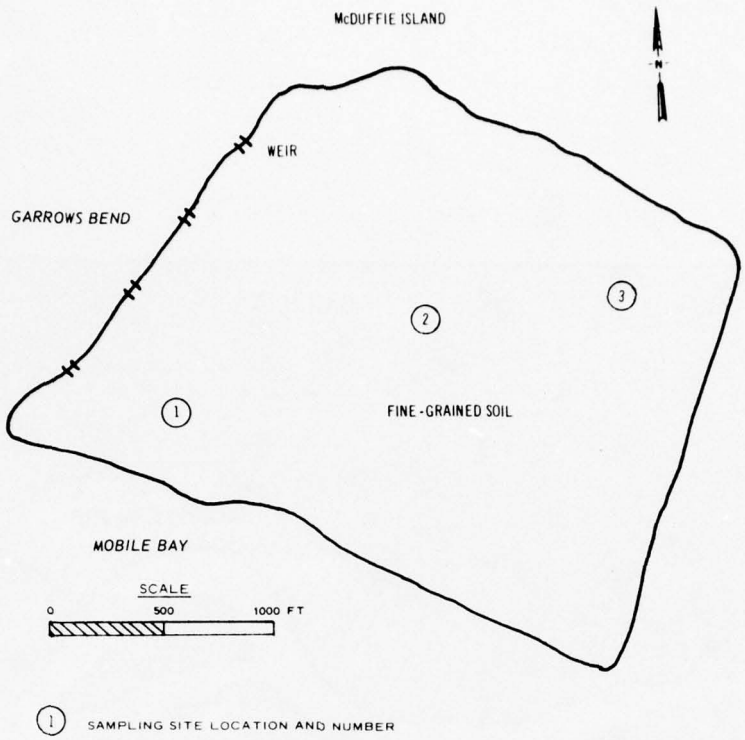


Figure 8. Schematic map of McDuffie Island area

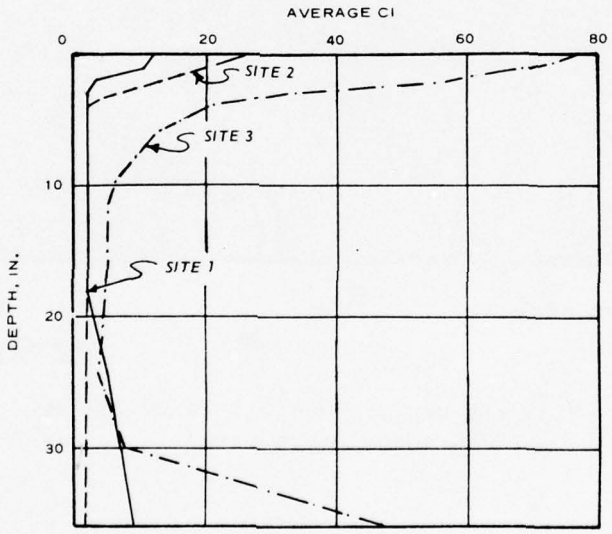


Figure 9. CI profiles for fine-grained soil, McDuffie Island area

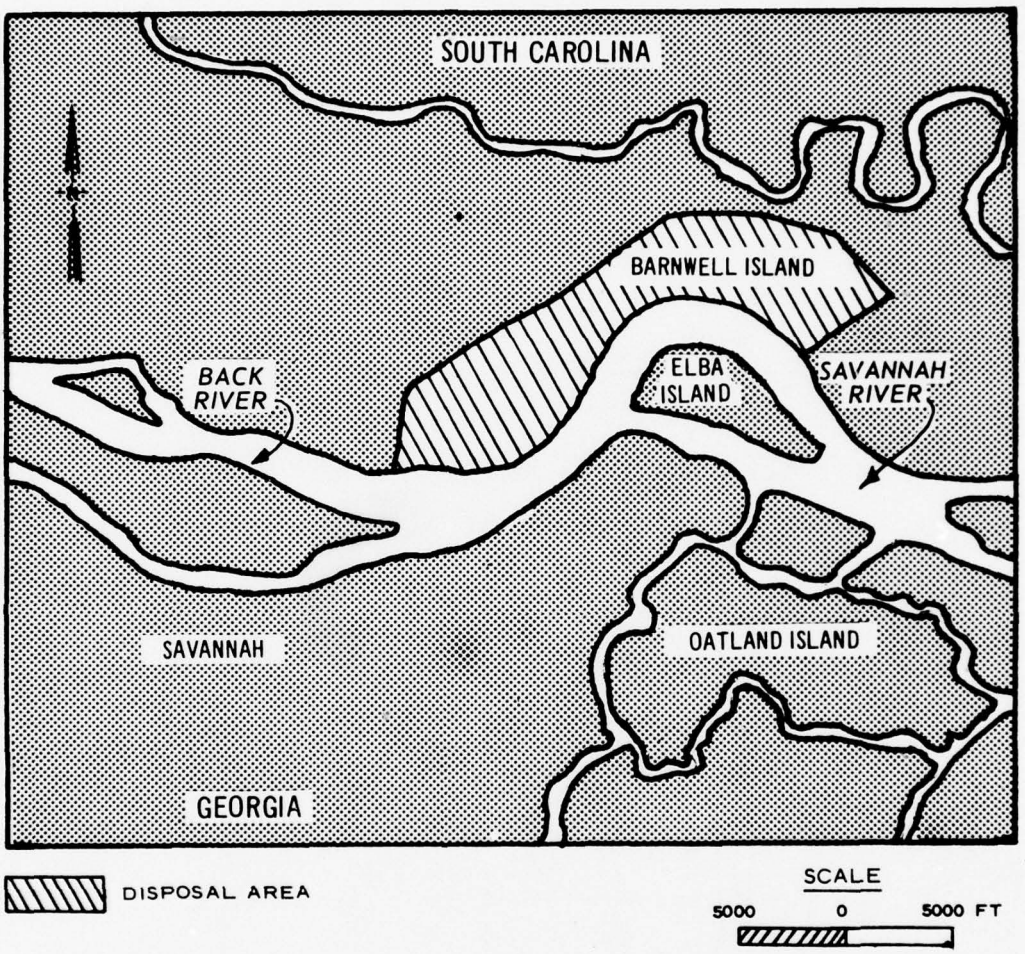


Figure 10. Vicinity map of Barnwell Island dredged material containment area

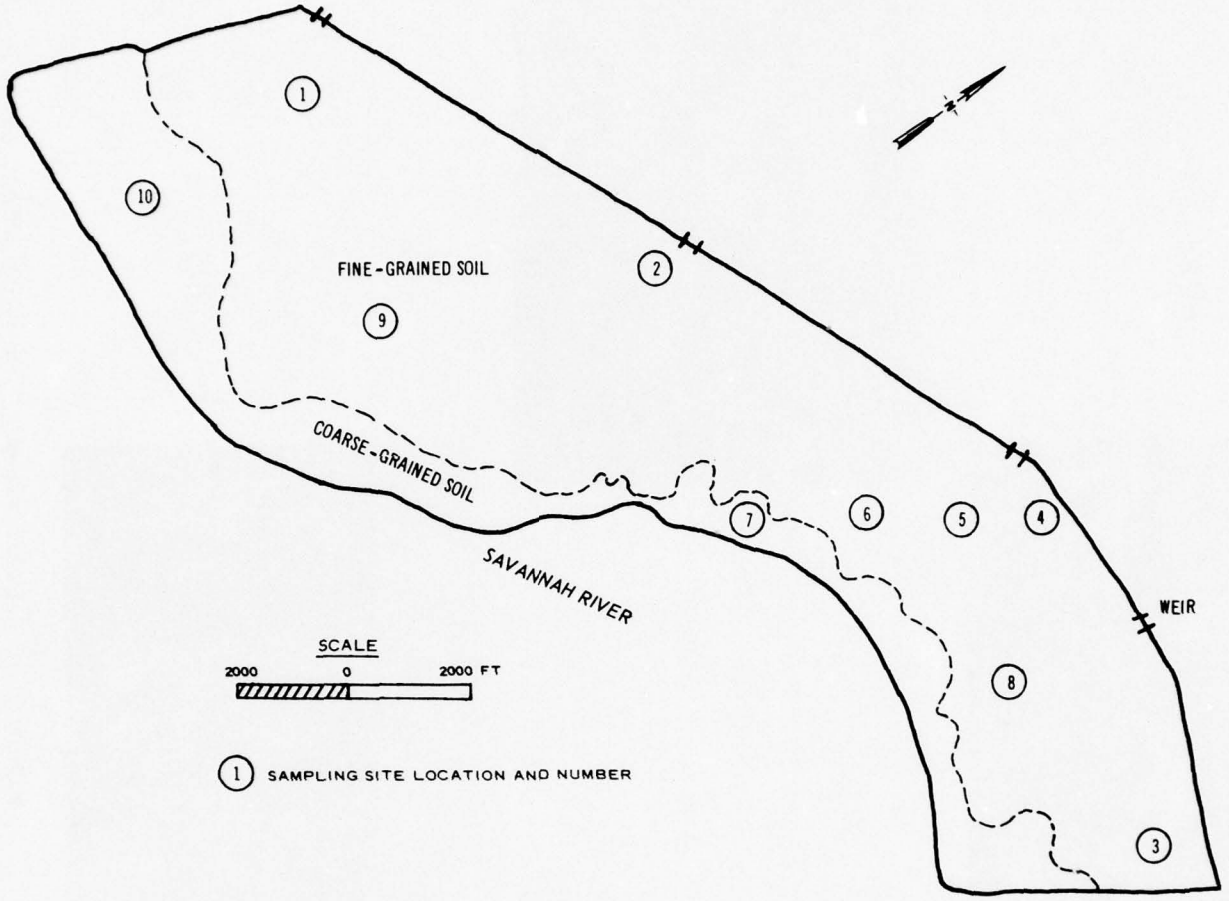


Figure 11. Schematic map of Barnwell Island area



a. Site 1

b. Site 2





c. Site 3

Figure 12. General views of Barnwell Island area
(sheet 1 of 2)

d. Site 4





e. Site 5

f. Site 6



Figure 12 (sheet 2 of 2)

variation in surface strength at this site than at the other sites. The average 0- to 6-in. CI's were higher in the SP soils (73 and 85 at sites 7 and 10); average 0- to 6-in. CI's of the MH and CH soils ranged from 4 to 34.

28. CI profiles from representative sites sampled at Barnwell Island for both classes of soil are shown in Figure 13. The CI profiles for both soil classes cover a wide range of strength values and profile shapes. Except for sites 4 and 5, the subsurface (6- to 12-in.) fine-grained soil was stronger than similar soil tested at the other sites.

Norfolk District

29. One area was sampled in the vicinity of Norfolk, Virginia (Figure 14). The area, known locally as Craney Island, is approximately 4 miles northwest of Portsmouth, Virginia, and about 8 miles southeast of Newport News, Virginia. Twenty-two sites were selected for sampling; their locations, surface water boundary, and soil classes are presented in Figure 15. At the time of sampling (May 1974), the area was bare except for a few scattered patches of marsh grass about 4 ft tall localized in the southwest corner. About 40 percent of the surface was covered with water. General views of the area are given in Figure 16.

30. The map in Figure 15 shows bands of coarse-grained soil along the northern, eastern, and southern boundaries of the containment area. It is estimated that about 20 percent of the area consisted of coarse-grained soils and about 80 percent of fine-grained soils. All of the coarse-grained soils (Table 1) were classified as poorly graded sand (SP); the fine-grained soils included silt (ML), lean clay (CL), and fat clay (CH). The consistency of the fine-grained soils ranged from a slurry (average CI of 1 and 2) to a fairly firm soil (average cone index of 25-55).

31. CI profiles for representative sites sampled at Craney Island for both classes of soil are shown in Figure 17. The range in strength is small for the coarse-grained soils, but large for the fine-grained soils, particularly in the top 15 in.

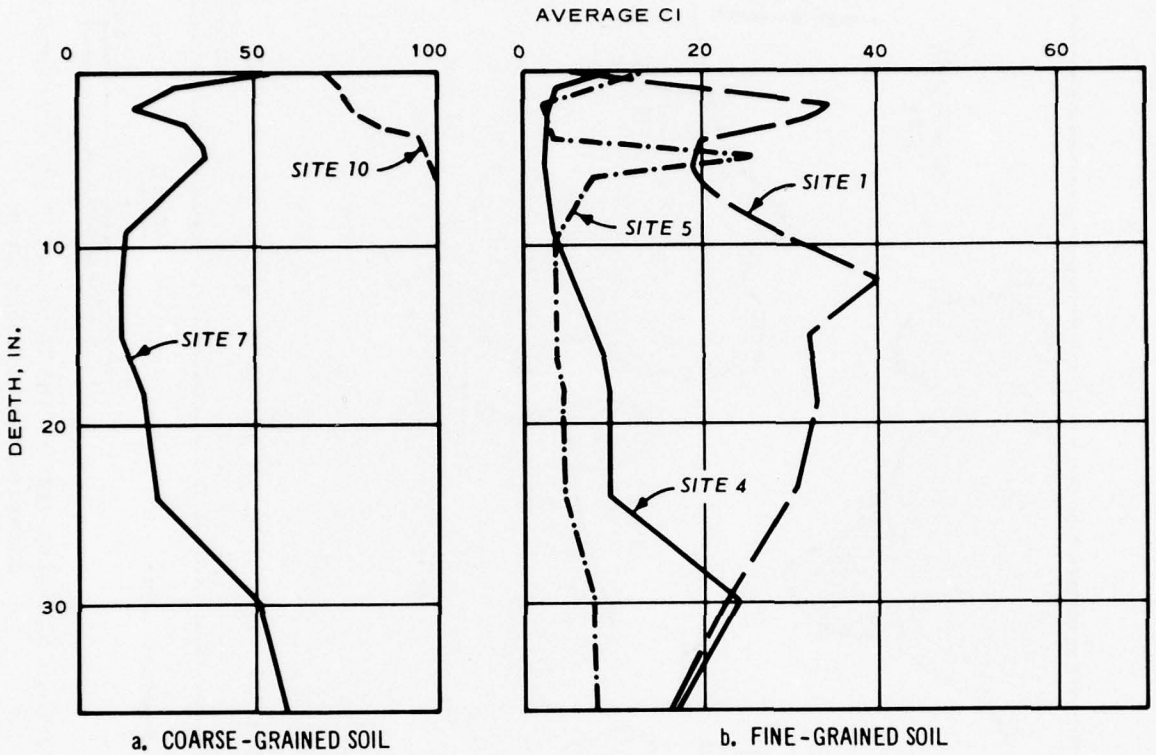


Figure 13. CI profiles for Barnwell Island area

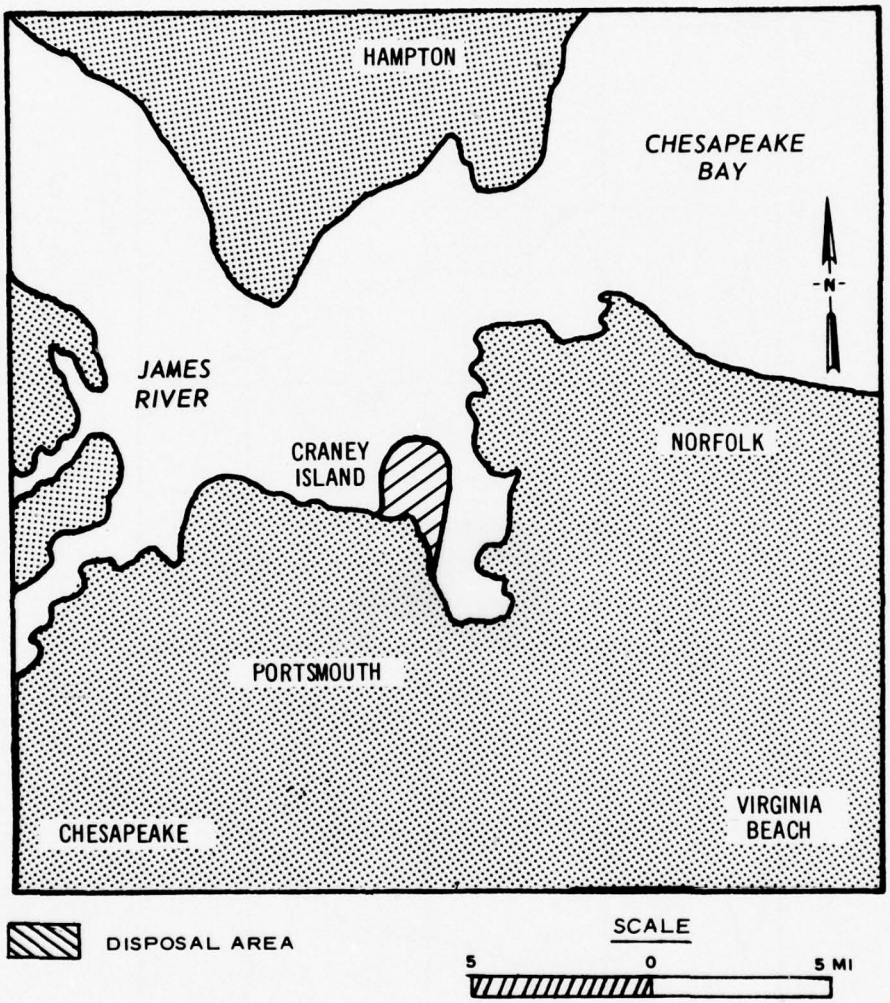


Figure 14. Vicinity map of the Norfolk, Virginia, dredged material containment area

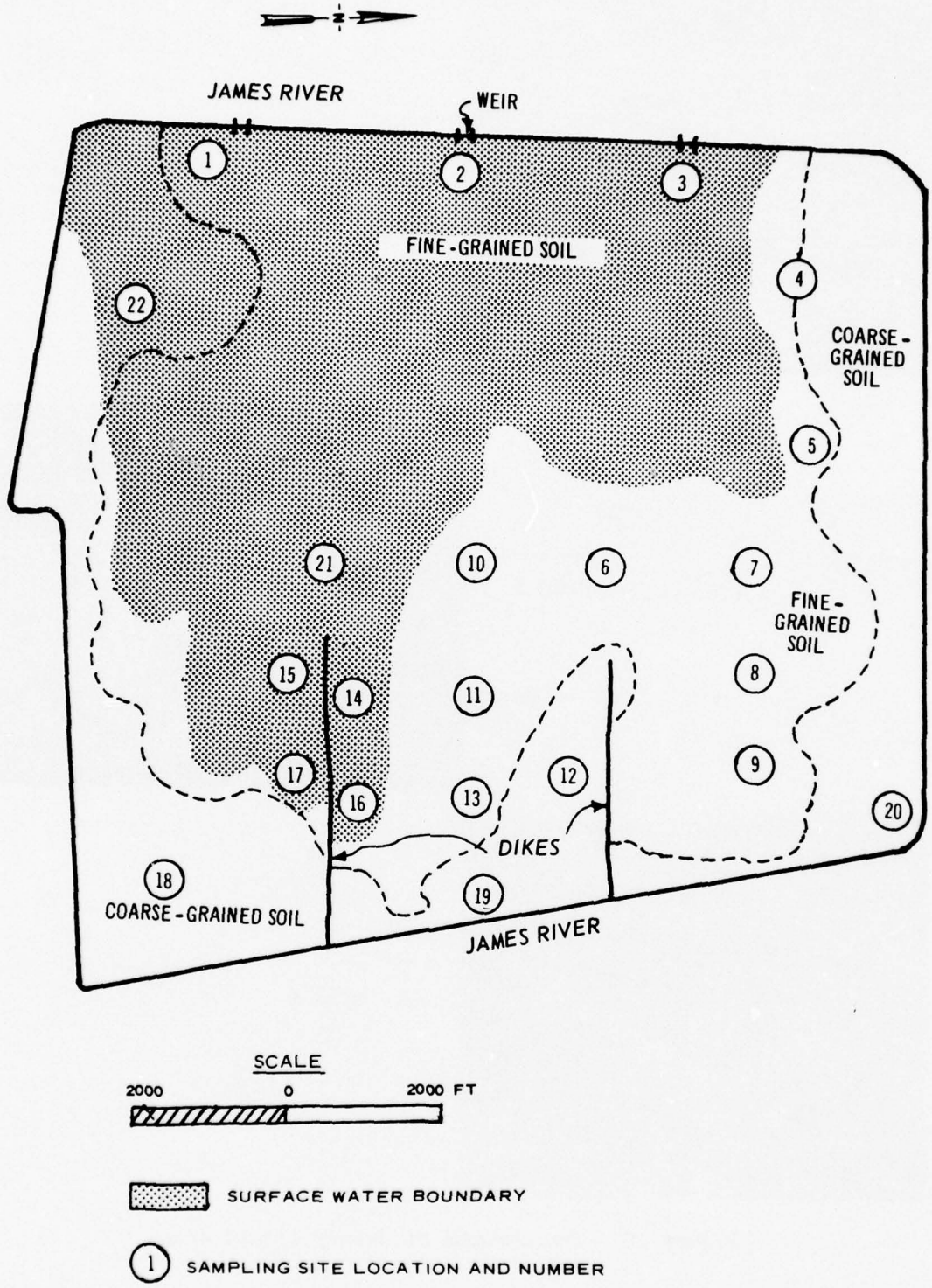


Figure 15. Schematic map of Craney Island area



a. Site 4



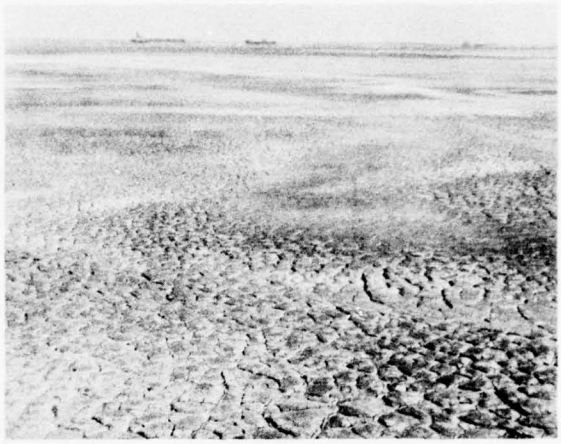
b. Site 5



c. Site 6

Figure 16. Photographs of Craney Island area
(sheet 1 of 2)

d. Site 9





e. Site 10

f. Site 19



Figure 16 (sheet 2 of 2)

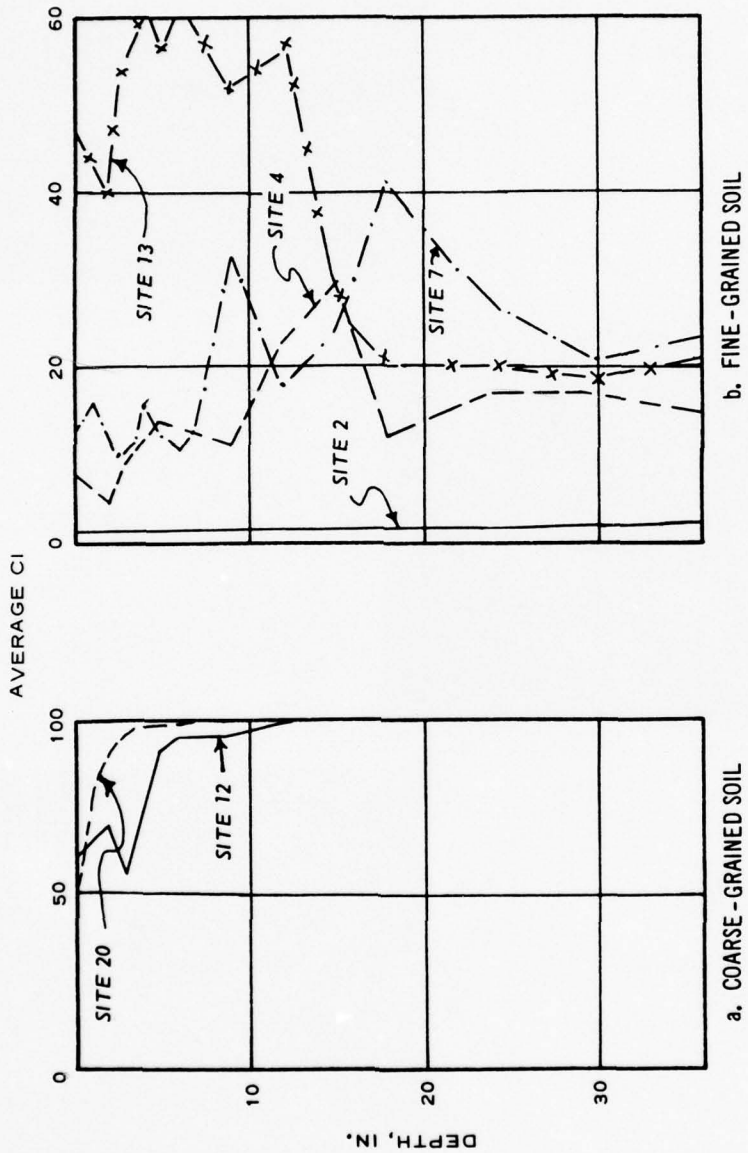


Figure 17. CI profiles for Craney Island area

Summary of Dredged Material Containment Areas

32. On the basis of the previous discussions and data presented, the pertinent characteristics used to describe operational environments of the selected dredged material containment areas from a trafficability standpoint are summarized in the following tabulation.

Location of Disposal Area	Coverage, %*		Coarse-Grained Soil				Fined-Grained Soil			
	Surface Water	Vegetation	Area %*	Types	Average CI, Range 0-6 in.	Average CI, Range 6-12 in.	Area %*	Types	Average CI, Range 0-6 in.	Average CI, Range 6-12 in.
Mobile District:										
Blakeley Island	40	0	15	SP	8-32	4-100+	85	MH,CH	8-24	2-18
Pinto Island	2	2	25	SP	63**	78**	75	CH	5-14	2-5
McDuffie Island	2	98	0	--	--	--	100	CL,CH	5-40	2-8
Savannah District:										
Barnwell Island	5	40	20	SP	73-85	98-100+	80	MH,CH	4-34	4-29
Norfolk District:										
Craney Island	40	2	20	SP	72-87	96-100+	80	CH,ML	1-55	1-60

* Estimated.
** Represents only one sample site.

33. These data show that the operational environments of dredged material containment areas can be highly variable. Surface water coverage ranged from about 2 to 40 percent, and vegetal coverage varied from none to about 98 percent. Both coarse- and fine-grained soils occurred at each disposal area, except that no coarse-grained soil was present in the McDuffie Island area. Coarse-grained soils were localized near the infall locations and, when present, occupied 15 to 25 percent of the area. The only type of coarse-grained soil was identified as poorly graded sand (SP). Except for one area (Blakeley Island), the coarse-grained soil was fairly strong, the average CI ranging from about 60 to 90 in the 0- to 6-in. layers and from 80 to 100+ at the 6- to 12-in. depth. Fine-grained soils predominated (75 to 100 percent) in all areas visited, and included fat clay (CH), silty clay (MH), lean clay (CL), and silt (ML). Generally, the strength of the surface layer (0- to 6-in.) was higher than that of the deeper layers. The average CI ranged from about 1 to 55 in the 0- to 6-in. layer and from 1 to 60 in the 6- to 12-in. layer. The soil strength data in Table 1 show that about 30 percent of the sites sampled had average CI values in the 6- to 12-in. layer of 5 or less, and about 75 percent had average CI values less than 30 in that same soil layer.

34. The data collected and the observations made make clear the fact that dredged material containment areas present a very harsh environment for vehicle or equipment operation. The problem is compounded by the combined effects of soft soil, availability of free water that may reduce soil strength when mixed into the soil by vehicle running gears, and vegetation that may foul the running gears. To ensure effective operation of equipment in the operation and maintenance of confined disposal areas, the operational environment must be considered in the selection of existing vehicles or in the design of new ones.

PART III: SELECTION OF VEHICLES FOR CATALOG AND ASSESSMENT OF THEIR CAPABILITIES

Selection of Vehicles

35. Available low-ground-pressure vehicles were inventoried by searching the literature and by contacting manufacturers in the United States and Canada. Only vehicles with 1-pass VCI's of 30 or less are included in the catalog (Appendix C). These VCI's were computed by procedures described in Appendix A; effects of buoyancy (Appendix B) were taken into account.

Methodology Used to Assess Vehicle Capabilities

36. The soil vehicle analytical submodel of AMC-71, hereafter called the WES-VCI submodel (see Appendix A), was used to predict the performance of the vehicles shown in Appendix C. Using the performance predictions, the capabilities of each vehicle to operate in soft, fine-grained soils were assessed. Coarse-grained soils were excluded from the evaluation because most vehicles included in this study experience little or no difficulty in negotiating such materials; however, the methodology used for coarse-grained soil is included in Appendix A in case operational problems occur. The vehicles listed in Appendix C were arbitrarily divided into six groups on the basis of payload. The group numbers, payload range, and number of vehicles in each group are as follows:

Vehicle Classification		Number of Vehicles in Group
Group No.	Payload Range tons	
I	>0-3/4	19
II	1-2-1/2	11
III	3-7-1/2	11
IV	8-15	8
V	>15	8
VI	0 (Bulldozers)	3
	Total	60

VCI's for 1- and 50-pass go-no go performance were computed for vehicles in each group, and these numbers were compared with specific soil strength values discussed in the next paragraph to obtain estimates of go-no go and excess traction performance for the respective number of passes.

37. The soil strength values used were arbitrarily selected in the range from 0 to 30 CI. This range was selected because 75 percent (paragraph 33) of the fine-grained soils sampled in the dredged material had a CI of 30 or less in the 6- to 12-in. layer. As indicated earlier (paragraph 14), only the CI was measured; however, for this analysis it was assumed that no change would occur in soil strength with vehicle traffic, making the RI equal to 1 and the CI equal to the RCI (see paragraph 9). Hereafter, RCI is used in the discussion in place of CI. The soil strength range of 0-30 was broken into five units with values assigned to each representing the approximate midpoint of each unit range. The soil classification units and soil strength values assigned to each unit are:

Soil Classification Unit Number	RCI
1	2
2	8
3	14
4	20
5	26

Analysis of Vehicle Performance Data

38. The computed or experimentally determined 1- and 50-pass VCI's (VCI_1 and VCI_{50}), and 1-pass drawbar pull of each vehicle on each of the above soil strengths that exceeded VCI_1 are presented in Table 2. (The vehicle data used to compute VCI are given in the vehicle specification data sheets in Appendix C.) For each vehicle group, excess traction or net drawbar-pull performance[4] was examined on the basis of the number of vehicles that could develop a designated amount of drawbar

pull on each soil unit. Based on experience and engineering judgment, it was assumed that for a vehicle to do an effective job in pushing or overturning soil material on a 1-pass basis, the vehicle should develop excess traction of about 50 percent of its weight, or a drawbar-pull coefficient of 0.50. Three categories of excess traction were established for comparing traction performance, i.e. <0.40, 0.40-0.60, and >0.60.

Group I vehicles,
>0- to 3/4-ton payload

39. The results of go-no go and drawbar-pull computations for the 19 vehicles in Group I are shown in Table 2. The number of vehicles that can equal a specified performance in specific soil strengths is given in the following tabulation.

Soil Classification		Number of Vehicles That Can Complete		Number of Vehicles That Can Develop 1-Pass Excess Traction, DBP/W*		
Soil Unit	RCI	1 Pass	50 Passes	<0.40	0.40-0.60	>0.60
1	2	6	4	19	0	0
2	8	16	8	19	4	0
3	14	19	12	19	13	0
4	20	19	16	19	17	0
5	26	19	18	19	19	10

* Drawbar pull divided by vehicle weight

40. The tabulation above shows that six vehicles can complete one pass and four vehicles can complete 50 passes on the softest soil unit (unit 1). None of the vehicles can develop excess traction equal to or exceeding 40 percent of the vehicle's weight. Soil strength increases with soil unit number; all vehicles in Group I can complete 1 pass on soil units 3-5, and 18 vehicles can complete 50 passes on soil unit 5. Four of the vehicles in this group can develop 1-pass excess traction (DBP/W) of 0.40 and not more than 0.60 in soil unit 2. The number of vehicles increases to 17 on soil unit 4; and on soil unit 5, 19 vehicles can develop DBP/W in the 0.40-0.60 range, and 10 can develop DBP/W greater than 0.60. The choice of vehicles in this group for survey or

reconnaissance jobs is very good even for the two softest soil units; however, this group is rather limited for jobs in the two softest soil units that may require excess traction for towing equipment or devices for reworking the soil.

Group II vehicles,
1- to 2-1/2-ton payload

41. Vehicle performance computations for the 11 vehicles in Group II are given in Table 2. A summary of the data in Table 2 is presented in the following tabulation.

Soil Classification Soil Unit	RCI	Number of Vehicles That Can Complete 1 Pass	Number of Vehicles That Can Complete 50 Passes	Number of Vehicles That Can develop 1-Pass Excess Traction, DBP/W <0.40	0.40-0.60	>0.60
1	2	4	3	11	0	0
2	8	11	5	11	3	0
3	14	11	6	11	7	0
4	20	11	11	11	11	0
5	26	11	11	11	11	6

42. The tabulation above shows that four vehicles in this group can complete 1 pass, and three vehicles can complete 50 passes in soil unit 1. On soil units 2-5, all vehicles can complete 1 pass, and in soil units 4 and 5, all vehicles can complete 50 passes. As in Group I, none of the Group II vehicles can develop a 1-pass DBP/W greater than 0.40 in soil unit 1. In soil unit 3, seven vehicles have a DBP/W in the 0.40-0.60 range, and in soil unit 4, this number increases to 11 vehicles. The number of vehicles available for survey and reconnaissance work is limited for soil unit 1; but on soil strengths corresponding to unit 2 or greater, the percentage of vehicles that have a potential for doing a variety of jobs is very high.

Group III vehicles,
3- to 7-1/2-ton payload

43. The results of vehicle performance computations for the 11 vehicles in this group are given in Table 2. A summary of Table 2 data by number of vehicles that can achieve a stated level of performance is given in the following tabulation.

Soil Classification Soil Unit	RCI	Number of Vehicles That Can Complete 1 Pass	50 Passes	Number of Vehicles That Can Develop 1-Pass Excess Traction, DBP/W <0.40	0.40-0.60	>0.60
1	2	3	3	11	0	0
2	8	8	3	11	3	0
3	14	11	3	11	6	0
4	20	11	9	11	9	0
5	26	11	10	11	11	3

44. The tabulation above shows that three vehicles can successfully complete 1 or 50 passes on soil unit 1; all vehicles can complete 1 pass on soil units 3, 4, and 5. Only one vehicle cannot complete 50 passes on soil unit 5 (Vehicle III-6). DBP/W on soil unit 1 is <0.40 for all vehicles in Group III, but on soil units 2-5, the number of vehicles whose DBP/W performance equals or exceeds 0.40 increases rapidly. The performance of Group III vehicles appears to be similar to the performance of Groups I and II.

Group IV vehicles,
8- to 15-ton payload

45. The results of go-no go and drawbar-pull calculations for eight vehicles in Group IV are shown in Table 2. The number of vehicles that can achieve a specified performance on specific soil strengths is given in the following tabulation.

Soil Classification Soil Unit	RCI	Number of Vehicles That Can Complete 1 Pass	50 Passes	Number of Vehicles That Can Develop 1-Pass Excess Traction, DBP/W <0.40	0.40-0.60	>0.60
1	2	0	0	8	0	0
2	8	4	0	8	0	0
3	14	6	0	8	2	0
4	20	7	4	8	6	0
5	26	8	6	8	6	0

46. The above data indicate that none of the vehicles can travel on soil unit 1, four vehicles can complete 1 pass on soil unit 2, and six vehicles can make 1 pass on soil unit 3. Fifty-pass performance is possible for four vehicles on soil unit 4; six vehicles can complete 50 passes on soil unit 5. Significant DBP/W in the range of 0.40-0.60

cannot be developed on soil units 1-3, but six of the vehicles in Group IV can develop a DBP/W in the range of 0.40-0.60 on soil units 4 and 5. The performance of Group IV vehicles is less than that of the first three vehicle groups.

Group V vehicles,
payloads >15 tons

47. The results of go-no go and drawbar-pull computations for the eight vehicles in this group are shown in Table 2. The number of vehicles that can equal a specified performance on specific soil strengths is given in the following tabulation.

Soil Classification		Number of Vehicles That Can Complete		Number of Vehicles That Can Develop 1-Pass Excess Traction, DBP/W		
Soil Unit	RCI	1 Pass	50 Passes	<0.40	0.40-0.60	>0.60
1	2	1	1	8	0	0
2	8	6	1	8	1	0
3	14	8	2	8	4	0
4	20	8	6	8	8	0
5	26	8	8	8	8	2

48. The above data show that one Group V vehicle can operate on soil unit 1; that vehicle (V-8) can complete 50 passes on soil unit 1. All Group V vehicles can complete 1 pass on soil units 3, 4, and 5. Fifty-pass go-no go performance is limited primarily to soil units 4 and 5. In terms of DBP/W performance, only one vehicle can develop traction in the 0.40-0.60 range on soil unit 2; however, the number of vehicles than can attain this level of traction performance increases to eight on soil units 4 and 5. The performance of Group V vehicles is better than that of the Group IV vehicles, but less than that of the first three vehicle groups.

Group VI vehicles,
0 payload (Bulldozers)

49. The results of go-no go and drawbar-pull computations for the three vehicles in this group are shown in Table 2. The number of vehicles that can equal a specified performance on specific soil strengths is given in the following tabulation.

Soil Classification Soil Unit	RCI	Number of Vehicles That Can Complete 1 Pass	50 Passes	Number of Vehicles That Can Develop 1-Pass Excess Traction, DBP/W <0.40	0.40-0.60	>0.60
1	2	0	0	3	0	0
2	8	3	0	3	0	0
3	14	3	0	3	0	0
4	20	3	3	3	3	0
5	26	3	3	3	3	0

50. The tabulation above shows that none of the vehicles can complete 1 or 50 passes on soil unit 1; three vehicles can complete one pass on soil units 2-5 and 50 passes on soil units 4 and 5. Significant DBP/W in the range of 0.40-0.60 cannot be developed on soil units 1-3, but all three vehicles in Group VI can develop a DBP/W in the range of 0.40-0.60 in soil units 4 and 5. None of the vehicles can develop a DBP/W >0.60 on any of the soil units.

PART IV: SUMMARY AND RECOMMENDATIONS

Summary

51. Sixty vehicles were selected for this study based on their potential of doing a useful job in operation and maintenance of confined dredged material disposal areas. The vehicles were divided into six payload groups, which indirectly reflect the size of the job that the vehicle or equipment may be expected to perform. Vehicle performance was expressed in terms of go-no go and traction on five selected soil strengths that cover the range of soil strengths measured in several disposal areas representative of many operational environments.

52. An examination of the summary tabulations (paragraphs 39, 41, 43, 45, 47, and 49), which include the number of vehicles that can complete 1 and 50 passes and/or develop a specified traction on specific soil strengths, shows that there is a reasonable selection of vehicles in all payload groups that can operate on soil units 3, 4, and 5 (14-26 RCI). The computed data show that several vehicles in payload Groups I-III are capable of successful operation in soil unit 1; however, with the low VCI prediction accuracy for low-ground-pressure open-track vehicles (see paragraph 5, Appendix C), the selection of these vehicles to perform specified jobs should be made with caution.

Recommendations

53. The results reported in this study represent the state of the art of vehicles that are commercially available or have undergone recent military testing, and that can operate in soft soils. Before the concept of using low-ground-pressure construction equipment for dredged material containment area operations can be applied with a higher level of confidence, other or follow-on studies should be conducted to identify missions or jobs to be performed, establish measures of performance, evaluate current automotive and mobility technology and focus on subject problems by modification and refinement

as required, describe the operational environment in engineering terms, validate performance predictions, and develop an analytical framework to account for the pertinent equipment-operational environment interactions. This technological base can then be used to prepare equipment performance criteria and/or specifications, evaluate testable specifications, and design new equipment if necessary.

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Table 1

Soil Data Collected at Dredged Material Containment Areas

Sample Site No.	USCS Soil Classification*	Cone Index: Average at Depths Indicated, in. 0	1	2	3	4	5	6	9	12	15	18	24	30	36	Average 0 to 6 in.	Average 6 to 12 in.
Blakeley Island Area, Alabama																	
1	SP	12	10	10	8	8	6	3	2	13	9	8	6	9	10	8	4
2	MH	20	19	17	14	9	6	3	2	2	2	3	2	2	2	13	2
3	CH	18	18	16	11	8	4	2	2	2	2	2	2	2	2	11	2
4	SP	28	69	89	95	98	100	--	--	--	--	--	--	--	--	82	--
5	CH	44	42	23	16	16	16	8	18	29	28	33	13	10	10	24	18
6	CH	15	11	9	7	6	6	4	2	3	2	2	2	2	2	8	3
Pinto Island Area, Alabama																	
1	SP	18	45	65	75	76	80	81	77	77	69	70	64	54	68	63	78
2	CH	40	19	10	8	7	8	5	6	3	4	2	3	4	5	14	5
3	CH	25	13	8	2	2	2	2	2	2	2	2	2	2	2	8	2
4	CH	13	7	4	2	2	2	2	2	2	2	2	2	2	2	5	2
McDuffie Island Area, Alabama																	
1	CH	12	11	3	2	2	2	2	2	2	2	2	5	7	9	5	2
2	CH	25	13	6	2	2	2	2	2	2	2	2	2	2	2	7	2
3	CL	76	69	55	34	20	16	12	7	5	5	5	4	8	48	40	8
Barnwell Island Area, Georgia																	
1	MH	11	18	35	31	20	19	19	28	40	32	33	26	23	17	19	29
2	MH	53	28	26	14	16	21	21	21	18	14	16	16	15	15	26	20
3	CH	29	34	46	28	26	25	30	19	21	19	21	25	28	25	31	23
4	CH	10	4	3	4	3	3	3	4	6	9	10	10	24	18	4	4
5	CH	14	8	2	3	3	26	8	4	4	4	5	5	8	8	9	5
6	CH	64	25	15	32	35	36	29	13	12	12	18	22	51	59	34	18
7	SP	64	58	62	57	78	94	97	96	100	--	--	--	--	--	73	98
8	CH	23	25	25	23	29	32	34	13	11	19	34	16	23	37	27	19
9	MH	31	28	24	19	26	31	23	10	16	19	24	13	26	41	26	16
10	SP	68	74	77	83	96	99	100	--	--	--	--	--	--	--	85	--
Craney Island Area, Virginia																	
1	CL	25	21	15	12	11	11	11	23	8	10	10	12	13	16	15	14
2	ML	1	1	1	1	1	1	1	1	1	1	1	2	2	2	1	1
3	ML	1	1	1	1	1	1	1	1	1	1	18	8	22	8	1	1
4	CL	8	6	5	7	11	14	13	11	23	29	12	17	17	15	9	16
5	ML	10	9	13	14	13	20	16	14	11	23	13	11	12	14	14	14
6	CH	6	8	4	2	2	5	23	27	25	18	14	12	24	19	7	25
7	CH	12	15	11	10	15	12	11	31	18	24	41	27	21	23	12	20
8	CH	19	26	13	11	15	32	46	44	20	19	27	49	78	97	23	37
9	CH	40	24	21	24	26	21	32	24	19	19	46	84	78	86	27	25
10	CH	1	1	1	1	1	1	1	31	20	18	13	13	16	23	1	17
11	CH	16	18	9	12	24	26	21	21	17	16	53	45	33	13	18	20
12	SP	60	65	69	55	70	90	95	95	98	100	--	--	--	--	72	96
13	CL	47	44	40	53	72	56	72	52	56	27	20	20	19	20	55	60
14	CH	2	2	2	2	2	2	2	2	3	15	13	16	11	11	2	2
15	CH	10	10	10	10	10	10	10	10	10	10	10	16	19	24	10	10
16	CH	16	21	18	9	30	29	51	48	59	56	21	21	20	20	25	53
17	CH	15	16	12	10	11	12	12	13	13	14	13	15	18	19	13	13
18	SP	46	78	90	96	98	90	100	--	--	--	--	--	--	--	85	--
19	SP	33	85	90	98	100	100	100	--	--	--	--	--	--	--	87	--
20	SP	48	84	93	91	97	94	100	--	--	--	--	--	--	--	87	--
21	CH	1	1	2	3	3	7	8	26	30	77	13	10	11	21	4	21
22	CL	14	10	9	11	13	22	16	12	15	21	23	12	10	13	14	14

Note: 0-, 1-, 2-, 3-, 4-, 5-, and 6-in.-depth CI readings were used to obtain the average for the 0- to 6-in. depth. 6-, 9-, 12-in.-depth CI readings were used to obtain the average for the 6- to 12-in. depth.

Dashes indicate that the cone index was beyond capacity of instrument; i.e., CI >100.

* For 0- to 12-in. depth.

Table 2

Vehicle Performance Data

Vehicle No.	Type of Traction Element	Fine-Grained Soils VCI_1	Fine-Grained Soils VCI_{50}	RCI_{x1}* for 1 Pass Soil Units** 1	2	3	4	5	Vehicle Performance: Go-Condition Soil Units 1 Pass	50 Passes	Drawbar Pull/Weight for Each Soil Unit, 1 Pass: 1	2	3	4	5
Group I Vehicles, >0- to 3/4-Ton Payload															
I-1	Tracks	7	17	0	1	7	13	19	2,3,4,5	4,5	0	0.06	0.36	0.52	0.59
I-2	Tracks	10	24	0	0	4	10	16	3,4,5	5	0	0	0.24	0.44	0.56
I-3	Tracks	0	2	2	8	14	20	26	1,2,3,4,5	1,2,3,4,5	0.12	0.40	0.54	0.60	0.64
I-4	Tracks	4	10	0	4	10	16	22	2,3,4,5	3,4,5	0	0.24	0.44	0.56	0.62
I-5	Wheels	1	3	1	7	13	19	25	1,2,3,4,5	2,3,4,5	0.05	0.30	0.47	0.57	0.59
I-6	Wheels	7	17	0	1	7	13	19	2,3,4,5	4,5	0	0.50	0.30	0.47	0.57
I-7	Wheels	12	29	0	0	2	8	14	3,4,5	None	0	0	0.09	0.34	0.48
I-8	Tracks	5	13	0	3	9	15	21	2,3,4,5	3,4,5	0	0.18	0.42	0.55	0.61
I-9	Wheels	11	26	0	0	3	9	15	3,4,5	5	0	0	0.16	0.36	0.49
I-10	Tracks	3	8	0	5	11	17	23	2,3,4,5	2,3,4,5	0	0.28	0.47	0.57	0.62
I-11	Tracks	4	10	0	4	10	16	22	2,3,4,5	3,4,5	0	0.24	0.44	0.56	0.62
I-12	Tracks	3	8	0	5	11	17	23	2,3,4,5	2,3,4,5	0	0.28	0.47	0.57	0.62
I-13	Tracks	7	17	0	1	7	13	19	2,3,4,5	4,5	0	0.06	0.36	0.52	0.59
I-14	Tracks	6	15	0	2	8	14	20	2,3,4,5	4,5	0	0.12	0.40	0.54	0.60
I-15	Tracks	0	2	2	8	14	20	26	1,2,3,4,5	1,2,3,4,5	0.12	0.40	0.54	0.60	0.64
I-16	Tracks	4	10	0	4	10	16	22	2,3,4,5	3,4,5	0	0.24	0.44	0.56	0.62
I-17	Tracks	0	2	2	8	14	20	26	1,2,3,4,5	1,2,3,4,5	0.12	0.40	0.54	0.60	0.64
I-18	Helical screws	1	5+	1	7	13	19	25	1,2,3,4,5	2,3,4,5	0.05	0.30	0.47	0.57	0.59
I-19	Tracks	0	2	2	8	14	20	26	1,2,3,4,5	1,2,3,4,5	0.12	0.40	0.54	0.60	0.64
Group II Vehicles, 1- to 2-1/2-Ton Payload															
II-1	Tracks	5	13	0	3	9	15	21	2,3,4,5	3,4,5	0	0.18	0.42	0.55	0.61
II-2	Tracks	3	8	0	5	11	17	23	2,3,4,5	2,3,4,5	0	0.28	0.47	0.56	0.62
II-3	Helical screws	0	0+	2	8	14	20	26	1,2,3,4,5	1,2,3,4,5	0.12	0.40	0.54	0.60	0.64
II-4	Tracks	2	6	0	6	12	18	24	1,2,3,4,5	2,3,4,5	0	0.32	0.50	0.58	0.63
II-5	Tracks	7	18	0	1	7	13	19	2,3,4,5	4,5	0	0.06	0.36	0.52	0.59
II-6	Tracks	6	15	0	2	8	14	20	2,3,4,5	4,5	0	0.12	0.40	0.54	0.60
II-7	Wheels	7	18	0	1	7	13	19	2,3,4,5	4,5	0	0.06	0.31	0.47	0.57
II-8	Tracks	0	2+	2	8	14	20	26	1,2,3,4,5	1,2,3,4,5	0.12	0.40	0.54	0.56	0.64
II-9	Wheels	7	18	0	1	7	13	19	2,3,4,5	4,5	0	0.06	0.31	0.47	0.57
II-10	Tracks	8	20	0	0	6	12	18	2,3,4,5	4,5	0	0	0.32	0.50	0.58
II-11	Tracks	0	2	2	8	14	20	26	1,2,3,4,5	1,2,3,4,5	0.12	0.40	0.54	0.56	0.64
Group III Vehicles, 3- to 7-1/2-Ton Payload															
III-1	Tracks	6	15	0	2	8	14	20	2,3,4,5	4,5	0	0.12	0.40	0.54	0.60
III-2	Tracks	7	17	0	1	7	13	19	2,3,4,5	4,5	0	0.06	0.36	0.52	0.59
III-3	Tracks	6	15	0	2	8	14	20	2,3,4,5	4,5	0	0.12	0.40	0.54	0.58
III-4	Wheels	9	20	0	0	5	11	17	3,4,5	4,5	0	0	0.28	0.41	0.53
III-5	Wheels	10	25	0	0	4	10	16	3,4,5	5	0	0	0.16	0.37	0.51
III-6	Wheels	13	31	0	0	1	7	13	3,4,5	None	0	0	0.05	0.31	0.47
III-7	Tracks	6	15	0	2	8	14	26	2,3,4,5	4,5	0	0.12	0.40	0.54	0.60
III-8	Tracks	7	17	0	1	7	13	19	2,3,4,5	4,5	0	0.06	0.36	0.52	0.59
III-9	Tracks	0	2	2	8	14	20	26	1,2,3,4,5	1,2,3,4,5	0.12	0.40	0.54	0.60	0.64
III-10	Tracks	0	2	2	8	14	20	26	1,2,3,4,5	1,2,3,4,5	0.12	0.40	0.54	0.60	0.64
III-11	Tracks	0	2	2	8	14	20	26	1,2,3,4,5	1,2,3,4,5	0.12	0.40	0.54	0.60	0.64

(Continued)

* $RCI_{x1} = RCI - VCI_1$.

** Soil Values

Unit	RCI
1	2
2	8
3	14
4	20
5	26

\+ Experimental value

Table 2 (Concluded)

Vehicle No.	Type of Traction Element	Fine-Grained Soils		RCI_{x1} for 1 Pass, Soil Units					Vehicle Performance: Go-Condition Soil Units		Vehicle Performance: Drawbar Pull/Weight for Each Soil Unit, 1 Pass				
		VCI_1	VCI_{50}	1	2	3	4	5	1 Pass	50 Passes	1	2	3	4	5
Group IV Vehicles, 8- to 15-Ton Payload															
IV-1	Tracks	6	15	0	2	8	14	20	2,3,4,5	4,5	0	0.12	0.40	0.54	0.60
IV-2	Wheels	10	24	0	0	4	10	16	3,4,5	5	0	0	0.16	0.40	0.52
IV-3	Wheels	25	57	0	0	0	0	1	5	None	0	0	0	0	0.05
IV-4	Tracks	6	15	0	2	8	14	20	2,3,4,5	4,5	0	0.12	0.40	0.54	0.60
IV-5	Tracks	7	17	0	1	7	13	19	2,3,4,5,	4,5	0	0.06	0.36	0.52	0.59
IV-6	Wheels	10	24	0	0	4	10	16	3,4,5	5	0	0	0.16	0.40	0.52
IV-7	Tracks	8	20	0	0	6	12	18	2,3,4,5	4,5	0	0	0.32	0.50	0.58
IV-8	Wheels	18	42	0	0	0	2	8	4,5	None	0	0	0	0.14	0.34
Group V Vehicles, ≥15-Ton Payload															
V-1	Tracks	8	20	0	0	6	12	18	2,3,4,5	4,5	0	0	0.32	0.50	0.58
V-2	Tracks	9	22	0	0	5	11	17	3,4,5	5	0	0	0.28	0.47	0.57
V-3	Tracks	6	15	0	2	8	14	20	2,3,4,5	4,5	0	0.12	0.40	0.54	0.60
V-4	Tracks	6	15	0	2	8	14	20	2,3,4,5	4,5	0	0.12	0.40	0.54	0.60
V-5	Tracks	5	13	0	3	9	15	21	2,3,4,5	3,4,5	0	0.18	0.42	0.55	0.61
V-6	Tracks	7	17	0	1	7	13	19	2,3,4,5	4,5	0	0.06	0.36	0.52	0.59
V-7	Tracks	9	22	0	0	5	11	17	3,4,5	5	0	0	0.28	0.47	0.57
V-8	Tracks	0	2	2	8	14	20	26	1,2,3,4,5	1,2,3,4,5	0.12	0.40	0.54	0.60	0.64
Group VI Vehicles, Bulldozers															
VI-1	Tracks	7	17	0	1	7	13	19	2,3,4,5	4,5	0	0.06	0.36	0.52	0.59
VI-2	Tracks	7	17	0	1	7	13	19	2,3,4,5,	4,5	0	0.06	0.36	0.52	0.59
VI-3	Tracks	7	17	0	1	7	13	19	2,3,4,5	4,5	0	0.06	0.36	0.52	0.59

APPENDIXES A AND B

of

WES TECHNICAL REPORT D-77-1

LOW-GROUND-PRESSURE CONSTRUCTION EQUIPMENT FOR USE IN DREDGED MATERIAL CONTAINMENT AREA OPERATION AND MAINTENANCE-EQUIPMENT INVENTORY

by

C. E. Green, A. A. Rula

INCL 1

APPENDIX A: METHODS USED FOR COMPUTING SOFT-SOIL VEHICLE PERFORMANCE

1. AMC-71[1,2*] is a comprehensive computer model for evaluating cross-country vehicle mobility. It consists of an aggregation of submodels designed to predict specific terrain-vehicle-driver interactions (i.e. soil-vehicle, dynamics, visibility, etc.) in engineering or quantitative terms. The methods used herein to compute vehicle soft-soil performance are contained in the soil-vehicle submodel, referred to hereafter as the WES-VCI submodel.

Description of WES-VCI Submodel

2. The WES-VCI submodel for predicting vehicle performance for fine- and coarse-grained inorganic soils includes determination of minimum soil strength required in terms of vehicle cone index (VCI), maximum towing force, and towed-motion resistance of a vehicle traveling in a straight line in unaccelerated motion on unobstructed level and sloping soil surfaces. All of the performance parameters are related to rating cone index (RCI) for fine-grained soils and cone index (CI) for coarse-grained soils. The pertinent soil-vehicle performance relations were empirically derived from field test data that included a wide range in vehicle characteristics and soil strengths. Initially, performance in fine-grained soils was predicted for 50-pass traffic; subsequently, 1-pass performance prediction was required. The VCI 1-pass performance prediction scheme was developed by adapting techniques used in the 50-pass prediction. For coarse-grained soils, 1-pass performance only is predicted, because tests have shown that the minimum soil strength for travel on the first pass is adequate for travel on all subsequent passes.

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* Superscript numbers in this appendix refer to similarly numbered entries in the References following main text.

Assumptions

3. Principal assumptions pertinent to this model are listed below.

a. Soil.

(1) The mean rating cone index RCI_{z_1,z_2} for a critical layer between depths z_1 and z_2, selected according to vehicle weight and type, soil type, and CI profile character, adequately represents the full CI profile.

(2) There is no large discontinuity between mass soil strength and surface soil strength.

(3) Nonwoody surface vegetation has no effect on performance.

(4) Soil stickiness has no effect on performance.

b. Vehicle.

(1) The vehicle moves only in straight, unaccelerated motion.

(2) Sufficient torque is available for self-propulsion in all soil conditions.

(3) Individual tractive elements (tires or tracks) share the gross load equally.

(4) All wheels in contact with the ground are powered.

(5) Tire deflection on self-propelled, wheeled vehicles is assumed constant at the level determined by the inflation pressure recommended for the vehicle in cross-country operation.

Soil parameters

4. Soil parameters used in this model are:

a. CI or RCI

b. Gross slope

c. Classification of soil (fine-grained, coarse-grained, or organic)

d. Critical layer:

(1) It may vary with weight and type of vehicle and soil strength profile.

(2) For freely draining or clean sand, it is usually the 0- to 6-in. layer.

(3) For fine-grained soil and remoldable sand, it is usually the 0- to 6-in. layer for 1-pass performance and the 6- to 12-in. layer for 50-pass performance.

Vehicle parameters

5. Vehicle parameters pertinent to this model are:

a. Tracked vehicles

(1) Gross weight
(2) Track width
(3) Track ground-contact area
(4) Track pitch
(5) Grouser height
(6) Total number of bogies or road wheels for all tracks
(7) Ground clearance to lowest point on hull
(8) Engine horsepower
(9) Transmission type (manual or automatic)

b. Wheeled vehicles

(1) Gross weight
(2) Number of tires
(3) Tire nominal width
(4) Undeflected tire outside diameter
(5) Tire inflation pressure
(6) Tire ply rating
(7) Number of axles
(8) Ground clearance to lowest point on chassis
(9) Engine horsepower
(10) Transmission type (manual or automatic)

Fine-grained soil and remoldable sand

6. VCI, towed-motion resistance, and drawbar-pull performance curves were derived from actual measurements in over 1,600 tests run in prepared and natural soil materials with self-propelled and towed wheeled and tracked vehicles. The complete data base covers a wide range of vehicle characteristics and types of fine-grained soils. Test vehicle weights ranged from about 4,000 to more than 100,000 lb; tire diameters ranged from about 30 to 60 in.; and soil conditions included all fine-grained soil types, each in strengths ranging from unquestionable go to unquestionable no go for each vehicle tested in it.

7. In fine-grained soils

$$VCI = RCI = \frac{1}{n+1} \sum_{j=0}^{j=n} CI_j \times RI_j \qquad (A1)$$

where

n = number of equal divisions in critical layer used for measurement purposes

j = summation index

CI_j = before-traffic CI for soil at a depth z

RI_j = RI at depth z

Depth z is determined by

$$z = z_1 + j \frac{(z_2 - z_1)}{n} \qquad (A2)$$

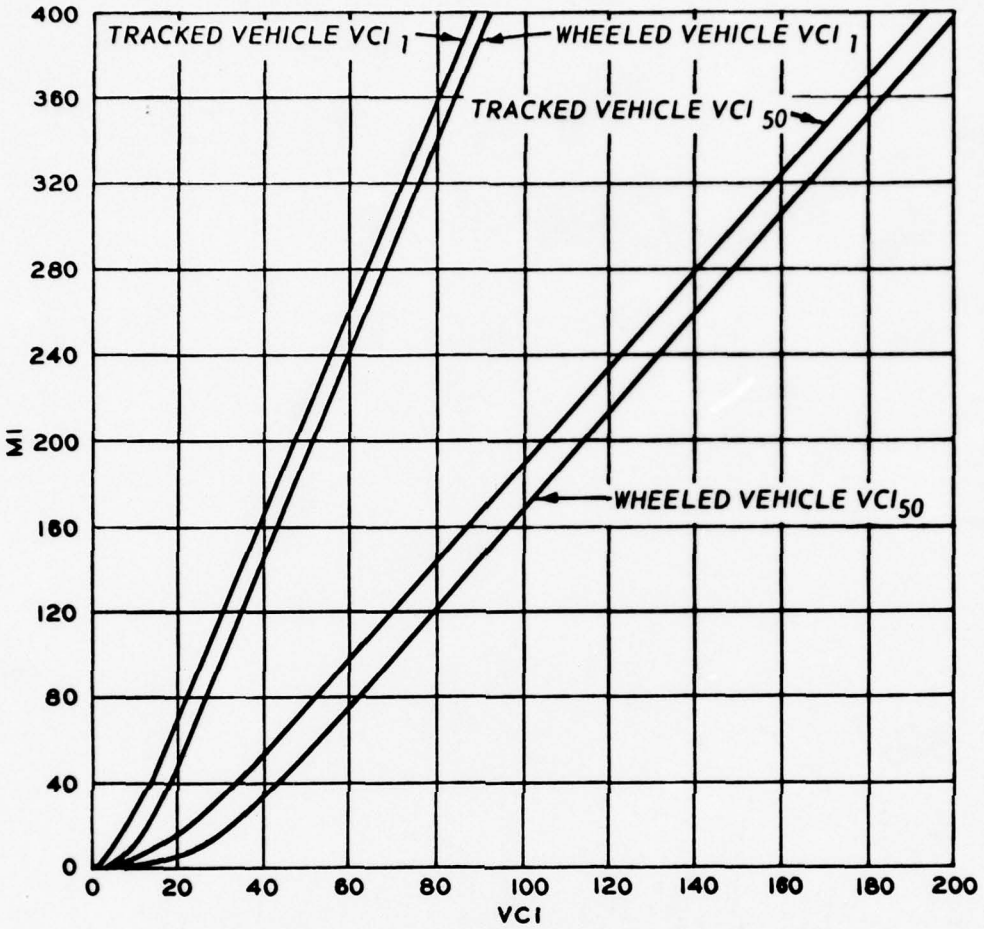
where z_1, z_2 = depth boundaries of the critical layer

8. The fundamental relations and empirically derived equations and graphs that are component parts of the WES-VCI model are used for predicting vehicle performance in fine-grained soils and are outlined below.

a. The mobility index (MI) is determined from Equation A3 or A4 for tracked or wheeled vehicles, respectively. These equations for self-propelled vehicles are given in Tables A1 and A2, respectively. Equations for computing MI for towed wheeled and tracked trailers are available; but since they are not used in any analytical ground mobility model, they are not included herein.

b. VCI is a function of vehicle type, MI, and the number of passes to be completed where VCI_1 is the VCI for 1 pass and VCI_{50} is the VCI for 50 passes. It is obtained from the curves in Figure A1.

c. The net maximum drawbar-pull coefficient on level ground and the corresponding maximum slope negotiable are determined as functions of the excess RCI over VCI (i.e., RCI - VCI), shown in Figure A2; classification of vehicle type; and number of passes to be completed. The relations used for 1- and 50-pass traffic for tracked and wheeled vehicles are given in Figures A3, and A4, respectively.



TRACKED VEHICLES

$$VCI_1 = 7.0 + 0.2\,MI - \left(\frac{39.2}{MI + 5.6}\right) \quad (1)$$

$$VCI_{50} = 19.27 + 0.43\,MI - \left(\frac{125.79}{MI + 7.08}\right) \quad (2)$$

WHEELED VEHICLES

$$VCI_1 = 11.48 + 0.2\,MI - \left(\frac{39.2}{MI + 3.74}\right) \quad (3)$$

$$VCI_{50} = 28.23 + 0.43\,MI - \left(\frac{92.67}{MI + 3.67}\right) \quad (4)$$

Figure A1. Relation of MI to VCI for self-propelled vehicles

$$U = 0.0146X + 0.419 - \sqrt{(0.0146X + 0.419)^2 - 0.021X} \quad (1)$$

$$U = 0.0146X + 0.425 - \sqrt{(0.0146X + 0.425)^2 - 0.0198X} \quad (2)$$

$$U = 0.0109X + 0.366 - \sqrt{(0.0109X + 0.366)^2 - 0.013X} \quad (3)$$

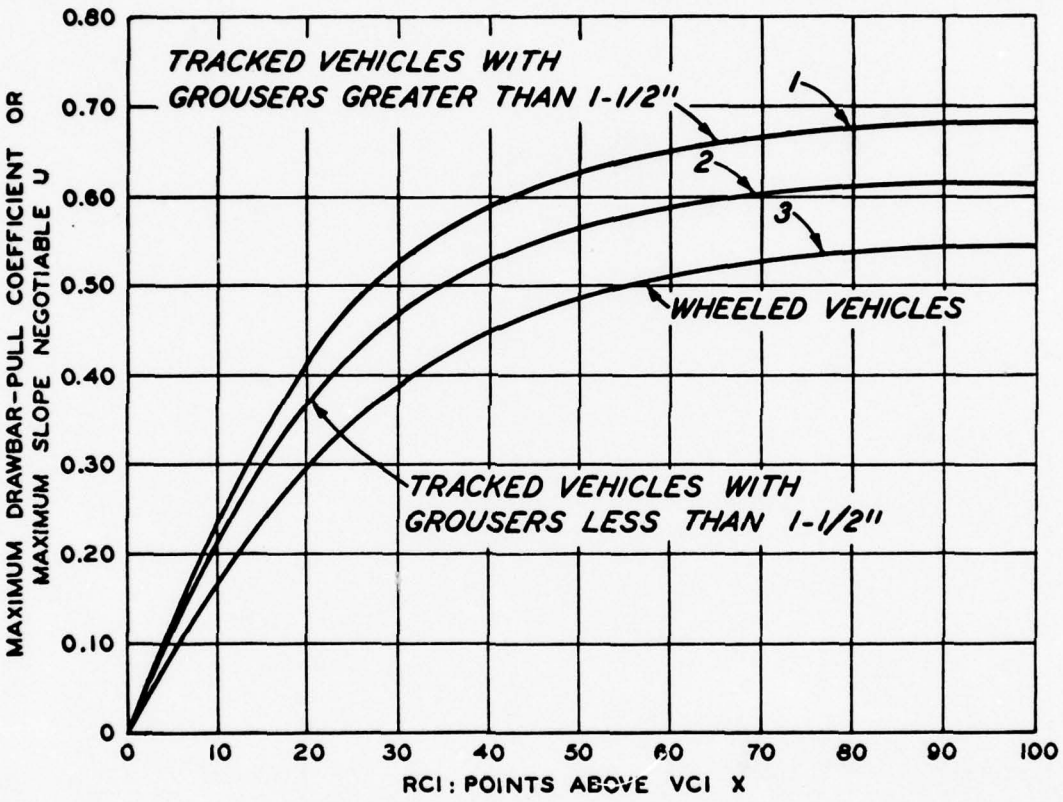
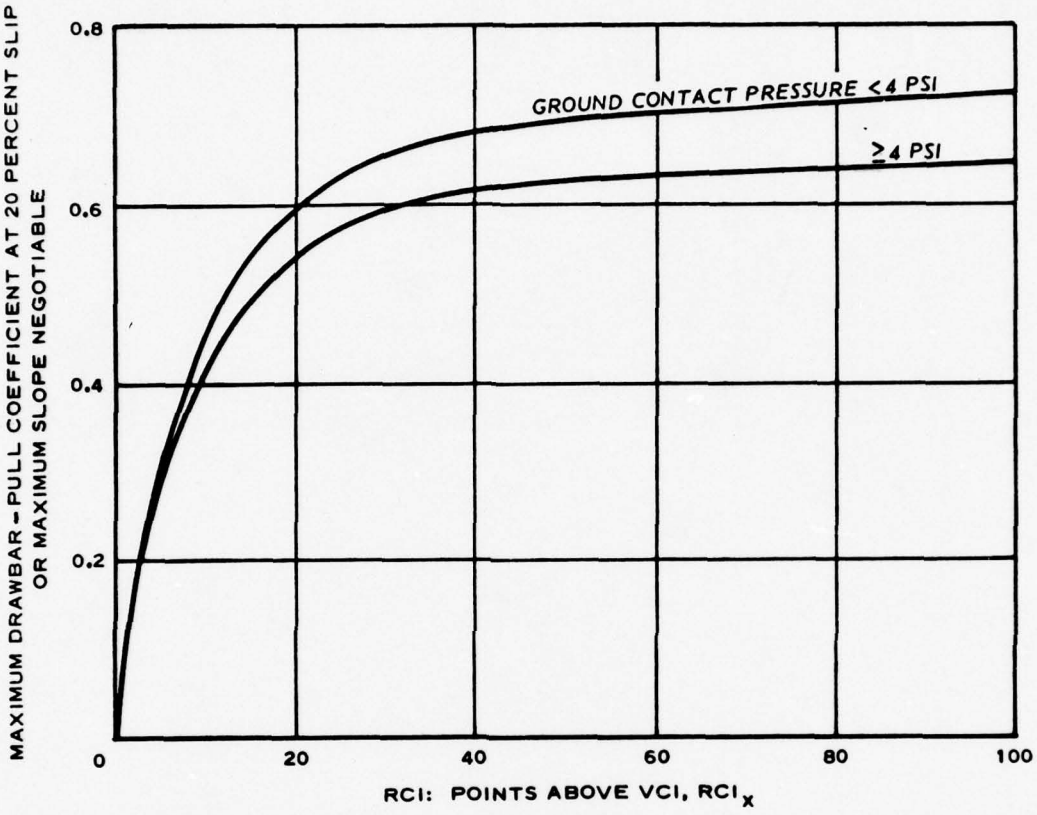
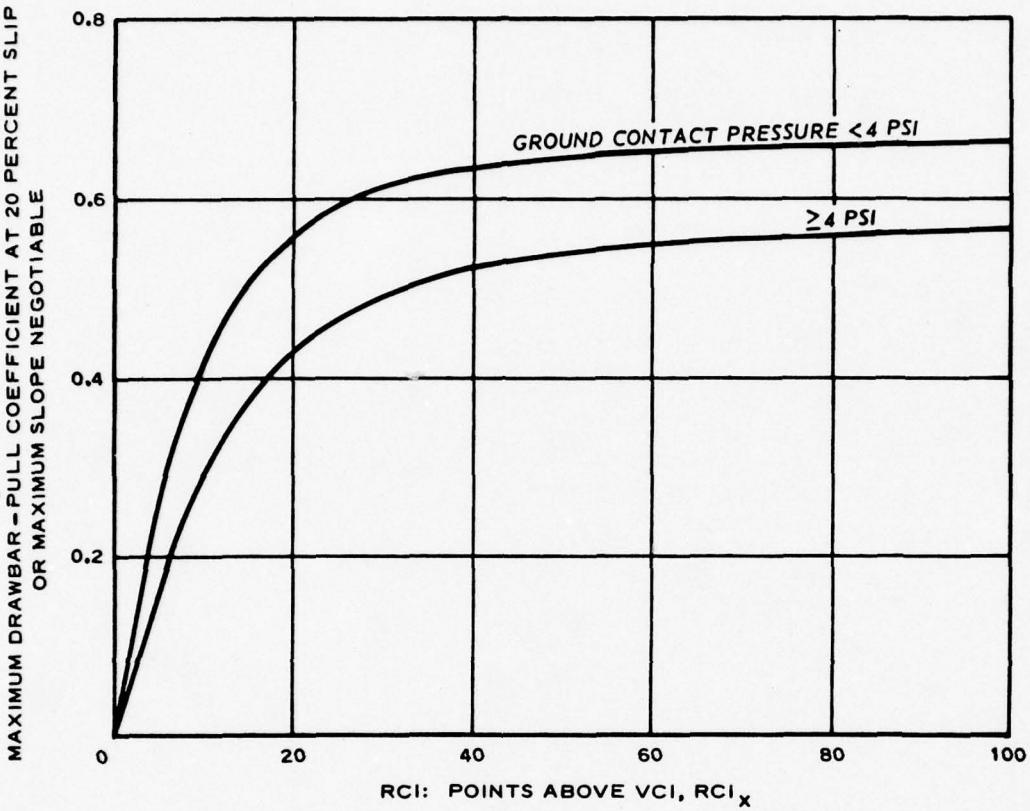


Figure A2. Relation of 50-pass maximum drawbar pull on level ground and maximum slope negotiable to RCI in excess of VCI



GROUND CONTACT PRESSURE PSI	
< 4	$DBP/W = 0.544 + 0.046\ RCI_X - (0.544 + 0.0463\ RCI_X)^2 - 0.0702\ RCI_X$
≥ 4	$DBP/W = 0.4554 + 0.0392\ RCI_X - (0.4554 + 0.0392\ RCI_X)^2 - 0.525\ RCI_X$

Figure A3. Relation of 1-pass maximum drawbar pull or maximum slope negotiable-soil strength for tracked vehicles operating on fine-grained soil



GROUND CONTACT PRESSURE PSI	
<4	$DBP/W = 0.544 + 0.046\ RCI_X - (0.544 + 0.0463\ RCI_X)^2 - 0.0702\ RCI_X$
≥4	$DBP/W = 0.4554 + 0.0392\ RCI_X - (0.4554 + 0.0392\ RCI_X)^2 - 0.525\ RCI_X$

Figure A4. Relation of 1-pass maximum drawbar pull or maximum slope negotiable-soil strength for wheeled vehicles operating on fine-grained soil

d. The towed-motion resistance coefficient on level ground can be estimated from its relation to RCI or excess RCI, the classification of the vehicle by load and type, and the number of passes to be completed. The relations used for 50 passes and 1 pass are shown in Figures A5 and A6, respectively.

Coarse-grained soil

9. The same basic soil and vehicle characteristics are used to predict vehicle performance in coarse-grained soils (clean sands) in terms of VCI, towed-motion resistance, drawbar pull, and maximum slope negotiable for tracked and wheeled vehicles. The relevant data were derived from some 1,400 tests of self-propelled wheeled vehicles (all-wheel drive) and about 200 tests of self-propelled tracked vehicles run mostly in natural sand conditions. Test site data are characteristic of dry and moist sands commonly found in inland deserts of the United States and on continental and river beaches of the United States and foreign countries. The sands were of quartz, coral, and volcanic ash origin. The available test data represent a reasonable range in vehicle and soil characteristics. The soil types tested included sand, gravel, and sand and gravel mixtures. Wheeled vehicle test weights ranged from 2,600 to 33,000 lb, tire diameters ranged from about 30 to 65 in., and tire pressures ranged from 10 to 60 psi. Tracked vehicles tested included those with girderized and flexible track with weights ranging from 4,500 to about 36,000 lb.

10. In clean sands

$$VCI_1 = \overline{CI}_{z_1,z_2} \tag{A5}$$

where

$\overline{CI}$ = average before-traffic cone index

11. Tracked vehicles. Data available on tracked vehicle performance in coarse-grained soils indicate that tracked vehicles usually experience little or no difficulty traversing level, clean sands. The effects of soil strength and ground contact pressure on the performance (drawbar pull and slope climbing) of a given tracked vehicle are small.

$$Y = 0.1858 - 0.01453X + \sqrt{(0.1858 - 0.01453)^2 - 0.00224X + 0.8623} \quad (1)$$

$$Y = 0.1609 - 0.00595X + \sqrt{(0.1609 - 0.00595X)^2 - 0.001X + 0.2838} \quad (2)$$

$$Y = 0.6 - 0.00885X + \sqrt{(0.6 - 0.00885X)^2 + 0.001X + 0.027} \quad (3)$$

$$Y = 0.4167 - 0.01052X + \sqrt{(0.4167 - 0.01052X)^2 + 0.1886} \quad (4)$$

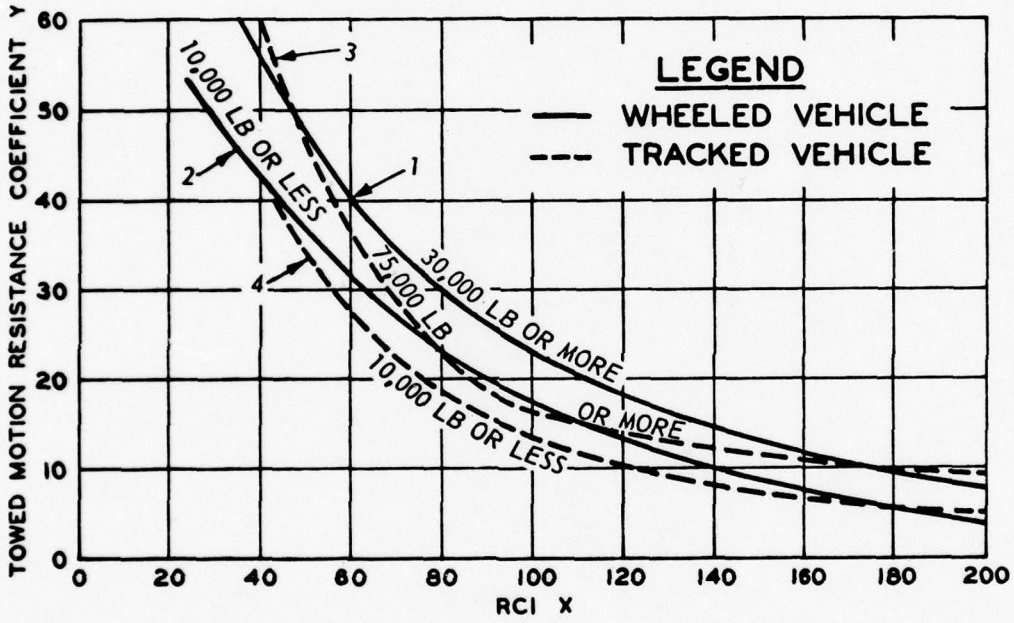


Figure A5. Relation of 50-pass towed motion resistance on level ground to RCI

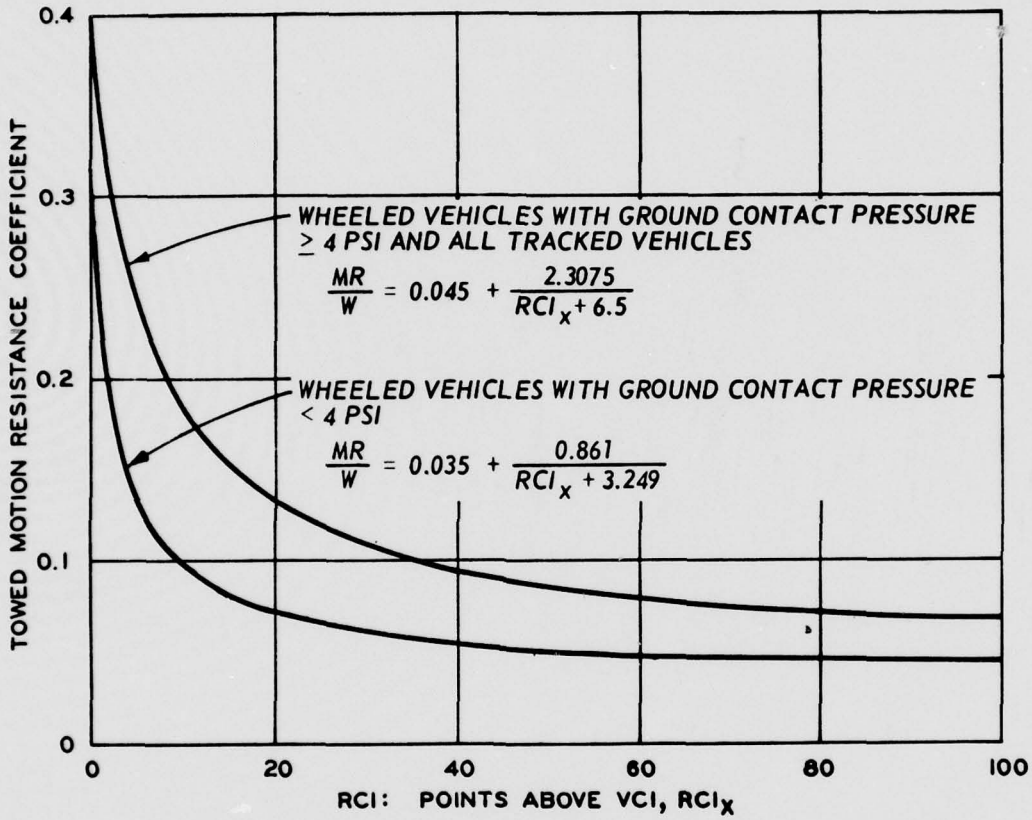


Figure A6. Relation of 1-pass towed motion resistance-soil strength for tracked and wheeled vehicles operating on fine-grained soils

Track type appears to be the principal factor influencing performance, as shown in Figure A7. On the basis of these data, average drawbar-pull values of 50 and 56 percent of gross vehicle weight are used for prediction purposes for flexible and girderized tracks, respectively. Motion resistance has not been well-defined. For the time being, however, the following equations are used.

a. Flexible tracks:

$$MR_s = 0.10W \tag{A6}$$

b. Girderized tracks:

$$MR_s = 0.074W \tag{A7}$$

where

MR_s = towed-motion resistance (soil), lb

W = gross vehicle test weight, lb

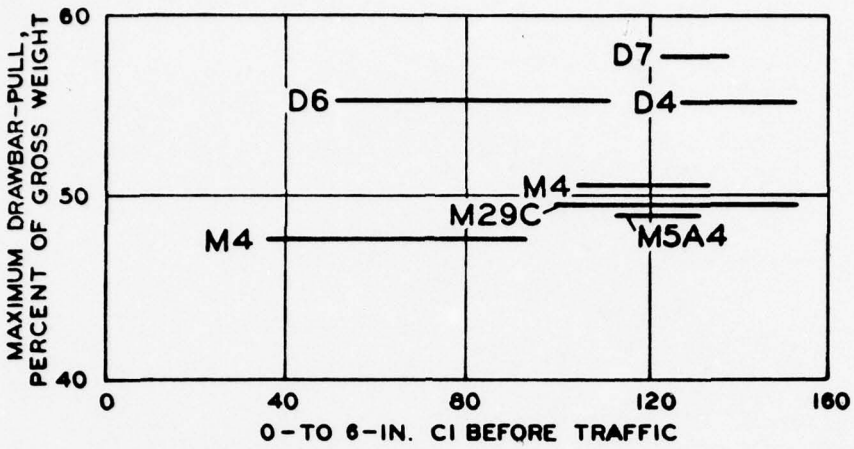
12. Wheeled vehicles. From the individual tests, 352 separate empirical soil-vehicle performance relations (see Figure A8a for examples) were established for specific vehicles, and data from these relations were input to a statistical analysis to develop regression equations relating the performance parameters to soil and vehicle factors. Multiple curvilinear regression techniques were used to establish equations for predicting VCI, maximum drawbar pull, and maximum slope negotiable; and linear regression techniques were used to develop an equation for towed-motion resistance. An example of the soil-vehicle performance parameter relations used in the analysis is shown in Figure A8. The vehicle and soil characteristics used, together with forms for computing performance, are given in Tables A3 and A4.

13. The equations for vehicle performance in coarse-grained soil resulting from this statistical analysis are as follows:

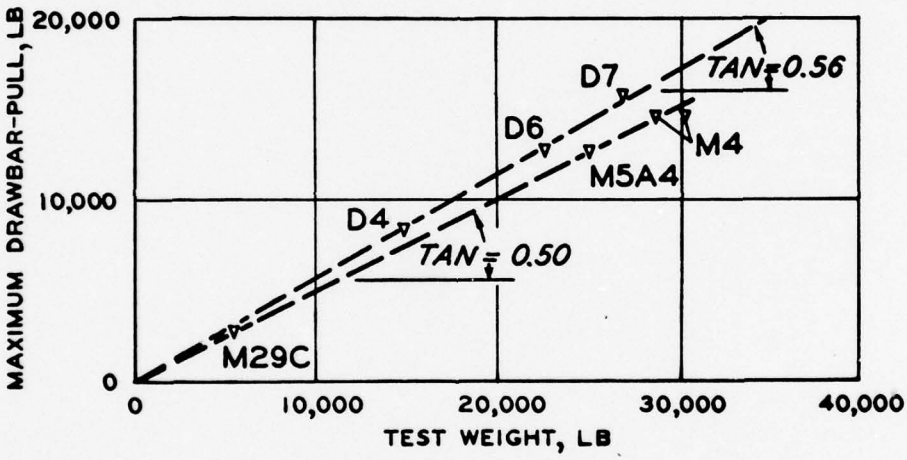
a. $VCI_1 = \text{antilogarithm}^* (-0.350X_2 + 0.0526X_3 + 0.0211X_4 + 1.5870)$. (A8)

b. Maximum drawbar pull, percent of gross weight $= (28.87X_1 + 10.10X_2 - 1.52X_3 - 0.61X_4 - 43.82)$ (A9)

* Logarithm to the base 10.



a. MAXIMUM DRAWBAR PULL, PERCENT OF VEHICLE WEIGHT



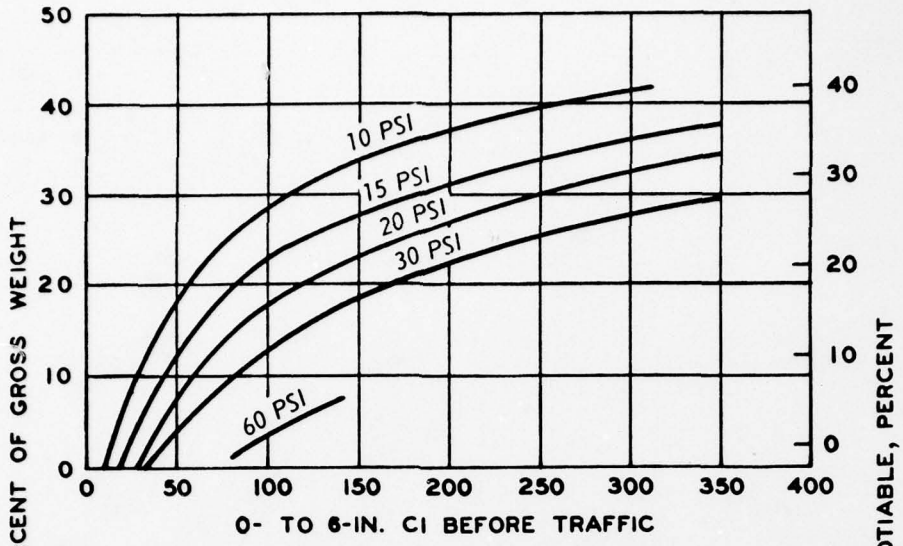
b. MAXIMUM DRAWBAR PULL, LB

LEGEND

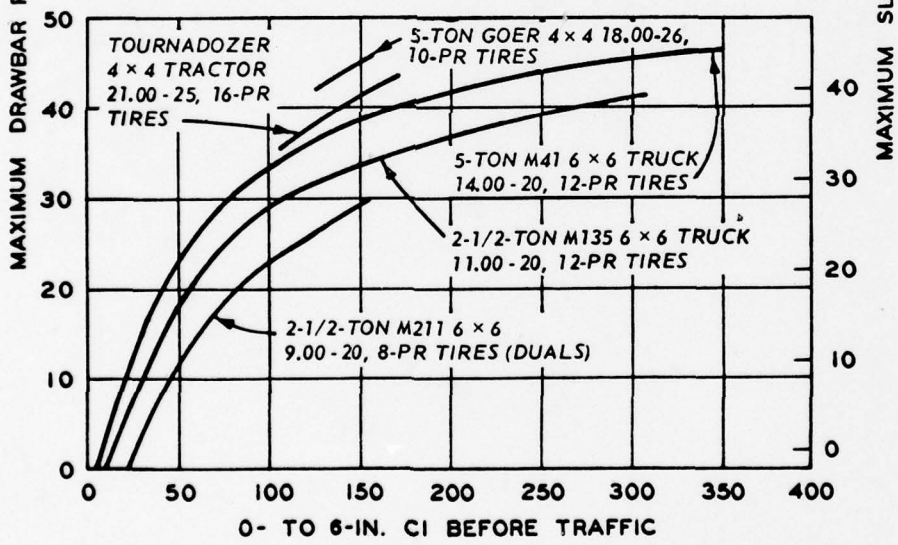
D4, D6, & D7 ENGINEER TRACTORS (GIRDERIZED TRACKS)

M4 & M5A4 HI-SPEED TRACTORS
M29C WEASEL
} (FLEXIBLE TRACKS)

Figure A7. Determination of maximum drawbar pull of tracked vehicles in dry-to-moist sand



a. EFFECT OF TIRE PRESSURE ON VEHICLE PERFORMANCE ON DRY-TO-MOIST SAND. M34 AND M135, 2-1/2-TON, 6×6 TRUCKS; 11.00-20, 12-PR, NDCC TIRES



b. EFFECT OF TIRE SIZE ON VEHICLE PERFORMANCE ON DRY-TO-MOIST SAND. VEHICLES OPERATED AT 10-PSI TIRE PRESSURE

Figure A8. Soil-vehicle performance relations used in coarse-grained soil prediction analysis

c. Maximum slope negotiable, percent = $(28.87X_1 + 10.10X_2 - 1.52X_3 - 0.61X_4 - 45.82)$ (A10)

d. Towed-motion resistance, percent = $\left\{(22.20 + 0.92 \times X_4) + \left[(-8 - 0.37 \times X_4)(\log X_1)\right]\right\}$ (A11)

where, for Equations A8, A9, A10, and A11,

X_1 = log of CI

X_2 = log of estimated total contact area in square inches (see Tables A3 and A4)

X_3 = number of tires powered

X_4 = tire inflation pressure, psi

45.82 and 43.82 = equation constants

14. The equations in the preceding paragraph were derived from available data, and after-the-fact field tests have not been conducted to determine their prediction accuracy. However, on the basis of the go and no-go performance data from which the relations were derived, the equations for maximum slope negotiable (Equation A10) and VCI_1 (Equation A8) predicted vehicle performance with an accuracy of 78 percent. The quality of the relations established, in terms of absolute deviation,* was the same (0.02) for both maximum drawbar pull (Equation A9) and towed-motion resistance (Equation A11).

15. Fundamental relations. The fundamental relations used in the WES-VCI submodel for predicting performance of vehicles operating in coarse-grained soils are summarized below.

a. Means for computing a VCI for tracked vehicles have not been developed.

b. VCI for wheeled vehicles is determined using a regression equation (Equation A8) involving vehicle type, soil slope, and vehicle characteristics. This equation is for dry-to-moist sands only; investigations of wet and inundated sands, which may present some problems for heavy vehicles because of sand liquefaction, have not been completed.

c. The net maximum drawbar-pull coefficient of and the corresponding maximum slope negotiable by wheeled vehicles are determined from empirical relations of CI and vehicle type classifications (Equations A9 and A10).

---

* Without regard to algebraic signs.

d. Motion-resistance coefficient, or percentage of gross vehicle weight, on level ground can be estimated by its relation to track type for tracked vehicles (Equations A6 and A7), and to tire pressure and CI for wheeled vehicles (Equation A11).

Application of WES-VCI Submodel

16. This part of the report presents examples of computational procedures and application of the WES-VCI submodel to type of surface material (fine- or coarse-grained soil), specific type of vehicle (tracked or wheeled), and traffic volume (1 or 50 passes).

Fine-grained soil

17. The submodel can be used to determine the number and type of vehicles that can cross an area, the loads they can tow, and the slopes they can climb. For a given area of fine-grained soil with an RCI equal to or higher than the VCI_1 or VCI_{50} of the vehicle in question, sufficient soil strength is available to permit the vehicle to complete 1 or 50 passes in the same straight-line path traveling at a slow speed. If it is desirable or necessary to enter an area, stop, back out of the ruts while turning, and retreat from the area, then the RCI of the area should be at least five RCI units higher than the VCI.

18. Criteria to establish fine-grained soil requirements for 50 passes in the same ruts were developed a number of years ago and have remained essentially unchanged. Criteria to establish soil requirements for 1 pass have been developed in recent years and are slightly different from the 50-pass criteria, but are more applicable to current needs.

19. Methods for determining minimum soil strength requirements and maximum drawbar pull for 1- and 50-pass traffic for self-propelled tracked and wheeled vehicles are illustrated in the following paragraphs. The effects of buoyancy in soft soil on VCI determinations are also discussed (Appendix B).

20. Determination of VCI_1 and VCI_{50} for self-propelled tracked and wheeled vehicles. Compute MI using Equation A3 (Table A1) for a tracked vehicle and Equation A4 (Table A2) for a wheeled vehicle.

Vehicle I-1, model J-5 Tractor (tracked), and vehicle I-9, model Kidd (wheeled), are used in the following examples. From the vehicle specification sheets in Appendix C, determine the necessary vehicle factors as follows:

	Tracked Vehicle I-1	Wheeled Vehicle I-9
Contact pressure	1.95	4.09
Weight factor	1.00	0.44
Track or tire factor	0.16	0.18
Grouser factor	1.00	1.00
Bogie factor or wheel load factor	1.02	0.40
Clearance factor	1.30	0.65
Engine factor	1.00	1.00
Transmission factor	1.05	1.05

Enter the above factors in the MI equations (A3 and A4) as follows:

a. For tracked vehicle I-1:

$$MI = \frac{1.95 \times 1.00}{0.16 \times 1.00} + 1.02 - 1.30 \times 1.00 \times 1.05 = 12.50$$

b. For wheeled vehicle I-9:

$$MI = \frac{4.09 \times 0.44}{0.18 \times 1.00} + 0.40 - 0.65 \times 1.00 \times 1.05 = 10.24$$

21. From Figure A1 (relations of MI to VCI):

a. VCI_1 for tracked vehicle I-1

$$= 7.0 + 0.2(12.5) - \left(\frac{39.2}{12.5 + 5.6}\right) = 7.33 \text{ or } 7$$

b. VCI_{50} for tracked vehicle I-1

$$= 19.27 + 0.43(12.5) - \left(\frac{125.79}{12.5 + 7.08}\right) = 18.22 \text{ or } 18$$

c. VCI_1 for wheeled vehicle I-9

$$= 11.48 + 0.2(10.24) - \left(\frac{39.2}{10.24 + 3.74}\right) = 10.72 \text{ or } 11$$

d. VCI_{50} for wheeled vehicle I-9

$$= 28.23 + 0.43(10.24) - \left(\frac{92.67}{10.24 + 3.67}\right) = 25.97 \text{ or } 26$$

22. Determination of maximum drawbar pull for 1 pass and 50 passes of self-propelled vehicles. When RCI = VCI, the soil has sufficient shear strength for a given vehicle to overcome its motion resistance. If the vehicle is required to tow a load, additional shear strength is required to produce the necessary thrust to overcome the additional motion resistance. Then RCI - VCI, or RCI_x, is a measure of additional shear strength that allows the vehicle to develop a towing force

(drawbar-pull) when required. Maximum drawbar-pull performance curves for 1 pass and 50 passes are presented for tracked wheels in Figures A2, A3, and A4, where maximum drawbar pull, expressed as a coefficient of gross vehicle weight that can be developed by a vehicle traveling in a straight line on level terrain, is related to RCI_x.

23. The maximum drawbar-pull performance relations for the tracked and wheeled vehicles used in this illustration are presented in Figures A9 and A10, respectively. These relations were developed from the following values, computed from the denoted curves.

a. Tracked vehicle I-1, 1-pass performance (Figure A3, upper curve).

RCI_x	RCI	Maximum Drawbar Pull	
		Coefficient	lb
0 (VCI_1)	7	0	0
5	12	0.27	0.27 × 4500 = 1214
10	17	0.44	0.44 × 4500 = 1980
15	22	0.55	0.55 × 4500 = 2475
20	27	0.60	0.60 × 4500 = 2700
40	47	0.68	0.68 × 4500 = 3060
100	107	0.73	0.73 × 4500 = 3285

b. Tracked vehicle I-1, 50-pass performance (Figure A2, curve 2).

RCI_x	RCI	Maximum Drawbar Pull	
		Coefficient	lb
0 (VCI_{50})	18	0	0
10	28	0.21	0.21 × 4500 = 945
20	38	0.37	0.37 × 4500 = 1665
30	48	0.48	0.48 × 4500 = 2160
40	58	0.55	0.55 × 4500 = 2475
50	68	0.58	0.58 × 4500 = 2610
100	118	0.62	0.62 × 4500 = 2925

c. Wheeled vehicle I-9, 1-pass performance (Figure A4, upper curve).

RCI_x	RCI	Maximum Drawbar Pull	
		Coefficient	lb
0 (VCI_1)	11	0	0
5	16	0.15	0.15 × 3200 = 480
10	21	0.27	0.27 × 3200 = 864
15	26	0.36	0.36 × 3200 = 1152
20	31	0.42	0.42 × 3200 = 1344
40	51	0.52	0.52 × 3200 = 1664
100	111	0.56	0.56 × 3200 = 1792

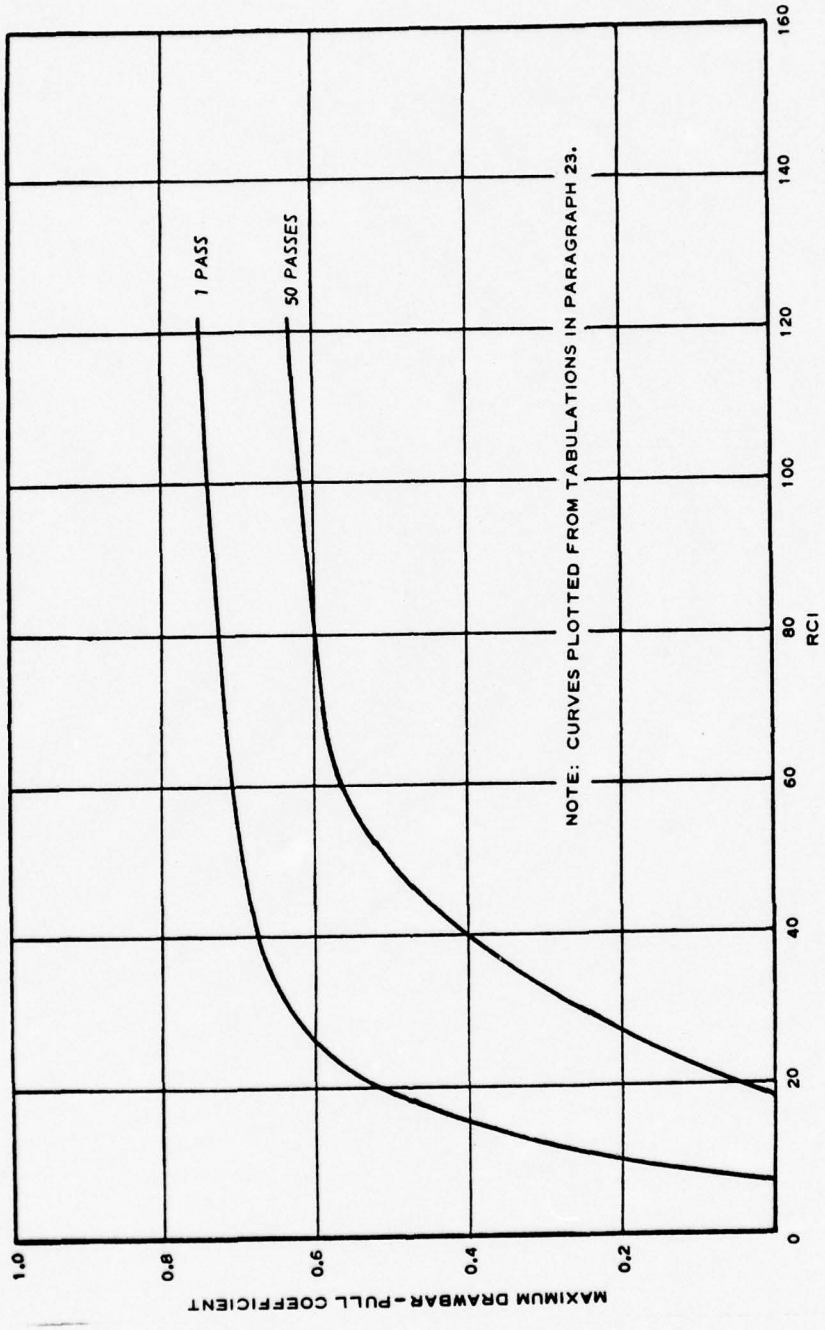


Figure A9. One- and 50-pass maximum drawbar-pull performance versus RCI, tracked vehicle I-1

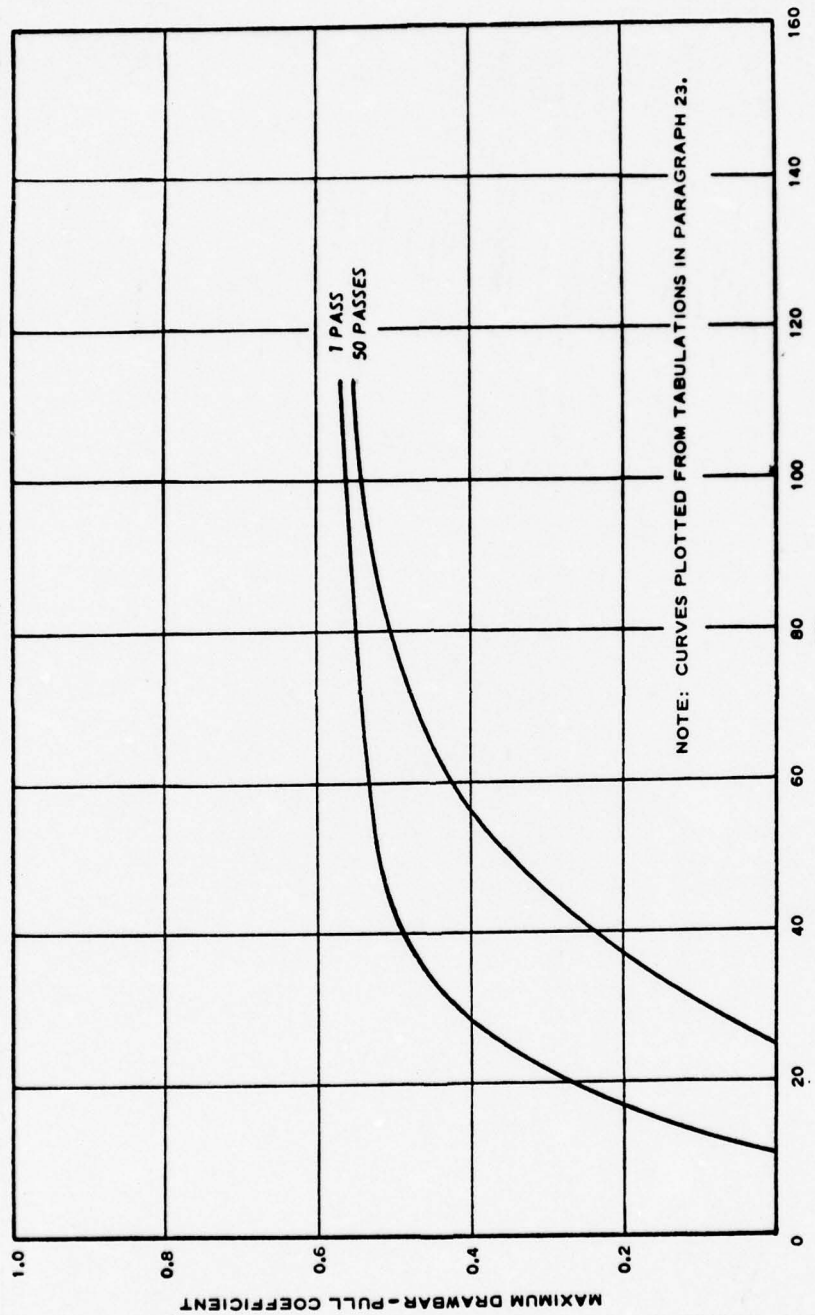


Figure A10. One- and 50-pass maximum drawbar-pull performance versus RCI, wheeled vehicle I-9

d. Wheeled vehicle I-9, 50-pass performance (Figure A2, curve 3).

RCI_x	RCI	Maximum Drawbar Pull	
		Coefficient	lb
0 (VCI_{50})	26	0	0
10	36	0.16	0.16 × 1395 = 223
20	46	0.30	0.30 × 1395 = 418
30	56	0.39	0.39 × 1395 = 544
40	66	0.45	0.45 × 1395 = 628
50	76	0.48	0.48 × 1395 = 670
100	126	0.55	0.55 × 1395 = 767

24. These computations are plotted in Figure A11 to demonstrate a method of graphically comparing performance evaluations among vehicles.

25. Effects of buoyancy in soft, viscous soil on VCI determinations. Limited testing of vehicles in areas of soft, viscous soil indicates that, if the vehicles can develop sufficient forward thrust to negotiate the areas, the immersing of traction elements and undercarriage in the soil provides immediate buoyancy, thus reducing the effective weight (gross vehicle weight minus buoyancy) of the vehicle by an amount equal to the volume displaced times the unit weight of the viscous soil. Since buoyancy of soft soils affects the weight of the vehicle, which, in turn, directly affects VCI determinations, closer agreement between computed and experimental VCI was afforded for such vehicles as the pneumatic track vehicle (Appendix C, vehicle II-8). An example of these computations is given in Appendix B. This approach may provide some adjustments needed to compute VCI's for nonstandard vehicles, such as the Riverine Utility Craft[5] (Appendix C, vehicle II-3) and others.

Coarse-grained soils

26. Coarse-grained soils (clean sands) present mobility problems different from those encountered in fine-grained soils because of differences in soil behavior under the vehicles' running gears. A few of the important differences in vehicle performance are as follows:

a. Tire inflation pressure changes affect wheeled vehicle performance more on coarse-grained soils than on fine-grained soils.

b. Level, coarse-grained soils seldom cause immobilizations of tracked vehicles or all-wheel-drive vehicles when the

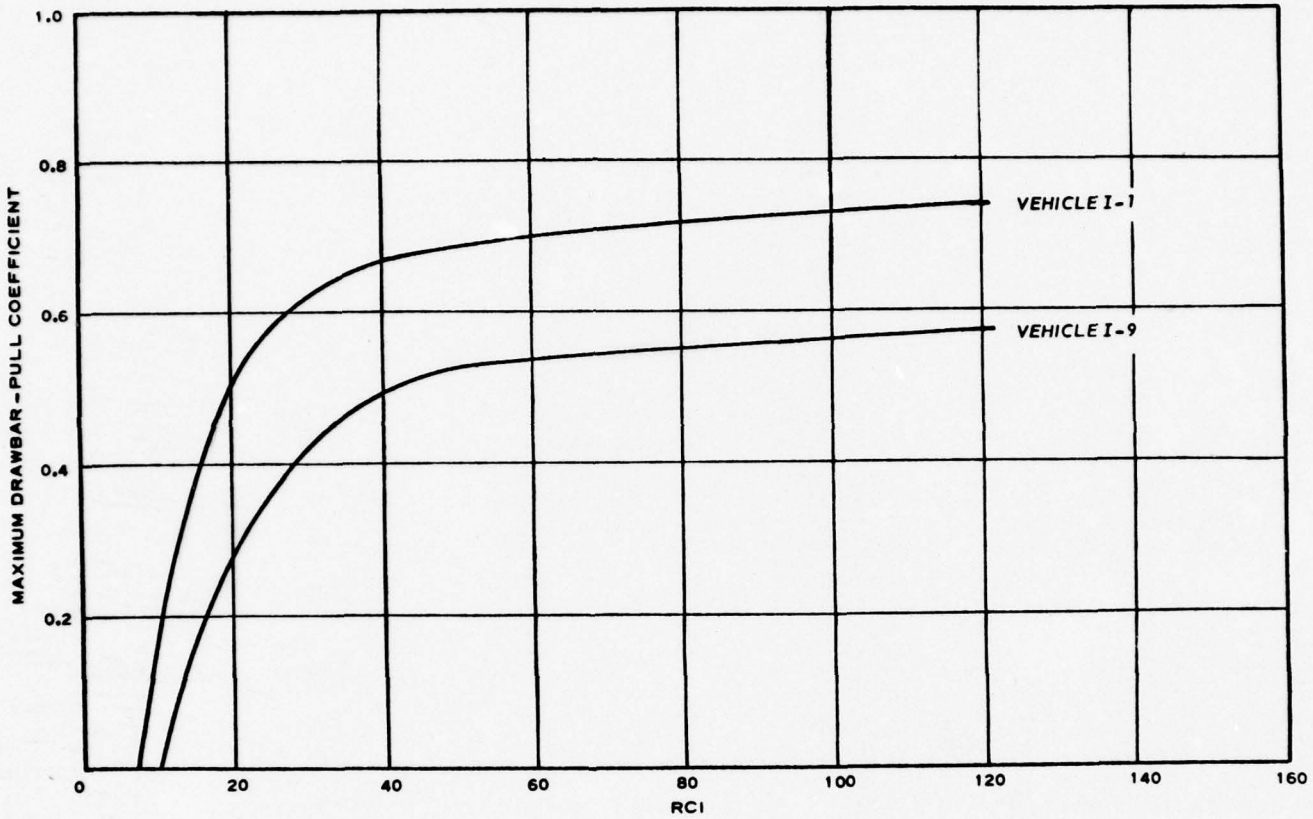


Figure A11. Comparative 1-pass performance evaluation of vehicles I-1 and I-9

wheeled vehicles are operating at low tire inflation pressures.

c. The first pass over a coarse-grained soil area is the most critical; subsequent passes are usually ensured if following passes are made in the first-pass ruts.

d. Loose sands are easily displaced by vehicles turning and maneuvering on them, producing irregular surfaces that are more difficult to negotiate by subsequent vehicles.

27. Testing, to date, has not permitted development of CI performance relations for tracked vehicles since all tracked vehicles have been able to travel in all level, coarse-grained soils encountered. Furthermore, the effect of soil strength on the maximum drawbar-pull performance of a given tracked vehicle is small. Since it has been established through testing of wheeled vehicles that the first pass is the most critical and subsequent passes are assured if the first pass is successful, only 1-pass CI performance relations of wheeled vehicles were developed.

28. Criteria for determining performance of vehicles in coarse-grained soils are presented in paragraphs 9-14. Two examples, one tracked vehicle and one wheeled vehicle, of the application of the criteria are presented in the following paragraphs. For this presentation, VCI for coarse-grained soils is distinguished from VCI for fine-grained soils by the addition of an S to the former, i.e., VCIS. Inflation pressures are denoted by the addition of appropriate numerals, e.g., VCIS-15 is the VCIS at 15-psi pressure.

29. Determination of maximum drawbar pull of tracked vehicles. To determine the maximum drawbar pull of vehicle I-1, Appendix C, use the equation of the straight line through the data points for flexible tracks in Figure A7b:

$$\begin{aligned}\text{Maximum drawbar pull, lb} &= 0.50 \times \text{test weight, lb} \\ &= 0.50 \times 4500 \\ &= 2250 \text{ lb, or 50 percent of gross vehicle weight.}\end{aligned}$$

30. Determination of VCI and maximum drawbar pull of wheeled vehicles. To determine the performance of vehicle I-6, Appendix C, assume the inflation pressure to be 3 psi, and compute VCIS-3 using Equation A8 as follows:

$$\text{VCIS-3} = \text{antilog}_{10}\ -0.35(1.98) + 0.0526(4) + 0.0211(3) + 1.587$$
$$= \text{antilog}_{10}\ -0.69 + 0.21 + 0.063 + 1.587$$
$$= \text{antilog}_{10}\ 1.170$$
$$= 14.79, \text{ or } 15$$

The vehicle will operate on level, coarse-grained soil with a CI of 15.

31. To compute the maximum drawbar pull for the same vehicle identified above when the vehicle is operating on a coarse-grained soil with a CI of 100, use Equation A9:

Maximum drawbar pull,

$$\text{percent of vehicle gross weight} = 28.87(2) + 10.10(1.98) - 1.52(4) - 0.61(3) - 43.82$$
$$= 57.74 + 20.00 - 6.08 - 1.83 - 43.82$$
$$= 26.0$$

Therefore, the vehicle can tow 26.0 percent of its gross weight on a level, coarse-grained soil with a CI of 100.

Table A1

Mobility Index Equation for Self-Propelled Tracked Vehicles (Equation A3)

$$MI^{*} = \left(\frac{\text{contact pressure factor} \times \text{weight factor}}{\text{track factor} \times \text{grouser factor}} + \text{bogie factor} - \text{clearance factor} \right) \times \text{engine factor} \times \text{transmission factor} \qquad \text{(A3)}$$

where

Contact pressure factor:	$\frac{\text{gross weight, lb}}{\text{area of tracks in contact with ground, sq in.}}$
Weight factor:	Less than 50,000 lb = 1.0 50,000 to 69,999 lb = 1.2 70,000 to 99,999 lb = 1.4 100,000 lb or greater = 1.8
Track factor:	$\frac{\text{track width, in.}}{100}$
Grouser factor:	Grousers less than 1.5 in. high = 1.0 Grousers more than 1.5 in. high = 1.1
Bogie factor:	$\frac{\text{gross weight, lb, divided by 10}}{\text{(total number of bogies on tracks in contact with ground)} \times \text{(area, sq in., of 1 track shoe)}}$
Clearance factor:	$\frac{\text{clearance, in.}}{10}$
Engine factor:	$\geq$10 hp/ton of vehicle wt = 1.00 <10 hp/ton of vehicle wt = 1.05
Transmission factor:	automatic = 1.0 manual = 1.05

* The MI obtained is converted to VCI for 1 or 50 passes by using Equations A1 or A2, respectively, or the curves shown in Figure A1.

Table A2

Mobility Index Equation for Self-Propelled Wheeled (All-Wheel Drive) Vehicles (Equation A4)

$$MI^{*} = \left(\frac{\text{contact pressure factor}}{\text{tire factor}} \times \frac{\text{weight factor}}{\text{grouser factor}} + \text{wheel load factor} - \text{clearance factor} \right) \times \text{engine factor} \times \text{transmission factor} \qquad \text{(A4)}$$

where

Contact pressure factor:

$$\frac{\text{gross weight, lb}}{\text{nominal tire width, in.} \times \frac{\text{outside diam of tire, in.}}{2} \times \text{No. of tires}}$$

Weight factor:

Weight Range, lb**	Weight Factor Equation†
<2,000	Y = 0.553X
2,000 to 13,500	Y = 0.033X + 1.050
13,501 to 20,000	Y = 0.142X - 0.420
>20,000	Y = 0.278X - 3.115

Tire factor: $\frac{10 + \text{tire width, in.}}{100}$

Grouser factor: With chains = 1.05
Without chains = 1.00

Wheel load factor: $\frac{\text{gross weight, kips}}{\text{No. of axles} \times 2}$

Clearance factor: $\frac{\text{clearance, in.}}{10}$

Engine factor: ≥10 hp/ton = 1.00
<10 hp/ton = 1.05

Transmission factor: automatic = 1.00
manual = 1.05

* The MI obtained is converted to VCI for 1 or 50 passes by using Equations A3 or A4, respectively, or the curves shown in Figure A1.

** $\frac{\text{Gross weight, lb}}{\text{No. of axles}}$.

† Y = weight factor

$X = \frac{\text{gross weight, kips}}{\text{No. of axles}}$

Table A3

Data Form for Computing Vehicle Cone Index (VCI) for Wheeled Vehicles in Sands (All-Wheel Drive)(Equation A8)

Vehicle _____

Equation: Vehicle cone index (VCI_1) = antilogarithm* (-0.350 (contact area factor, X_2) + 0.0526 (number of tires powered, X_3) + 0.0211 (tire pressure, X_4) + 1.5870)

Vehicle Characteristics

(1) Gross vehicle wt, lb = _____

(2) Nominal tire width, in. = _____

(3) Rim diameter, in. = _____

(4) Number of tires powered = X_3 = _____

(5) Tire ply rating = _____

(6) Tire pressure, psi = X_4 = _____

Factors

(7) $\frac{\text{Nominal tire width, in.}}{\text{Rim diameter, in.}}$ = _____; if ≥2.4, factor (7) = 2.0
if <2.4, factor (7) = 5.0

(8) Wheel diameter factor = (7) × (2) + (3) = _____
= (7) × _____ + _____ = _____

(9) Contact pressure factor = $0.607 \times (6) + 1.35 \left(\frac{117.0 \times (5)}{(8)}\right) - 4.93$ = _____
= $0.607 \times$ _____ + $1.35 \left(\frac{117.0 \times \text{_____}}{\text{_____}}\right) - 4.93$
= _____

(10) Contact area factor = $X_2 = \log \frac{(1)}{(9)} = \log$ (_____) = _____

(11) Strength factor = $-0.350 \times (10) + 0.0526 \times (4) + 0.0211 \times (6) + 1.5870$ = _____ = $-0.350 \times$ _____ + 0.0526 × _____ + 0.0211 × _____ + 1.5870 = _____

Vehicle cone index (VCI_1) = antilogarithm (11) = antilogarithm (_____)
= _____

Note: Number in parentheses indicates vehicle characteristic or factor to be used in equation.

* Logarithm to the base 10.

Table A4

Data Form for Computing Maximum Net Drawbar Pull (DBP_{max}) and Maximum Slope Negotiable (S_{max}) for Wheeled Vehicles in Sands (Equations A9 and A10)

Vehicle _____

Basic Equations

$$DBP_{max}, \text{ percent of vehicle weight} = 28.87X_1 + 10.10X_2 - 1.52X_3 - 0.61X_4 - X_5 = _____ \quad \text{(A9)}$$

$$S_{max}, \text{ percent} = 28.87X_1 + 10.10X_2 - 1.52X_3 - 0.61X_4 - X_6 = _____ \quad \text{(A10)}$$

Vehicle Characteristics and Cone Index

(1) Gross wt, lb _____ (2) Nominal tire width, in. _____

(3) Rim diameter, in. _____ (4) No. of tires powered _____

(5) Tire ply rating _____ (6) Tire inflation pressure, psi _____

(7) CI of 0- to 6-in. layer _____

X Factors

X_1 = strength factor = log (7) = _____

X_2 = contact area factor = $\log \frac{(1)}{(X_a)}$ = _____

X_a = contact pressure factor = $0.607 \times (6) + 1.35 \left(\frac{117.0 \times (5)}{(X_b)} \right) - 4.93$ = _____

X_b = wheel diameter factor = $X_7 \times (2) + (3)$ = _____

X_3 = same as (4)

X_4 = same as (6)

X_5 = 43.82 for maximum net drawbar-pull computations

X_6 = 45.82 for maximum slope negotiable

$X_7 = \frac{\text{nominal tire width, in.}}{\text{rim diameter, in.}}$ = _____ if ≥ 2.4 factor (7) = 2.0; if < 2.4 factor (7) = 5.0

DBP_{max} = 28.87(_____) + 10.10(_____) - 1.52(_____) - 0.61(_____) - 43.82

= _____

S_{max} = 28.87(_____) + 10.10(_____) - 1.52(_____) - 0.61(_____) - 45.82

= _____

Note: Number in parentheses indicates the vehicle characteristic, CI, or X factor to use.

APPENDIX B: EFFECTS OF SOFT-SOIL BUOYANCY ON VEHICLE CONE INDEX DETERMINATION*

Introduction

1. Tests with vehicles that will operate on soft, viscous soils indicate that buoyancy provided by the hull and undercarriage of such vehicles affects their performance. This appendix gives an example of the additional computations necessary and the analyses that can be performed that tend to improve the relations between results computed using the WES-VCI submodel and the experimental results.

2. A comparison of the computed and experimentally determined vehicle cone indexes for 50 passes (VCI_{50}) for the XM759 operating on fine-grained soils has shown that a large difference occurred between the two values. The XM759 was able to complete 50 passes on all soil strengths tested, including extremely soft, viscous soils with a rating cone index (RCI) of 2; whereas the computed VCI_{50} indicated that the XM759 with 100 percent payloads should not travel on an RCI of less than 18. Test observations revealed that the Terra-tires and sponsons provided immediate buoyancy when immersed in soft, viscous soils, thereby reducing the vehicle weight by the weight of the soil displaced (see Figure B1). To



Figure B1. Example of effect of buoyancy

* Extracted from Reference 6. Superscript numbers in this Appendix refer to similarly numbered entries in the References following the main text.

achieve a closer agreement between experimental and computed VCI, the effects of soft-soil buoyancy for soils of 7 RCI and less were examined.

Volume and Weight Computations

Vehicle component volumes

3. The volume computations for the vehicle components that provide vehicle flotation are as follows:

a. Terra-tires

$$\text{Volume per tire} = \frac{\pi D^2}{4} \times w = \frac{\pi \times 24^2}{4} \times 21 = \frac{9500}{1728}$$
$$= 5.5 \text{ cu ft} \qquad \text{(B1)}$$

where

$\frac{\pi D^2}{4}$ = the area of a cylinder (D is in inches)

w = width of tire, in.

b. Sponson

$$\text{Volume} = \text{width (26 in.)} \times \text{length (166 in.)} \times \text{height in inches (depending upon depth to which sponson is immersed)} \qquad \text{(B2)}$$
$$= \frac{4320 \times h}{1728} \text{ cu ft}$$

c. Hull

$$\text{Volume} = \text{width (56 in.)} \times \text{length (210 in.)} \times \text{height in inches (depending upon depth to which hull is immersed)} \qquad \text{(B2)}$$
$$= \frac{1750 \times h}{1728} \text{ cu ft}$$

The equations above were used to compute displaced volume for the vehicle's flotation components for assumed sinkages 12 in. and greater. Sinkage is plotted against total volume displaced in Figure B2.

Effects of buoyancy on vehicle weight

4. The effects of buoyancy on weight when a vehicle is operating in water and soft soil are considered separately in the following paragraphs.

5. Water. In water the XM759 floats at 100 and 200 percent rated payload with sinkages of 40 and 44 in., respectively. The decreases in

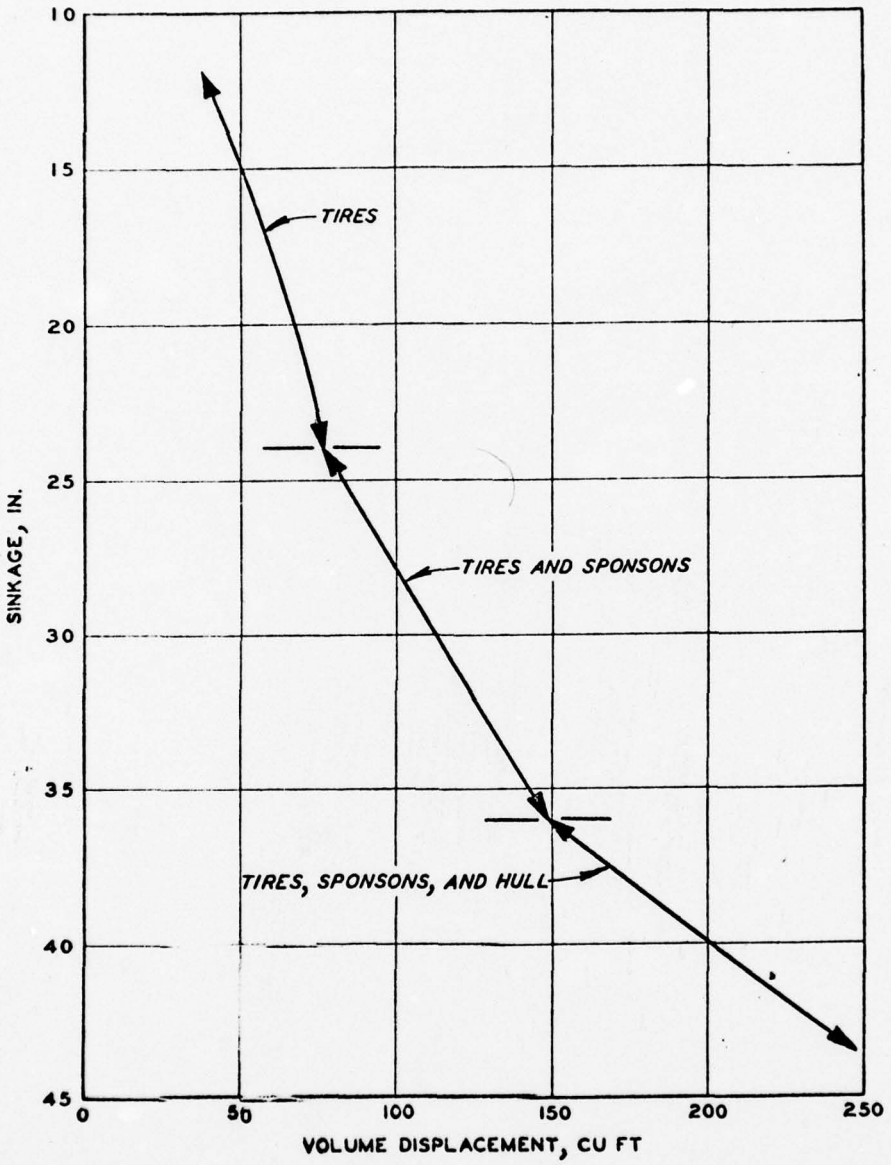


Figure B2. Sinkage versus total volume displaced

weight provided by the tires, sponsons, and hull when the vehicle is floating in water with 100 and 200 percent rated payloads are as follows:

a. Tires

100% payload: 5.5 cu ft/tire × 17 tires × 62.4 pcf = 5,800 lb

200% payload: 5.5 cu ft/tire × 18 tires × 62.4 pcf = 6,200 lb

b. Sponson

100% payload: $\frac{4,320 \times 16}{1,728}$ × 2 sponsons × 62.4 pcf = 5,000 lb

200% payload: $\frac{4,320 \times 20}{1,728}$ × 2 sponsons × 62.4 pcf = 6,200 lb

c. Hull

100% payload: $\frac{11,750 \times 4}{1,728}$ × 62.4 pcf = 1,700 lb

200% payload: $\frac{11,750 \times 8}{1,728}$ × 62.4 pcf = 3,400 lb

d. Total displacement

100% payload = 12,500 (13,000)* lb

200% payload = 15,800 (16,000)* lb

6. Soil. Computations were made to determine the buoyancy for a range of wet soil densities and vehicle sinkages. The buoyancy in water is also included for comparison. The results of these computations are shown below, and a curve of buoyancy versus sinkage for several wet soil densities is shown in Figure B3.

7. Several tests were conducted during the referenced study[6] on flooded soil of less than 7 RCI, in which the buoyancy of both water and soft soil affected the performance of the vehicle by reducing its effective weight (gross vehicle weight minus buoyancy). The test weights and sinkages measured after 50 passes are as follows:

Test No.	Vehicle Test Wt lb	Sinkage After 50 Passes, in.			Wet Soil Density pcf**
		Water	Soil	Total	
9	13,000	16.0	17.0	33.0	85.2
19	13,000	14.4	23.6	38.0	73.3
13	16,000	15.6	24.4	40.0	73.3

* Vehicle test weight.

** Average of all depths sampled.

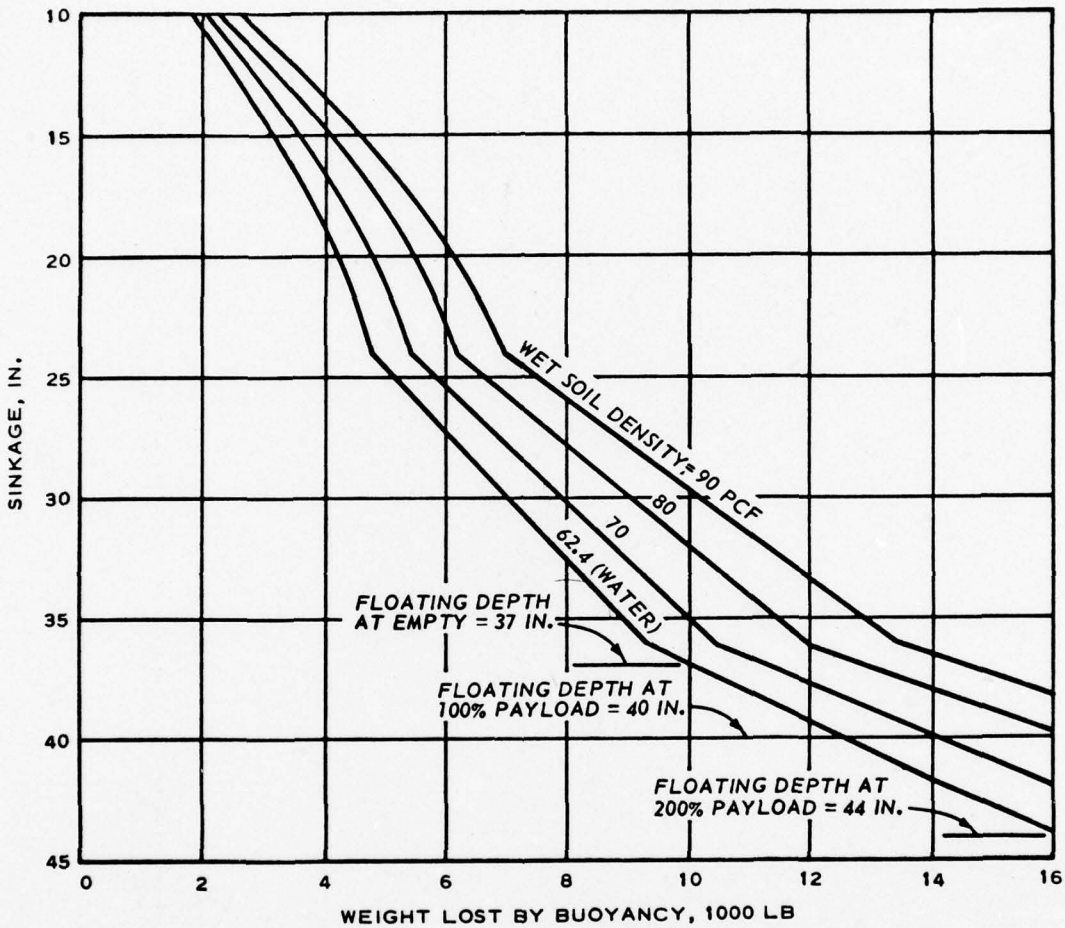


Figure B3. Sinkage versus weight lost by buoyancy

8. From the information given above, the volume of either water or soil displaced by the vehicle and the reductions in vehicle weight lost by buoyancy were determined from Figure B2 and B3. The results are as follows:

Test No.	Volume Displaced cu ft		Vehicle Weight Lost by Buoyancy, lb		
	Water	Soil	Water	Soil	Total
9	73	58	4550	4940	9,490
19	98	77	6110	5650	11,760
13	123	78	7660	5710	13,370

9. From the above-listed weight reductions, the effective weight of the vehicle becomes:

Test No.	Total Vehicle Weight, lb	Weight Reduction, lb	Effective Weight, lb
9	13,000	9,490	3510
19	13,000	11,760	1240
13	16,000	13,370	2630

10. By taking into account the effect of buoyancy on vehicle weight, computed VCI's can be obtained that more nearly agree with experimental VCI's. Experimental, VCI_{50} was determined to be 2, whereas the VCI_{50} computed without consideration of the effects of buoyancy was 18. Thus, if buoyancy is considered as demonstrated herein, the completed VCI_{50} becomes 0, which compares favorably with the experimental VCI of 2.

APPENDIX C: VEHICLE CATALOG

1. The primary purpose of this appendix is to present pertinent vehicle data in catalog form to assist potential vehicle users in the assessment and/or selection of the vehicles to perform jobs relevant to the operation and maintenance of dredged material containment areas. The secondary purpose is to identify the limitations of the methodology used in computing vehicle performance data.

2. Each vehicle included in the catalog is described by several photographs or drawings; manufacturer's address; general vehicle data, under which performance data can be found; mechanical components data that give dimensions or describe major components of the vehicle, i.e., engine, suspension, etc.; and miscellaneous data, under which cost (1974), primary use, potential use (based on physical size and payload), etc., information is found.

3. The vehicles presented herein were selected from a literature search or personal contact with vehicle manufacturers in the United States and Canada. The vehicle catalog is by no means complete, nor are all the data on some vehicles included complete. Final selection of vehicles was based on 1-pass vehicle cone index (VCI) of 30 or less. This process resulted in the selection of 60 vehicles. To obtain some idea as to the size of job that the vehicle can perform, they were divided into six vehicle groups in terms of payload ranges, as follows:

Vehicle Classification		
Group No.	Payload Ranges, tons	Number of Vehicles in Group
I	>0 - 3/4	19
II	1 - 2-1/2	11
III	3 - 7-1/2	11
IV	8 - 15	8
V	>15	8
VI	0 (Bulldozers)	3
	Total	60

4. The WES-VCI submodel was used to compute the minimum soil strength required by a vehicle to complete 1 pass and 50 passes successfully while the vehicle is traveling in a straight-line path in

fine-grained soils. These performance levels are identified as VCI_1 and VCI_{50} in the catalog. The vehicle data given in the catalog were used to compute VCI's. When the computed mobility index (MI) was a negative value, zero was assigned as VCI_1 and 2 as VCI_{50}; these are the VCI_1 and VCI_{50} values in the WES-VCI submodel for an MI equal to zero. The VCI data shown for vehicles with helical screw running gear were determined by actual vehicle tests[7*] and are identified as experimental VCI's.

5. Tests conducted to evaluate the accuracy of predicted VCI's have shown that the computations are very good for wheeled and tracked vehicles operating in fine-grained soils that are not in a viscous state (rating cone index >7). VCI prediction accuracy is also good for tracked vehicles with sealed sponsons that are part of the track system, provided the effects of buoyancy are accounted for in the computations (Appendix B). On the other hand, the VCI prediction accuracy for low-ground-pressure tracked vehicles with open track systems is very low. Experience has shown that an open track operating in viscous soils develops a high motion resistance because the soft soil flows into the track system and interferes with the running gear components. For this reason, when the computed VCI (particularly VCI_{50}) is ≤ 6 for tracked vehicles with open track systems (vehicles I-3, I-15, I-17, and II-4), these values should be used with caution.

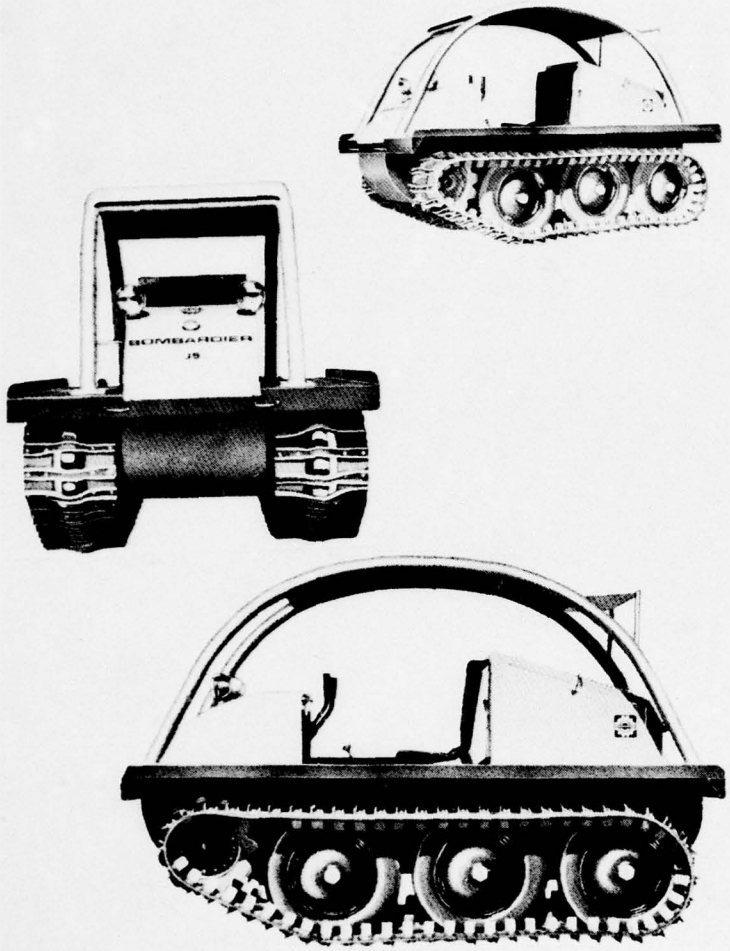
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* Superscript numbers in this appendix refer to similarly numbered entries in the References following the main text.

Index of Group I Vehicles, >0- to 3/4-Ton Payload

Vehicle No.	Vehicle Identification
I-1	J-5 Tractor
I-2	SW-48F
I-3	2100-C Trackmaster
I-4	Muskeg Tractor Gas
I-5	Amphicat
I-6	Terra-Jet
I-7	Coot
I-8	Bombi
I-9	The Kidd
I-10	Thiokol Swamp Spryte 1301
I-11	FN 10
I-12	Skidozer 200
I-13	*Marsh Cub (Model 104T-LPC-68)*
I-14	M29C Weasel
I-15	Skidozer 301-D
I-16	1404 Imp
I-17	Skidozer 301
I-18	Marsh Screw Amphibian
I-19	Ditcher Model 104T-DSP-70

Specifications for Vehicle No. I-1
Vehicle Identification: J-5 Tractor



Vehicle Manufacturer: Bombardier Limited
Industrial Division
Valcourt, Quebec, Canada

General Data

Weight – Basic:	4126 lb	Maximum Speed – Land:	26 mph
Payload:	374 lb	– Water:	6 mph
Gross Weight:	4500 lb	Ground Clearance:	13 in.
Ground Pressure – Empty:	2.31 psi	Fording Depth:	36 in.
– Loaded:	psi	Maximum Slope Negotiable:	50 %
Overall – Length:	122-1/4 in.	Vehicle Cone Index (1-Pass):	7
– Width:	64-1/4 in.	Vehicle Cone Index (50-Pass):	17
– Height:	73 in.	Track or Tire Size:	16.5 × 70 in.
Grouser Height:	<1.5 in.		
Sprocket Pitch:	4.45 in.	Tire Pressure:	NA psi
Number of Roadwheels or Bogies per Side:	3		

Mechanical Components Data

Engine –
Standard: Chrysler, 251 Industrial, 113 BHP
Optional: None

Transmission –
Main: 4 speed manual
Optional: None
Auxiliary: None

Suspension: Front wheel on bogie spindle, center and rear wheels on tandem, standard bogie spring.

Tracks or Wheels: Two 5-1/2-in.-wide endless rubber and fabric belts reinforced with steel wire.

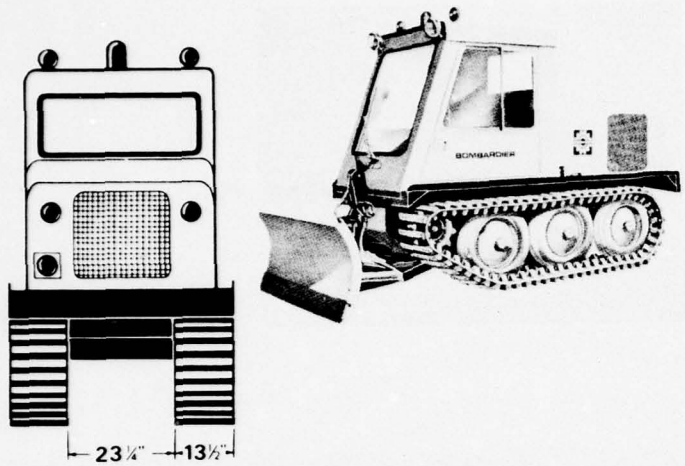
Miscellaneous

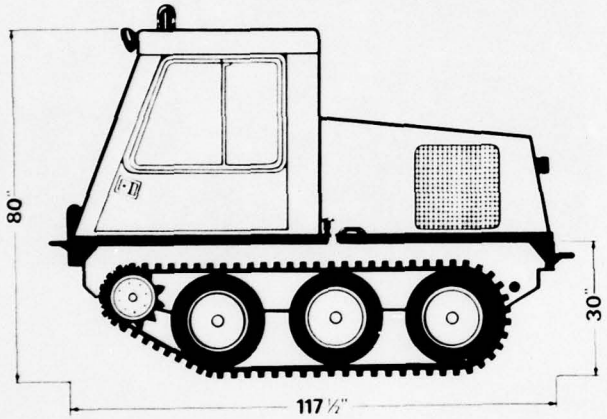
Primary Use: Mount for push blade or pull plow. Cost: $9830

Potential Uses:

Available: Yes

Specifications for Vehicle No. 152
Vehicle Identification: SW-48F





Vehicle Manufacturer: Bombardier Limited
Industrial Division
Valcourt, Quebec, Canada

General Data

Weight – Basic:	4540 lb	Maximum Speed – Land:	22 mph
Payload:	460 lb	– Water:	0 mph
Gross Weight:	5000 lb	Ground Clearance:	10 in.
Ground Pressure – Empty:	2.71 psi	Fording Depth:	30 in.
– Loaded:	2.99 psi	Maximum Slope Negotiable:	60 %
Overall – Length:	117.5 in.	Vehicle Cone Index (1-Pass):	30
– Width:	50.25 in.	Vehicle Cone Index (50-Pass):	24
– Height:	85 in.	Track or Tire Size:	13.5 × 62 in.
Grouser Height:	1.5 in.		
Sprocket Pitch:	4.45 in.	Tire Pressure:	NA psi
Number of Roadwheels or Bogies per Side:	3		

Mechanical Components Data

Engine –
Standard: Ford, 250 CID, 140 BHP
Optional: None

Transmission –
Main: 4 speed manual Synchromesh
Optional: None
Auxiliary: None

Suspension: Rubber torsion trailing lever.

Tracks or Wheels: Endless rubber and fabric reinforced with steel wire with cross-links of spring steel

Miscellaneous

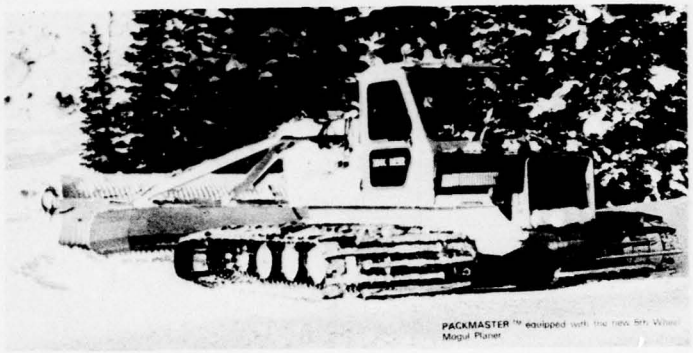
Primary Use: Small push tractor

Cost: $9015

Potential Uses: Mount for small pull plow.

Available: Yes

Specifications for Vehicle No. 1-3
Vehicle Identification: 2100-C Trackmaster



PACKMASTER™ equipped with the new 8ft. Wheel Mogul Planer

SKETCH NOT AVAILABLE

Vehicle Manufacturer: Thiokol Chemical Corporation
Logan Division, P. O. Box 407
Logan, UT 84321

General Data

Weight – Basic:	6128 lb	Maximum Speed – Land:	10 mph
Payload:	372 lb	– Water:	2 mph
Gross Weight:	6500 lb	Ground Clearance:	16 in.
Ground Pressure – Empty:	0.57 psi	Fording Depth:	-- in.
– Loaded:	0.60 psi	Maximum Slope Negotiable:	100 %
Overall – Length:	178 in.	Vehicle Cone Index (1-Pass):	0
– Width:	147 in.	Vehicle Cone Index (50-Pass):	0
– Height:	72 in.	Track or Tire Size:	57 × 92 in
Grouser Height:	<1.5 in.		
Sprocket Pitch:	4.5 in.	Tire Pressure:	NA psi
Number of Roadwheels or Bogies per Side:	4		

Mechanical Components Data

Engine –
- Standard: Ford, 300 CID, 165 BHP, gasoline, L6
- Optional: 391 CID, V-8, 235 BHP
  380 CID, L6, 120 BHP

Transmission –
- Main: 4 speed manual
- Optional: Automatic
- Auxiliary: None

Suspension: Rubber compression trailing arm

Tracks or Wheels: Rubber-covered belting with high-strength tempered alloy steel grousers

Miscellaneous

Primary Use: Slope maintenance

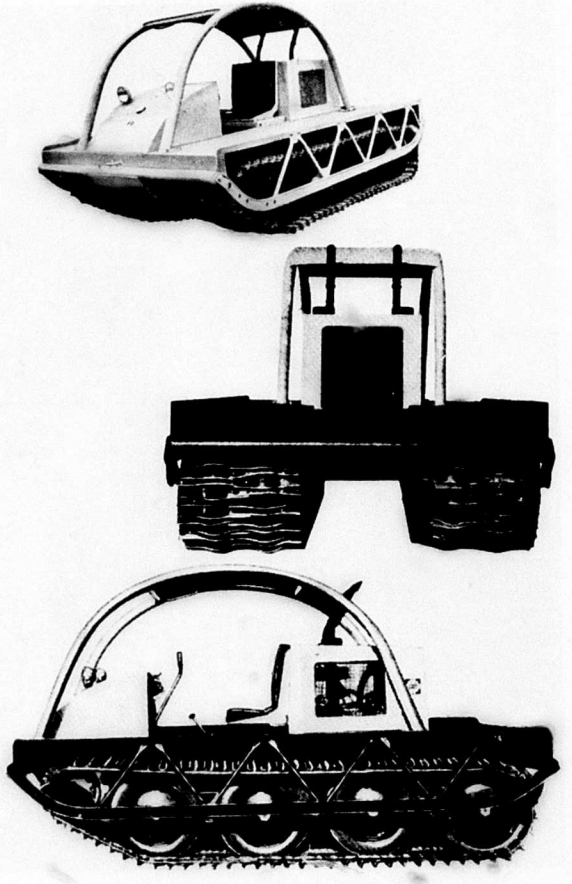
Cost: $18,995

Potential Uses: Mount for push blade or pull plow

Available: Yes

Specifications for Vehicle No. 1-4

Vehicle Identification: Muskeg Tractor Gas



Vehicle Manufacturer: Bombardier Limited
Industrial Division
Valcourt, Quebec, Canada

General Data

Weight – Basic:	7000 lb	Maximum Speed – Land:	23 mph
Payload:	500 lb	– Water:	0 mph
Gross Weight:	7500 lb	Ground Clearance:	14 in.
Ground Pressure – Empty:	1.32 psi	Fording Depth:	32 in.
– Loaded:	1.49 psi	Maximum Slope Negotiable:	80 %
Overall – Length:	142.5 in.	Vehicle Cone Index (1-Pass):	4
– Width:	87.2 in.	Vehicle Cone Index (50-Pass):	10
– Height:	78.5 in.	Track or Tire Size:	28 × 90 in.
Grouser Height:	<1.5 in.		
Sprocket Pitch:	4.45 in.	Tire Pressure:	NA psi
Number of Roadwheels or Bogies per Side:	4		

Mechanical Components Data

Engine –

Standard: Chrysler, 318 CID, 187 BHP

Optional: Perkins diesel, 88 BHP

Transmission –

Main: 4 speed manual

Optional: None

Auxiliary: None

Suspension: Tandem and rubber bushings

Tracks or Wheels: Rubber and fabric belt, reinforced with steel wire with cross-links of spring steel.

Miscellaneous

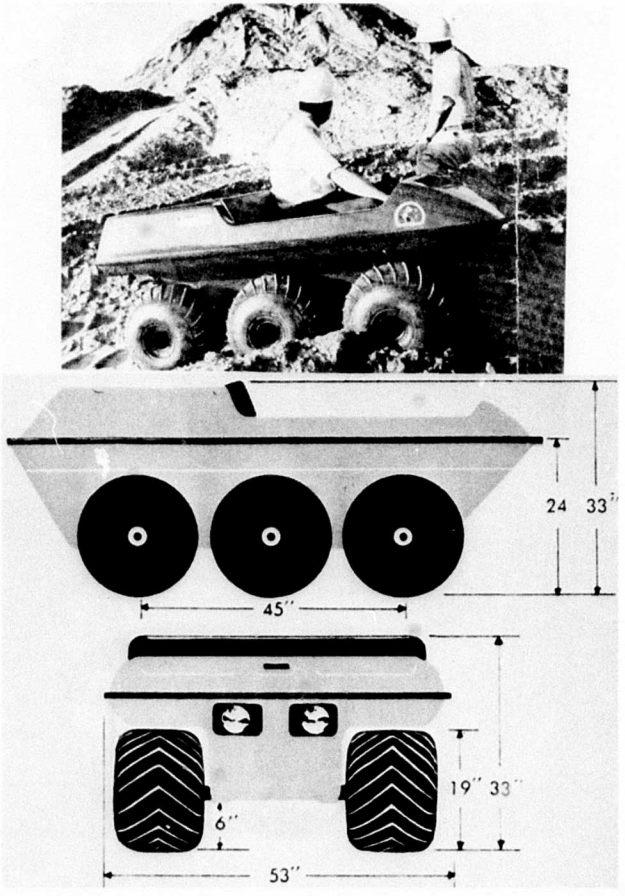
Primary Use: Mount for push blade, pull plow, or backhoe

Cost: $14,539

Potential Uses: Mount for small drill rig

Available: Yes

Specifications for Vehicle No. I-5
Vehicle Identification: Amphicat



Vehicle Manufacturer: Mobility Unlimited, Inc.
44 S. Squirrel Road
Auburn Heights, MI 48057

General Data

Weight – Basic:	569 lb	Maximum Speed – Land:	37 mph
Payload:	440 lb	– Water:	2 mph
Gross Weight:	909 lb	Ground Clearance:	8 in.
Ground Pressure – Empty:	0.61 psi	Fording Depth:	AMP in.
– Loaded:	1.0 psi	Maximum Slope Negotiable:	70 %
Overall – Length:	81 in.	Vehicle Cone Index (1-Pass):	1
– Width:	53 in.	Vehicle Cone Index (50-Pass):	3
– Height:	34 in.	Track or Tire Size: 11.5 × 20 in.	
Nominal Tire Diameter:	20.0 in.		
Nominal Tire Width:	11.5 in.	Tire Pressure:	1.5 psi

Mechanical Components Data

Engine –
Standard: Sacka, 16 BHP
Optional: None

Transmission –
Main: Automatic
Optional: None
Auxiliary: None

Suspension: Rigid

Tracks or Wheels: 11.5 × 20 in. super-soft Amphicat tires

Miscellaneous

Primary Use: Reconnaissance and recreation

Cost: $2500

Potential Uses: Surveying

Available: Yes

Specifications for Vehicle No. I-6
Vehicle Identification: Terra-Jet



SKETCH NOT AVAILABLE

Vehicle Manufacturer: Terra-Jet, Inc.
C. P. 724, P. O. Box
Drummondville, Quebec, Canada

General Data

Weight – Basic:	895 lb	Maximum Speed – Land:	25 mph
Payload:	500 lb	– Water:	-- mph
Gross Weight:	1395 lb	Ground Clearance:	10 in.
Ground Pressure – Empty:	2.23 psi	Fording Depth:	-- in.
– Loaded:	3.48 psi	Maximum Slope Negotiable:	60 %
Overall – Length:	100 in.	Vehicle Cone Index (1-Pass):	7
– Width:	55.6 in.	Vehicle Cone Index (50-Pass):	17
– Height:	59 in.	Track or Tire Size:	26- × 12- × 12-in. Terra tire
Nominal Tire Diameter:	26.3 in.		
Nominal Tire Width:	12.2 in.	Tire Pressure:	3 psi

Mechanical Components Data

Engine –
Standard: Tecumseh, 4 cycles, 16 BHP
Optional: None

Transmission –
Main: 2 speed manual
Optional: None
Auxiliary: None

Suspension: Rigid

Tracks or Wheels: Rims 12 × 11 in. with 26- × 12- × 12-in. tires

Miscellaneous

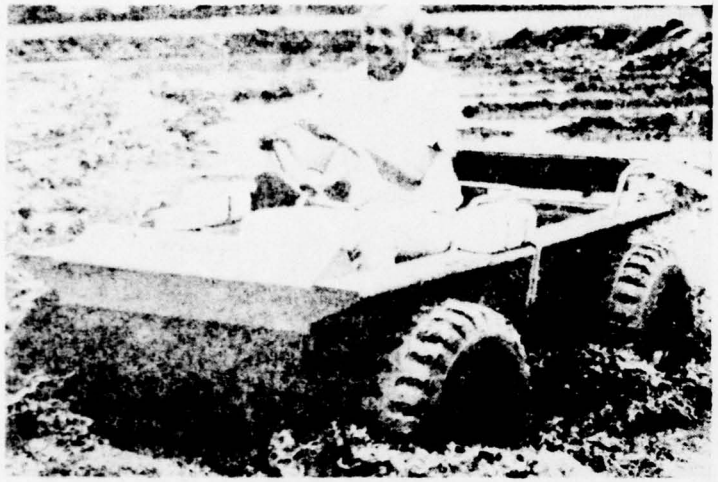
Primary Use: Reconnaissance

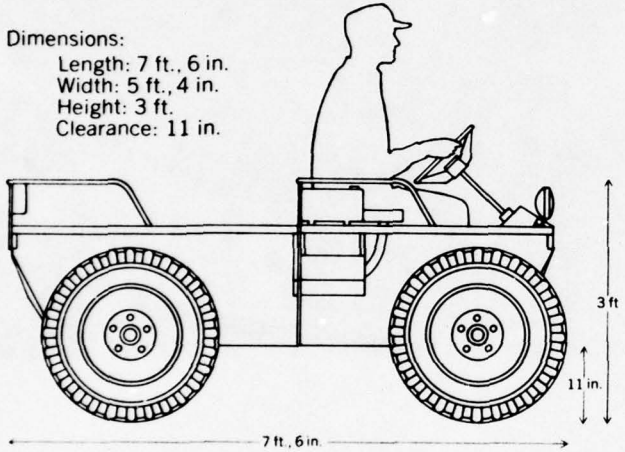
Cost: $2000

Potential Uses: Mount for small push blade or pull plow

Available: Yes

Specifications for Vehicle No. I-7
Vehicle Identification: Coot





Vehicle Manufacturer: Coot, Inc., World Trade Center
Ferry Building
San Francisco, CA 94111

General Data

Weight – Basic:	1000 lb	Maximum Speed – Land:	20 mph
Payload:	1000 lb	– Water:	2 mph
Gross Weight:	2000 lb	Ground Clearance:	11 in.
Ground Pressure – Empty:	____ psi	Fording Depth:	AMP in.
– Loaded:	____ psi	Maximum Slope Negotiable:	75 %
Overall – Length:	90 in.	Vehicle Cone Index (1-Pass):	12
– Width:	64 in.	Vehicle Cone Index (50-Pass):	29
– Height:	36 in.	Track or Tire Size:	885-15 special tires
Nominal Tire Diameter:	26 in.		
Nominal Tire Width:	9 in.	Tire Pressure:	4 psi

Mechanical Components Data

Engine –
Standard: Air cooled, 12 BHP
Optional: None

Transmission –
Main: Automatic
Optional: None
Auxiliary: None

Suspension: Rigid

Tracks or Wheels: Standard rims with 885-15 special tires.

Miscellaneous

Primary Use: Reconnaissance

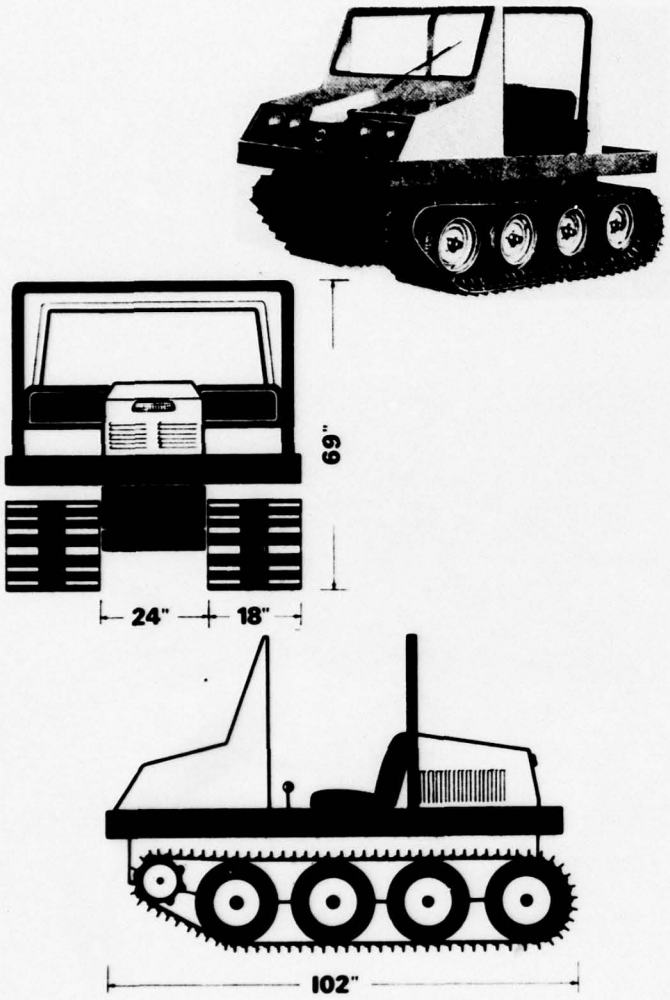
Cost: $2000

Potential Uses: Mount for small push blade or pull plow

Available: Yes

Specifications for Vehicle No. I-8

Vehicle Identification: Bombi



Vehicle Manufacturer: Bombardier Limited
Industrial Division
Valcourt, Quebec, Canada

General Data

Weight – Basic:	2000 lb	Maximum Speed – Land:	22.5 mph
Payload:	1000 lb	– Water:	0 mph
Gross Weight:	3000 lb	Ground Clearance:	12.5 in.
Ground Pressure – Empty:	0.82 psi	Fording Depth:	____ in.
– Loaded:	1.23 psi	Maximum Slope Negotiable:	80 %
Overall – Length:	102 in.	Vehicle Cone Index (1-Pass):	5
– Width:	60 in.	Vehicle Cone Index (50-Pass):	13
– Height:	69 in.	Track or Tire Size:	18 × 68 in.
Grouser Height:	<1.5 in.		
Sprocket Pitch:	2.5 in.	Tire Pressure:	NA psi
Number of Roadwheels or Bogies per Side:	4		

Mechanical Components Data

Engine –

Standard: Ford, 57 BHP

Optional: None

Transmission –

Main: 4 speed manual

Optional: None

Auxiliary: None

Suspension: All wheels mounted on rubber torsion trailing levers

Tracks or Wheels: Rubber and fabric belts with forged spring steel cross-links

Miscellaneous

Primary Use: Reconnaissance

Cost: $6050

Potential Uses: Mount for small push blade or pull plow

Available: Yes

Specifications for Vehicle No. I-9
Vehicle Identification: The Kidd



SKETCH NOT AVAILABLE

Vehicle Manufacturer: Kinetics International Division
LTV Aerospace Corporation, P. O. Box 493
Tyler, TX 75701

General Data

Weight – Basic:	2200 lb	Maximum Speed – Land:	25 mph
Payload:	1000 lb	– Water:	1.5 mph
Gross Weight:	3200 lb	Ground Clearance:	6.5 in.
Ground Pressure – Empty:	1.61 psi	Fording Depth:	AMP in.
– Loaded:	2.34 psi	Maximum Slope Negotiable:	70 %
Overall – Length:	96 in.	Vehicle Cone Index (1-Pass):	11
– Width:	60 in.	Vehicle Cone Index (50-Pass):	26
– Height:	40 in.	Track or Tire Size:	23 × 8.50-12
Nominal Tire Diameter:	23.0 in.		
Nominal Tire Width:	8.5 in.	Tire Pressure:	3 psi

Mechanical Components Data

Engine –
Standard: 30 BHP, gasoline
Optional: 30 BHP, diesel

Transmission –
Main: Automatic
Optional: None
Auxiliary: None

Suspension: Rigid

Tracks or Wheels: 23 × 8.50-12 tires on 12-in. rim

Miscellaneous

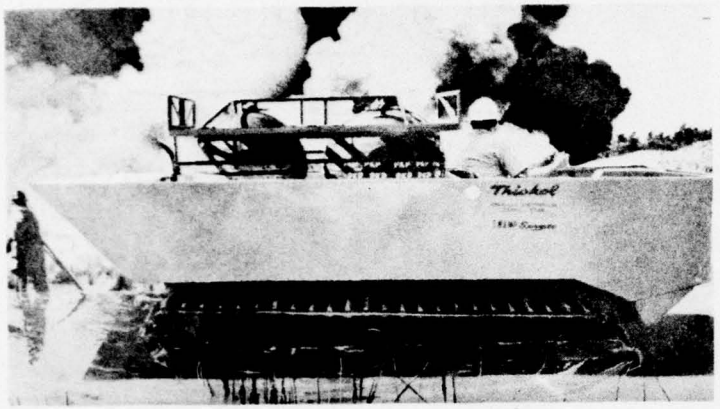
Primary Use: Reconnaissance

Cost: $2000

Potential Uses: Plow, rake, and tiller attachments available

Available: Yes

Specifications for Vehicle No. I-10
Vehicle Identification: Thiokol Swamp Spryte 1301



SKETCH NOT AVAILABLE

Vehicle Manufacturer: Thiokol Chemical Corporation
Logan Division
Logan, UT 84321

General Data

Weight – Basic:	3000 lb	Maximum Speed – Land:	35 mph
Payload:	1000 lb	– Water:	4.5 mph
Gross Weight:	4000 lb	Ground Clearance:	12 in.
Ground Pressure – Empty:	0.78 psi	Fording Depth:	AMP in.
– Loaded:	1.04 psi	Maximum Slope Negotiable:	60 %
Overall – Length:	157 in.	Vehicle Cone Index (1-Pass):	3
– Width:	77.5 in.	Vehicle Cone Index (50-Pass):	8
– Height:	79 in.	Track or Tire Size: 26 × 90 in.	
Grouser Height:	<1.5 in.		
Sprocket Pitch:	4.5 in.	Tire Pressure:	NA psi
Number of Roadwheels or Bogies per Side:	4		

Mechanical Components Data

Engine –
Standard: Ford, 6 cylinder, 170 CID, 101 BHP
Optional: None

Transmission –
Main: 4 speed manual
Optional: None
Auxiliary: None

Suspension: Trailing arms with torsion springs

Tracks or Wheels: 4 ply, rubber-covered belting with tubular steel grousers.

Miscellaneous

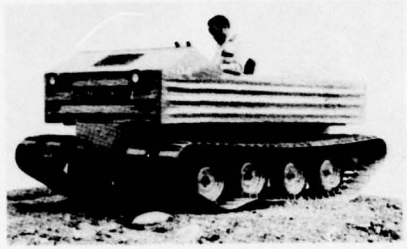
Primary Use: Reconnaissance and surveying

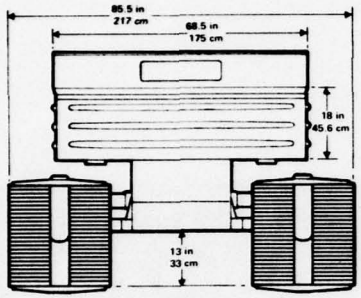
Cost: _____

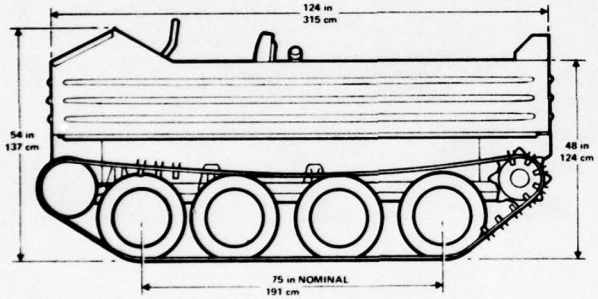
Potential Uses: Mount for push blade or pull plow.

Available: Yes

Specifications for Vehicle No. I-11
Vehicle Identification: FN 10







Vehicle Manufacturer: Flextrac Nodwell, P. O. Box 5544
Station A, 1201 42nd Ave, SE
Calgary, Alberta, Canada

General Data

Weight – Basic:	3550 lb	Maximum Speed – Land:	22 mph
Payload:	1000 lb	– Water:	2 mph
Gross Weight:	4550 lb	Ground Clearance:	13 in.
Ground Pressure – Empty:	0.95 psi	Fording Depth:	AMP in.
– Loaded:	1.21 psi	Maximum Slope Negotiable:	60 %
Overall – Length:	1.27 in.	Vehicle Cone Index (1-Pass):	4
– Width:	85.5 in.	Vehicle Cone Index (50-Pass):	10
– Height:	80.0 in.	Track or Tire Size:	25 × 75 in.
Grouser Height:	<1.5 in.		
Sprocket Pitch:	6.00 in.	Tire Pressure:	NA psi
Number of Roadwheels or Bogies per Side:	4		

Mechanical Components Data

Engine –
- Standard: Ford, 104 CID, V-4, gasoline, 65 BHP
- Optional: Diesel

Transmission –
- Main: 3 speed manual
- Optional: Automatic
- Auxiliary: 2 speed transfer

Suspension: Neidhart, rubber in compression

Tracks or Wheels: Rubber belt and channel grousers

Miscellaneous

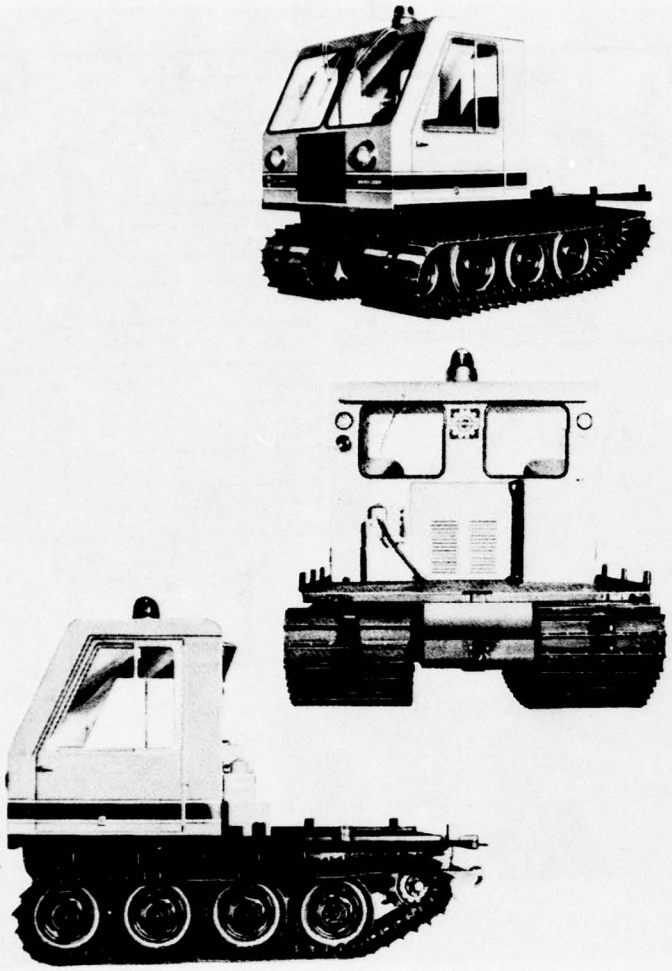
Primary Use: Cargo and personnel carrier

Cost: $15,391

Potential Uses: Mount for small push blade or pull plow

Available: Yes

Specifications for Vehicle No. I-12
Vehicle Identification: Skidozer 200



Vehicle Manufacturer: Bombardier Limited
Industrial Division
Valcourt, Quebec, Canada

General Data

Weight – Basic:	4400 lb	Maximum Speed – Land:	21.5 mph
Payload:	1000 lb	– Water:	0 mph
Gross Weight:	5400 lb	Ground Clearance:	14.5 in.
Ground Pressure – Empty:	0.84 psi	Fording Depth:	32.5 in.
– Loaded:	1.03 psi	Maximum Slope Negotiable:	50 %
Overall – Length:	133 in.	Vehicle Cone Index (1-Pass):	3
– Width:	6 in.	Vehicle Cone Index (50-Pass):	8
– Height:	87 in.	Track or Tire Size: 29 × 90 in.	
Grouser Height:	<1.5 in.		
Sprocket Pitch:	4.45 in.	Tire Pressure:	NA psi
Number of Roadwheels or Bogies per Side:	4		

Mechanical Components Data

Engine –

Standard: Ford, 250 CID, 6 cylinder, 124 BHP
Optional: None

Transmission –

Main: 3 speed automatic
Optional: None
Auxiliary: None

Suspension: Wheels mounted on rubber torsion trailing arms

Tracks or Wheels: Four belts each measuring 12-in., rubber and nylon fabric with 29-in. steel cross-links

Miscellaneous

Primary Use: Cargo carrier

Cost: $12,628

Potential Uses: Mount for small drill rig, push blade or pull plow

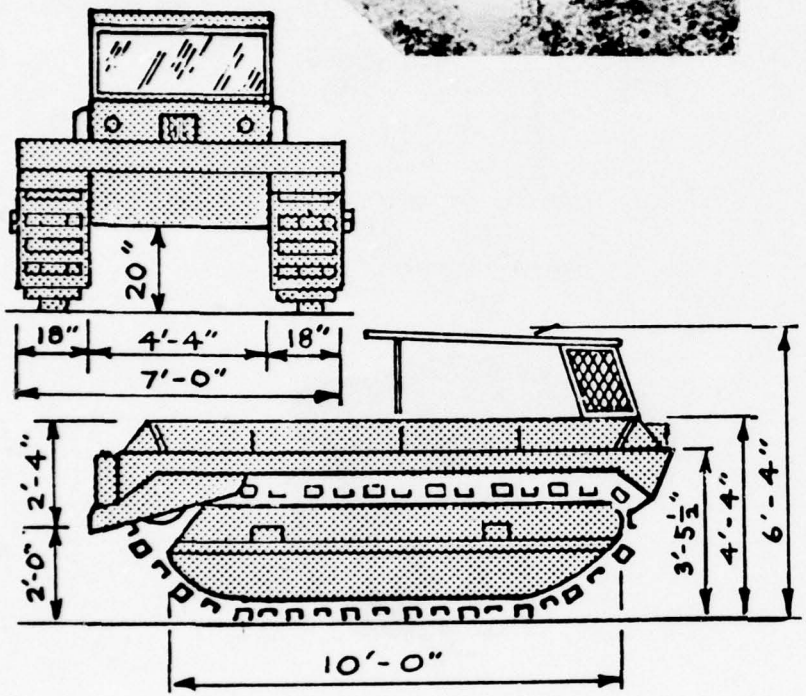
Available: Yes

Specifications for Vehicle No. I-13

Vehicle Identification: The Marsh Cub (Model 104T-LPC-68)

Vehicle Manufacturer: Quality Marsh Equipment Co., Inc.
P. O. Box 406
Thibodaux, LA 70301





General Data

Weight – Basic:	4788 lb	Maximum Speed – Land:	8 mph
Payload:	750 lb	– Water:	2-4 mph
Gross Weight:	5538 lb	Ground Clearance:	20 in.
Ground Pressure – Empty:	1.75 psi	Fording Depth:	AMP in.
– Loaded:	2.02 psi	Maximum Slope Negotiable:	60 %
Overall – Length:	152 in.	Vehicle Cone Index (1-Pass):	7
– Width:	84 in.	Vehicle Cone Index (50-Pass):	17
– Height:	76 in.	Track or Tire Size:	18 × 76 in.
Grouser Height:	<1.5 in.		
Sprocket Pitch:	4 in.	Tire Pressure:	NA psi
Number of Roadwheels or Bogies per Side:	4		

Mechanical Components Data

Engine –

Standard: 75 BHP, gasoline

Optional: None

Transmission –

Main: Automatic

Optional: None

Auxiliary: None

Suspension: Rigid

Tracks or Wheels: 2 strands of heavy-duty track chain with 4-in. aluminum cleats

Miscellaneous

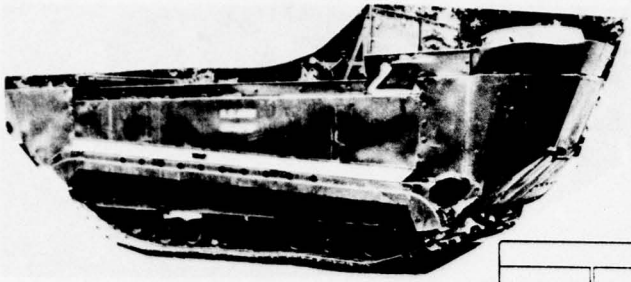
Primary Use: Cargo and personnel carrier

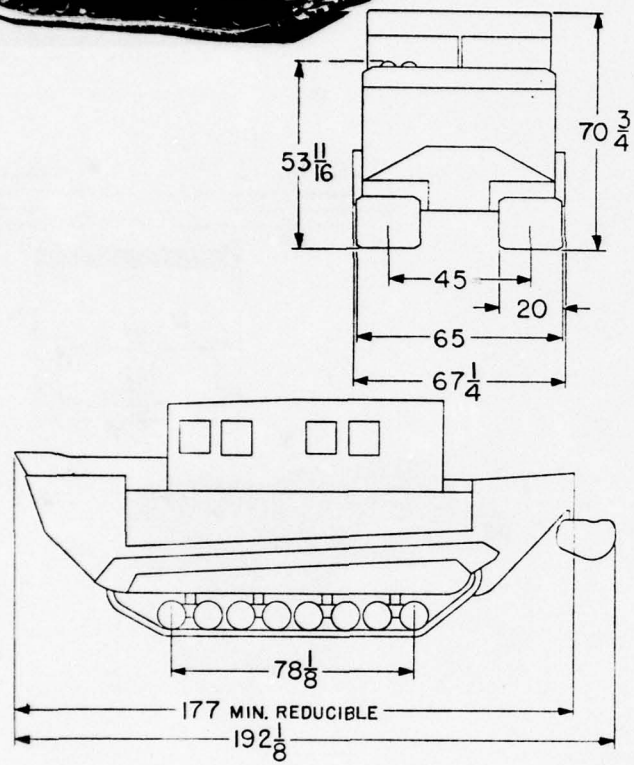
Cost: _____

Potential Uses: Mount for small push blade or pull plow.

Available: Yes

Specifications for Vehicle No. I-14
Vehicle Identification: M29C, Weasel





Vehicle Manufacturer: Property of U. S. Army

General Data

Weight – Basic:	4800 lb	Maximum Speed – Land:	36 mph
Payload:	1200 lb	– Water:	4 mph
Gross Weight:	6000 lb	Ground Clearance:	11 in.
Ground Pressure – Empty:	1.53 psi	Fording Depth:	AMP in.
– Loaded:	1.21 psi	Maximum Slope Negotiable:	100 %
Overall – Length:	122 in.	Vehicle Cone Index (1-Pass):	6
– Width:	67.25 in.	Vehicle Cone Index (50-Pass):	15
– Height:	70.75 in.	Track or Tire Size:	20 × 78.5 in.
Grouser Height:	<1.5 in.		
Sprocket Pitch:	4.5 in.	Tire Pressure:	NA psi
Number of Roadwheels or Bogies per Side:	4		

Mechanical Components Data

Engine –

Standard: 6 cylinder, 65 BHP

Optional: None

Transmission –

Main: Automotive Synchromesh

Optional: None

Auxiliary:

Suspension: Leaf springs

Tracks or Wheels: Type T76E1, 4-1/2- × 20-in. track shoes, 56 per track

Miscellaneous

Primary Use: Cargo carrier

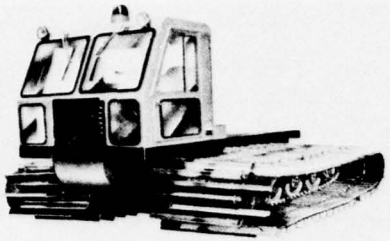
Cost: Military

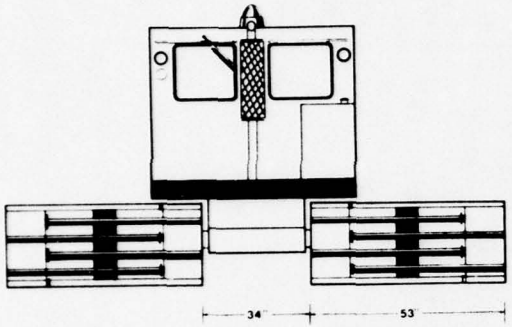
Potential Uses: Mount for small push blade or pull plow

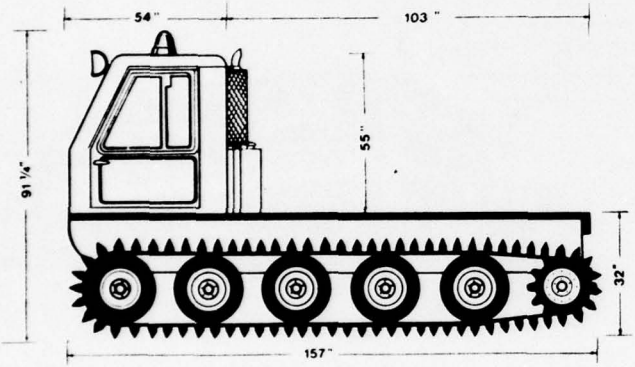
Available: Possibly on Army surplus

Specifications for Vehicle No. I-15

Vehicle Identification: Skidozer 301-D







Vehicle Manufacturer: Bombardier Limited
Industrial Division
Valcourt, Quebec, Canada

General Data

Weight – Basic:	6300 lb	Maximum Speed – Land:	11.9 mph
Payload:	1000 lb	– Water:	0 mph
Gross Weight:	7300 lb	Ground Clearance:	14.5 in.
Ground Pressure – Empty:	0.40 psi	Fording Depth:	30 in.
– Loaded:	0.46 psi	Maximum Slope Negotiable:	80 %
Overall – Length:	157 in.	Vehicle Cone Index (1-Pass):	0
– Width:	140 in.	Vehicle Cone Index (50-Pass):	2
– Height:	91-1/4 in.	Track or Tire Size:	53 × 150 in.
Grouser Height:	<1.5 in.		
Sprocket Pitch:	4.46 in.	Tire Pressure:	NA psi
Number of Roadwheels or Bogies per Side:	4		

Mechanical Components Data

Engine –

Standard: Perkins diesel model No. 4.236 – 88 BHP

Optional:

Transmission –

Main: 4 speed manual new process gear 435-A

Optional:

Auxiliary:

Suspension: Ten wheels mounted on rubber torsion trailing levers

Tracks or Wheels: Eight rubber and fabric track belts, all-aluminum staggered cross-links

Miscellaneous

Primary Use: Cargo carrier

Cost: $21,100

Potential Uses: Mount for small push blade or pull plow

Available: Yes

Specifications for Vehicle No. I-16
Vehicle Identification: 1404 IMP



SKETCH NOT AVAILABLE

Vehicle Manufacturer: Thiokol Chemical Corporation
Logan Division
Logan, UT 84321

General Data

Weight – Basic:	2432 lb	Maximum Speed – Land:	25 mph
Payload:	1400 lb	– Water:	0 mph
Gross Weight:	3825 lb	Ground Clearance:	6 in.
Ground Pressure – Empty:	0.74 psi	Fording Depth:	-- in.
– Loaded:	1.17 psi	Maximum Slope Negotiable:	80 %
Overall – Length:	116 in.	Vehicle Cone Index (1-Pass):	4
– Width:	70 in.	Vehicle Cone Index (50-Pass):	10
– Height:	73.5 in.	Track or Tire Size:	24 × 68 in.
Grouser Height:	4.5 in.		
Sprocket Pitch:	4.5 in.	Tire Pressure:	NA psi
Number of Roadwheels or Bogies per Side:	4		

Mechanical Components Data

Engine –

Standard: Ford, V-4, 104 CID, 80 BHP

Optional: None

Transmission –

Main: 3 speed manual

Optional: None

Auxiliary: 4 speed transfer

Suspension: Semielliptic springs

Tracks or Wheels: Drop center plus tire guides

Miscellaneous

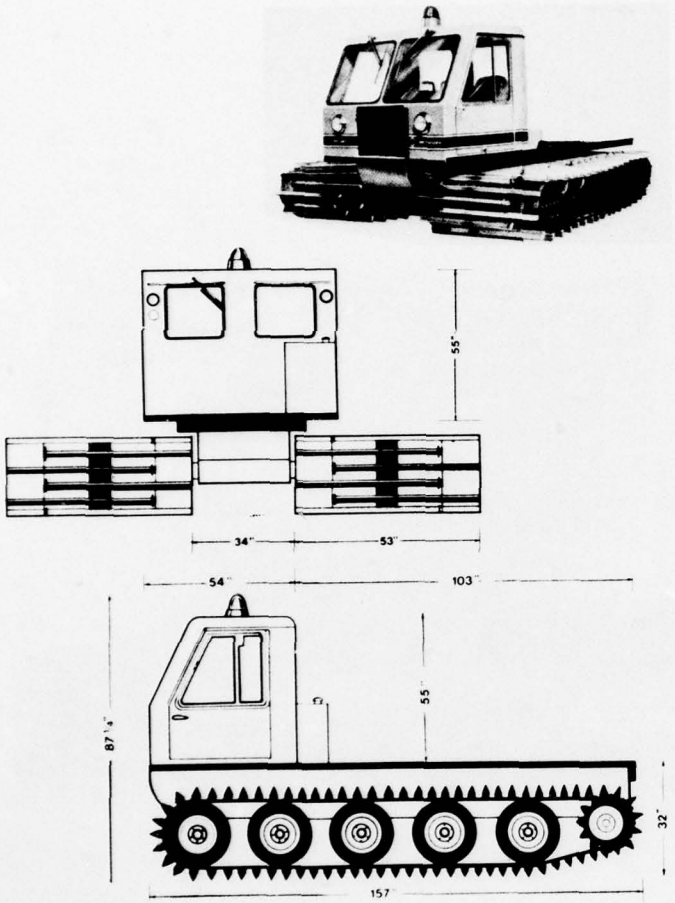
Primary Use: Cargo carrier

Cost: $9,200

Potential Uses: Mount for push blade or pull plow

Available: Yes

Specifications for Vehicle No. I-17
Vehicle Identification: Skidozer 301



Vehicle Manufacturer: Bombardier Limited
Industrial Division
Valcourt, Quebec, Canada

General Data

Weight – Basic:	6000 lb	Maximum Speed – Land:	11.5 mph
Payload:	1500 lb	– Water:	0 mph
Gross Weight:	7500 lb	Ground Clearance:	14.50 in.
Ground Pressure – Empty:	0.36 psi	Fording Depth:	32 in.
– Loaded:	0.45 psi	Maximum Slope Negotiable:	80 %
Overall – Length:	157 in.	Vehicle Cone Index (1-Pass):	0
– Width:	140 in.	Vehicle Cone Index (50-Pass):	2
– Height:	87.25 in.	Track or Tire Size: 53 × 157 in.	
Grouser Height:	<1.5 in.		
Sprocket Pitch:	4.45 in.	Tire Pressure:	NA psi
Number of Roadwheels or Bogies per Side:	5		

Mechanical Components Data

Engine –
Standard: Ford, 300 CID, industrial, 6 cylinder engine
Optional: None

Transmission –
Main: 3 speed Ford automatic FMX transmission
Optional: None
Auxiliary: None

Suspension: Ten wheels mounted on rubber torsion trailing levers

Tracks or Wheels: Eight rubber and fabric track belts, all-aluminum staggered cross-links

Miscellaneous

Primary Use: Cargo carrier

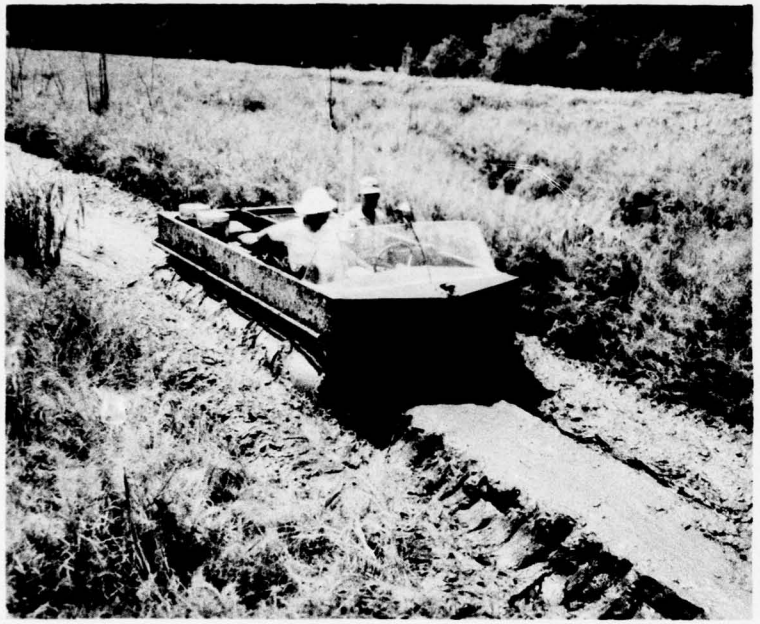
Cost: $19,260

Potential Uses: Mount for small drill rig, push blade, or pull plow

Available: Yes

Specifications for Vehicle No. I-18

Vehicle Identification: Marsh Screw Amphibian



SKETCH NOT AVAILABLE

Vehicle Manufacturer: Manufactured by Chrysler Corporation for the U. S. Navy

General Data

Weight – Basic:	3954 lb	Maximum Speed – Land:	-- mph
Payload:	1000 lb	– Water:	-- mph
Gross Weight:	3954 lb	Ground Clearance:	20 in.
Ground Pressure – Empty:	0.52** psi	Fording Depth:	AMP in.
– Loaded:	0.72** psi	Maximum Slope Negotiable:	-- %
Overall – Length:	164 in.	Vehicle Cone Index (1-Pass):	1*
– Width:	98 in.	Vehicle Cone Index (50-Pass):	8*
– Height:	57 in.	Track or Tire Size: NA	
Rotor Diameter:	26 in.		
		Tire Pressure:	NA psi

** At 3-in. penetration

* Experimental values

Mechanical Components Data

Engine –

Standard: Chrysler - RC special, 116 BHP

Optional: None

Transmission –

Main: Chrysler Torque Flite

Optional:

Auxiliary:

Suspension: Rigid

Tracks or Wheels: Helical screws

Miscellaneous

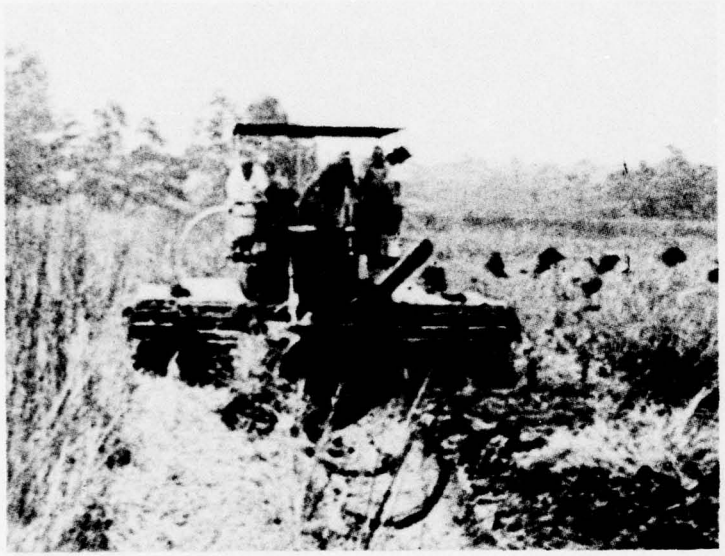
Primary Use: Reconnaissance

Cost: _____

Potential Uses: Mount for small push blade or pull plow

Available: Possibly on surplus

Specifications for Vehicle No. I-19
Vehicle Identification: Ditcher Model 1Q4T-D8P-70



SKETCH NOT AVAILABLE

Vehicle Manufacturer: Quality Marsh International Corp.
P. O. Box 406
Thibodaux, LA 70301

General Data

Weight – Basic:	22,000 lb	Maximum Speed – Land:	5 mph
Payload:	1,500 lb	– Water:	3-4 mph
Gross Weight:	23,500 lb	Ground Clearance:	38 in.
Ground Pressure – Empty:	1.21 psi	Fording Depth:	AMP in.
– Loaded:	1.29 psi	Maximum Slope Negotiable:	60 %
Overall – Length:	____ in.	Vehicle Cone Index (1-Pass):	0
– Width:	____ in.	Vehicle Cone Index (50-Pass):	2
– Height:	____ in.	Track or Tire Size:	48 × 190 in.
Grouser Height:	<1.5 in.		
Sprocket Pitch:	2.5 in.	Tire Pressure:	NA psi
Number of Roadwheels or Bogies per Side:	4		

Mechanical Components Data

Engine –
Standard: Ford, 380 CID, diesel
Optional: None

Transmission –
Main: Automatic
Optional: None
Auxiliary: None

Suspension: Rigid

Tracks or Wheels: Two stands of heavy-duty track chains with 4-in. aluminum channel cleats

Miscellaneous

Primary Use: Ditching machine

Cost: $37,550

Potential Uses: Mount for pull plow or push blade

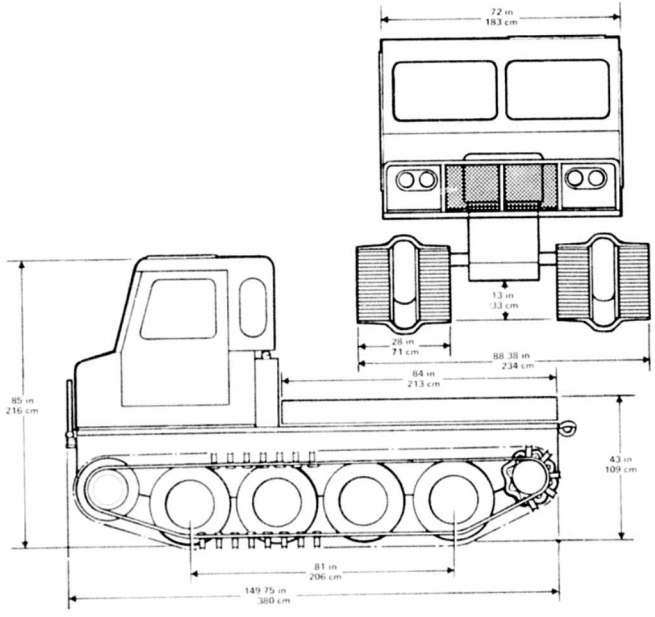
Available: Yes

Index of Group II Vehicles, 1- to 2-1/2-Ton Payload

Vehicle No.	Vehicle Identification
II-1	FN 20
II-2	Model 1201 Spryte
II-3	Riverine Utility Craft
II-4	FN 21
II-5	M116
II-6	FN 20 W/B
II-7	Rolligon 4450
II-8	XM759, Cargo Carrier
II-9	Mexa 10 × 10
II-10	Mexa Track
II-11	Amphibious Carrier Model 104-W-HD-59

Specifications for Vehicle No. II-1
Vehicle Identification: FN 20





Vehicle Manufacturer: Flextrac Nodwell, P. O. Box 5544
Station A, 1201 42nd Ave., SE
Calgary, Alberta, Canada

General Data

Weight – Basic:	5600 lb	Maximum Speed – Land:	22 mph
Payload:	8400 lb	– Water:	9 mph
Gross Weight:	7000 lb	Ground Clearance:	18 in.
Ground Pressure – Empty:	1.23 psi	Fording Depth:	32 in.
– Loaded:	1.68 psi	Maximum Slope Negotiable:	60 %
Overall – Length:	156 in.	Vehicle Cone Index (1-Pass):	5
– Width:	88.2 in.	Vehicle Cone Index (50-Pass):	13
– Height:	85 in.	Track or Tire Size:	28 × 81 in.
Grouser Height:	<1.5 in.		
Sprocket Pitch:	7 in.	Tire Pressure:	NA psi
Number of Roadwheels or Bogies per Side:	4		

Mechanical Components Data

Engine –
Standard: Ford, 200 CID, 6 cylinder, 105 BHP
Optional: Diesel

Transmission –
Main: 4 speed manual
Optional: Automatic
Auxiliary: None

Suspension: Crank arm and torsion coil spring

Tracks or Wheels: Rubber belt and spring steel drop center grousers

Miscellaneous

Primary Use: Cargo and personnel carrier

Cost: $16,947

Potential Uses: Mount for small drill rig, push blade, or pull plow

Available: Yes

Specifications for Vehicle No. II-2

Vehicle Identification: Model 1201 Spryte



SKETCH NOT AVAILABLE

Vehicle Manufacturer: Thiokol Chemical Corporation
Logan Division
Logan, UT 84321

General Data

Weight – Basic:	6180 lb	Maximum Speed – Land:	14.7 mph
Payload:	1900 lb	– Water:	-- mph
Gross Weight:	8080 lb	Ground Clearance:	11 in.
Ground Pressure – Empty:	0.88 psi	Fording Depth:	-- in.
– Loaded:	1.15 psi	Maximum Slope Negotiable:	80 %
Overall – Length:	154.5 in.	Vehicle Cone Index (1-Pass):	3
– Width:	118 in.	Vehicle Cone Index (50-Pass):	8
– Height:	84 in.	Track or Tire Size: 36 × 98 in.	
Grouser Height:	<1.5 in.		
Sprocket Pitch:	4.5 in.	Tire Pressure:	NA psi
Number of Roadwheels or Bogies per Side:	5		

Mechanical Components Data

Engine –

Standard: Ford, 6 cylinder, 300 CID, 170 BHP

Optional: None

Transmission –

Main: Ford C-6 Automatic

Optional: None

Auxiliary: None

Suspension: Trailing arms in rubber

Tracks or Wheels: Rubber-covered polyester fabric with steel grousers

Miscellaneous

Primary Use: Cargo carrier

Cost: $16,400

Potential Uses: Mount for small drill rig, push blade, or pull plow

Available: Yes

Specifications for Vehicle No. 11-1

Vehicle Identification: Riverine Utility Craft (RUC)

Vehicle Manufacturer: Developed by Chrysler Corporation for the U. S. Navy



SKETCH NOT AVAILABLE

General Data

Weight – Basic:	11,085 lb	Maximum Speed – Land:	9 mph
Payload:	2000 lb	– Water:	18 mph
Gross Weight:	13,085 lb	Ground Clearance:	42 in.
Ground Pressure – Empty:	____ psi	Fording Depth:	AMP in.
– Loaded:	____ psi	Maximum Slope Negotiable:	____ %
Overall – Length:	242 in.	Vehicle Cone Index (1-Pass):	0 *
– Width:	____ in.	Vehicle Cone Index (50-Pass):	0 *
– Height:	107 in.	Track or Tire Size:	Helical screws
Rotor Diameter:	39 in.		
		Tire Pressure:	NA psi

* Experimental values

Mechanical Components Data

Engine –

Standard: 2 each, 440 CID, 380 BHP

Optional: None

Transmission –

Main: 2 each 2 speed automatic

Optional: None

Auxiliary: None

Suspension: Rigid

Tracks or Wheels: Special 58-in.-diameter helical screws

Miscellaneous

Primary Use: Cargo or personnel carrier

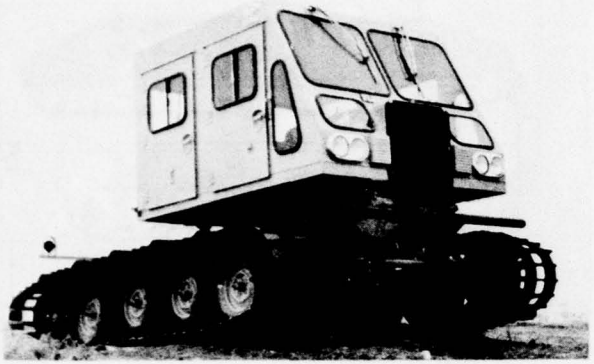
Cost: _____

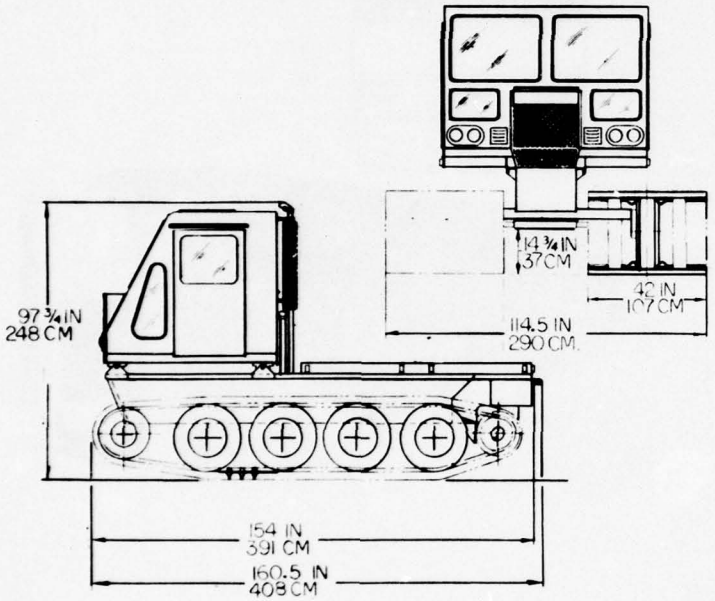
Potential Uses: Mount for small drill rig, push blade, or pull plow

Available: Possibly from DMRP

Specifications for Vehicle No. 11-4

Vehicle Identification: FN 21





Vehicle Manufacturer: Flextrac Nodwell, P. O. Box 5544
Station A, 1201 42nd Ave., SE
Calgary, Alberta, Canada

General Data

Weight – Basic:	11,000 lb	Maximum Speed – Land:	15 mph
Payload:	2,100 lb	– Water:	0 mph
Gross Weight:	13,100 lb	Ground Clearance:	14.75 in.
Ground Pressure – Empty:	0.85 psi	Fording Depth:	32 in.
– Loaded:	1.01 psi	Maximum Slope Negotiable:	70 %
Overall – Length:	154 in.	Vehicle Cone Index (1-Pass):	8
– Width:	114.5 in.	Vehicle Cone Index (50-Pass):	6
– Height:	98 in.	Track or Tire Size:	42 × 154 in.
Grouser Height:	<1.5 in.		
Sprocket Pitch:	7.0 in.	Tire Pressure:	NA psi
Number of Roadwheels or Bogies per Side:	4		

Mechanical Components Data

Engine –

Standard: Ford, 250 CID, 108 BHP

Optional: Ford, 300 CID, 132 BHP, Perkins diesel

Transmission –

Main: 4 speed manual

Optional: Automatic

Auxiliary: None

Suspension: Crank arm with torsion

Tracks or Wheels: Rubber belts with one-piece, high-strength, aluminum alloy grousers.

Miscellaneous

Primary Use: Cargo carrier

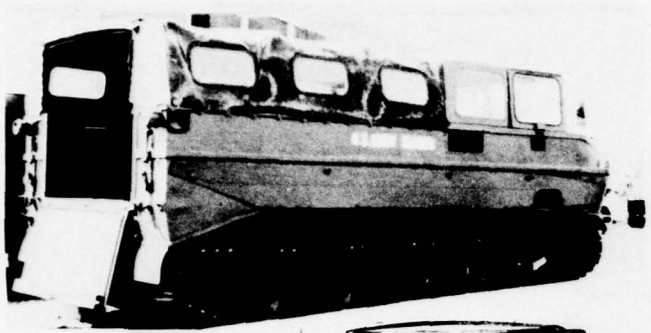
Cost: $19,749

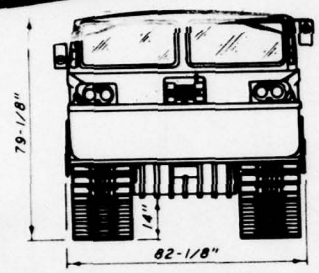
Potential Uses: Mount for small drill rig, push blade, or pull plow

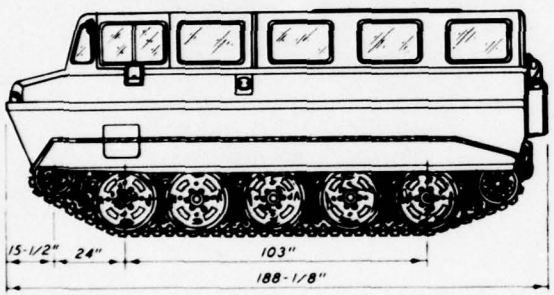
Available: Yes

Specifications for Vehicle No. II-5
Vehicle Identification: M116

Vehicle Manufacturer: Property of U. S. Army







General Data

Weight – Basic:	7,880 lb	Maximum Speed – Land:	37 mph
Payload:	3,000 lb	– Water:	4 mph
Gross Weight:	10,880 lb	Ground Clearance:	11.5 in.
Ground Pressure – Empty:	1.91 psi	Fording Depth:	AMP in.
– Loaded:	2.64 psi	Maximum Slope Negotiable:	60 %
Overall – Length:	188.0 in.	Vehicle Cone Index (1-Pass):	7
– Width:	82 in.	Vehicle Cone Index (50-Pass):	18
– Height:	79 in.	Track or Tire Size:	20 × 103 in.
Grouser Height:	<1.5 in.		
Sprocket Pitch:	4 in.	Tire Pressure:	38 psi
Number of Roadwheels or Bogies per Side:	5		

Mechanical Components Data

Engine –
Standard: 283 CID, V-8, 160 BHP
Optional: None

Transmission –
Main: 3 speed automatic
Optional: None
Auxiliary: None

Suspension: Individual Torsion Bar

Tracks or Wheels: Rubber band, 22 sections 32 in. long with 4-in. wide × 20-in. track cleats

Miscellaneous

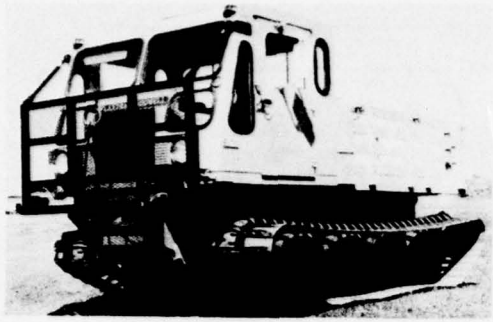
Primary Use: Cargo carrier

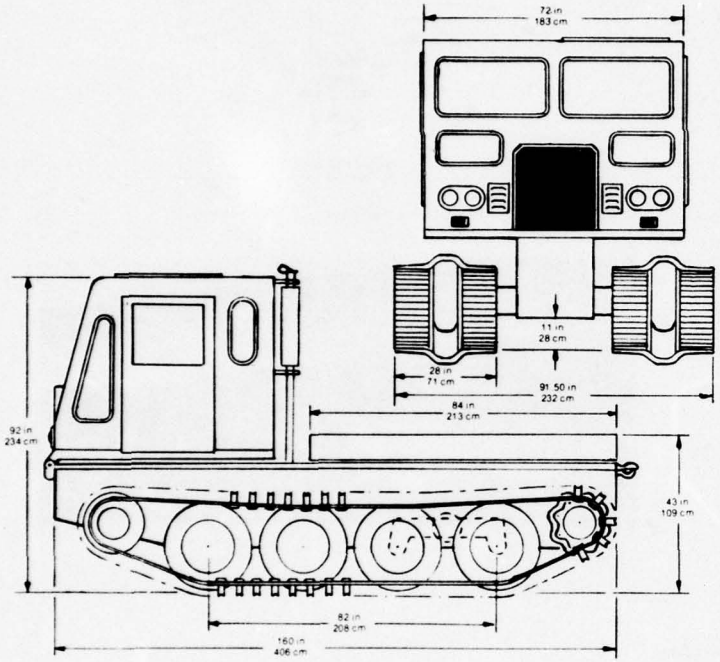
Cost: _____

Potential Uses: Mount for small drill rig, push blade, or pull plow

Available: Possibly Army surplus

Specifications for Vehicle No. II-6
Vehicle Identification: PN 20 W/B





Vehicle Manufacturer: Flextrac Nodwell, P. O. Box 5944
Station A, 1201 42nd Ave. SE
Calgary, Alberta, Canada

General Data

Weight – Basic:	7,300 lb	Maximum Speed – Land:	22 mph
Payload:	2,500 lb	– Water:	0 mph
Gross Weight:	10,800 lb	Ground Clearance:	11 in.
Ground Pressure – Empty:	1.99 psi	Fording Depth:	32 in.
– Loaded:	2.35 psi	Maximum Slope Negotiable:	45 %
Overall – Length:	160 in.	Vehicle Cone Index (1-Pass):	6
– Width:	91.5 in.	Vehicle Cone Index (50-Pass):	15
– Height:	92 in.	Track or Tire Size:	28 × 82 in.
Grouser Height:	<1.5 in.		
Sprocket Pitch:	7 in.	Tire Pressure:	8A psi
Number of Roadwheels or Bogies per Side:	4		

Mechanical Components Data

Engine –
Standard: Ford, 250 CID, 6 cylinder, 108 BHP
Optional: Diesel

Transmission –
Main: 4 speed manual
Optional: Automatic
Auxiliary:

Suspension: Walking beam

Tracks or Wheels: Rubber belt and spring steel drop center grousers

Miscellaneous

Primary Use: Cargo carrier

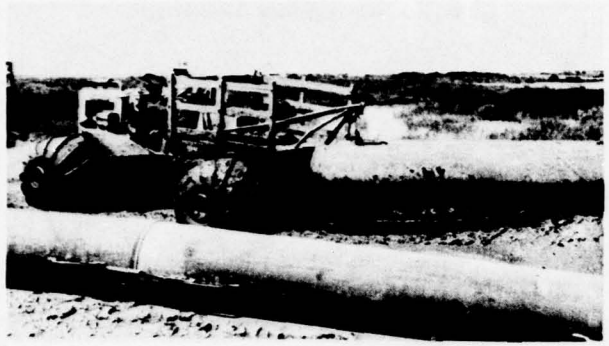
Cost: $16,947

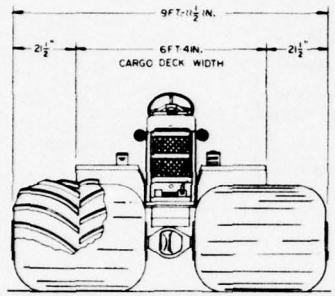
Potential Uses: Mount for small drill rig, push blade, or pull plow

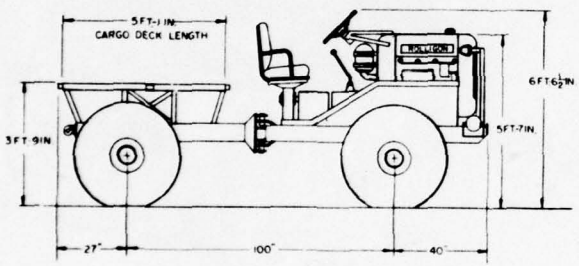
Available: Yes

Specifications for Vehicle No. II-7

Vehicle Identification: Rolligon 4450







Vehicle Manufacturer: The Rollingon Corporation
10635 Brighton Lane
Stafford, TX 77477

General Data

Weight – Basic:	3500 lb	Maximum Speed – Land:	25 mph
Payload:	4000 lb	– Water:	4 mph
Gross Weight:	7500 lb	Ground Clearance:	19 in.
Ground Pressure – Empty:	____ psi	Fording Depth:	AMP in.
– Loaded:	____ psi	Maximum Slope Negotiable:	60 %
Overall – Length:	167 in.	Vehicle Cone Index (1-Pass):	7
– Width:	112.5 in.	Vehicle Cone Index (50-Pass):	18
– Height:	78.5 in.	Track or Tire Size:	40 × 50 Rolligon
Nominal Tire Diameter:	40 in.		
Nominal Tire Width:	50 in.	Tire Pressure:	6 psi

Mechanical Components Data

Engine –

Standard: 4 cylinder diesel, 59 BHP

Optional: Gasoline

Transmission –

Main: 4 speed manual

Optional: None

Auxiliary: None

Suspension: Rigid

Tracks or Wheels: 40 × 50 10-ply cleated Rolligon tires with special rims

Miscellaneous

Primary Use: Cargo carrier

Cost: $16,450

Potential Uses: Mount for small drill rig, push blade, or pull plow

Available: Yes

Specifications for Vehicle No. 1152

Vehicle Identification: XM759, Cargo Carrier

Vehicle Manufacturer: Developed by Pacific Car and Foundry for the U. S. Army



SKETCH NOT AVAILABLE

General Data

Weight – Basic:	10,000 lb	Maximum Speed – Land:	30 mph
Payload:	3,000 lb	– Water:	5 mph
Gross Weight:	13,000 lb	Ground Clearance:	11 in.
Ground Pressure – Empty:	1.77 psi	Fording Depth:	Amph in.
– Loaded:	2.60 psi	Maximum Slope Negotiable:	60 %
Overall – Length:	245 in.	Vehicle Cone Index (1-Pass):	0 *
– Width:	110 in.	Vehicle Cone Index (50-Pass):	0 *
– Height:	108 in.	Track or Tire Size:	Pneumatic track or tires, 24 × 106 in.
Grouser Height:	4.25 in.		
Sprocket Pitch:	4.12 in.	Tire Pressure:	5 psi
Number of Roadwheels or Bogies per Side:	6		

* Experimental values

Mechanical Components Data

Engine –

Standard: Gasoline, 160 BHP

Optional: None

Transmission –

Main: Hydramatic

Optional: None

Auxiliary:

Suspension: Rigid

Tracks or Wheels: Pneumatic track or tires, 24 × 106 in. with tires 16 × 24 in.

Miscellaneous

Primary Use: Cargo carrier

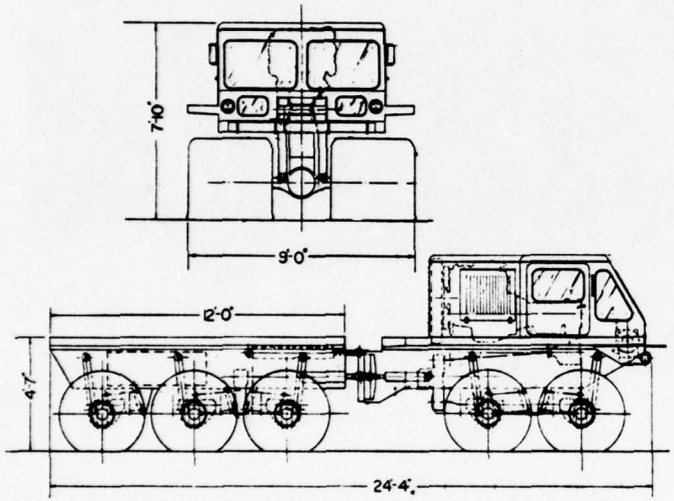
Cost: _____

Potential Uses: Mount for small drill rig, push blade, or pull plow

Available: Possibly Army surplus

Specifications for Vehicle No. II-9
Vehicle Identification: Mexa 10 × 10





Vehicle Manufacturer: Vehicle Manufactured by Clark Equipment Company for the U. S. Army

General Data

Weight – Basic:	13,030 lb	Maximum Speed – Land	30 mph
Payload:	5,000 lb	– Water	0 mph
Gross Weight:	18,030 lb	Ground Clearance:	14.5 in.
Ground Pressure – Empty:	2.38 psi	Fording Depth:	40 in.
– Loaded:	3.3 psi	Maximum Slope Negotiable:	60 %
Overall – Length:	292 in.	Vehicle Cone Index (1-Pass):	7
– Width:	108 in.	Vehicle Cone Index (50-Pass):	18
– Height:	94 in.	Track or Tire Size:	42 × 40
Nominal Tire Diameter:	42 in.		
Nominal Tire Width:	40 in.	Tire Pressure:	3 psi

Mechanical Components Data

Engine –

Standard: 214 BHP

Optional: None

Transmission –

Main: Hydraulic

Optional: None

Auxiliary: 2 speed transfer

Suspension: Air shock absorbers

Tracks or Wheels: 42 × 40 4-ply Terra tires mounted on a 16-in.-diameter rim

Miscellaneous

Primary Use: Cargo carrier

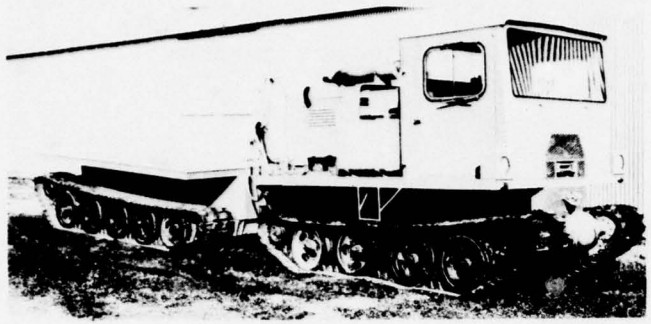
Cost: _____

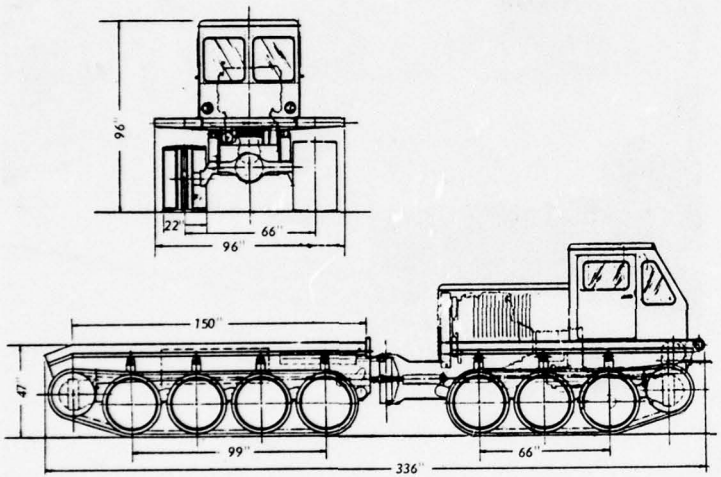
Potential Uses: Mount for small drill rig, push blade, or pull plow

Available: Only one made

Specifications for Vehicle No. II-10

Vehicle Identification: Mexa Track





Vehicle Manufacturer: Developed by Clark Equipment Company for U. S. Army

General Data

Weight – Basic:	14,680 lb	Maximum Speed – Land:	30 mph
Payload:	5,000 lb	– Water:	0 mph
Gross Weight:	19,680 lb	Ground Clearance:	18.0 in.
Ground Pressure – Empty:	2.08 psi	Fording Depth:	-- in.
– Loaded:	2.11 psi	Maximum Slope Negotiable:	60 %
Overall – Length:	366 in.	Vehicle Cone Index (1-Pass):	8
– Width:	96 in.	Vehicle Cone Index (50-Pass):	20
– Height:	96 in.	Track or Tire Size:	Two units (1) 22 × 99 in., (1) 22 × 66 in.
Grouser Height:	<1.5 in.		
Sprocket Pitch:	4 in.	Tire Pressure:	NA psi
Number of Roadwheels or Bogies per Side:	7		

Mechanical Components Data

Engine –

Standard: 214 BHP

Optional: None

Transmission –

Main: Hydraulic

Optional:

Auxiliary: 2 speed transfer

Suspension: Air shock absorbers

Tracks or Wheels: Two track units (1) 22 × 99 in. (1) 22 × 66 in.

Miscellaneous

Primary Use: Cargo carrier

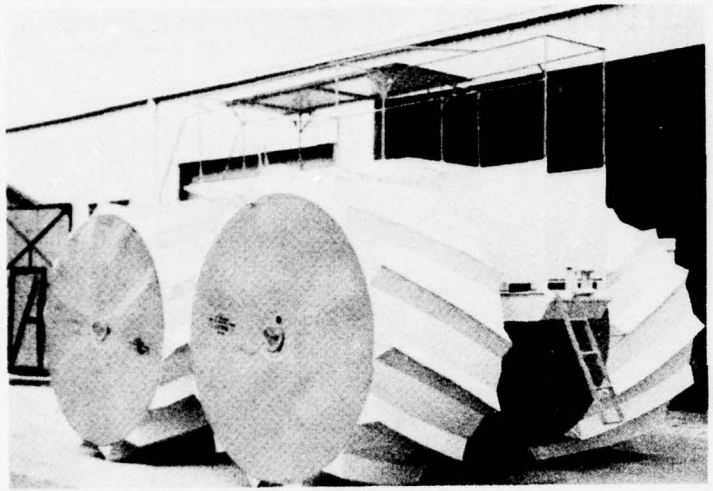
Cost: _____

Potential Uses: Mount for small drill rig, push blade, or pull plow

Available: Only one made

Specifications for Vehicle No. 11-11
Vehicle Identification: Amphibious Carrier Model 104-W-HD-59

Vehicle Manufacturer: Quality Marsh International Corp.
P. O. Box 406
Thibodaux, LA 70301



SKETCH NOT AVAILABLE

General Data

Weight – Basic:	18,000	lb	Maximum Speed – Land:	30	mph
Payload:	4,000	lb	– Water:	3-6	mph
Gross Weight:	22,000	lb	Ground Clearance:	54	in.
Ground Pressure – Empty:	--	psi	Fording Depth:	AMP	in.
– Loaded:	--	psi	Maximum Slope Negotiable:	60	%
Overall – Length:	240	in.	Vehicle Cone Index (1-Pass):	0	
– Width:	183	in.	Vehicle Cone Index (50-Pass):	0	
– Height:	158	in.	Track or Tire Size:	50 in. wide x 108 in. diameter	
Nominal Tire Diameter:	108	in.			
Nominal Tire Width:	50	in.	Tire Pressure:	5	psi

Mechanical Components Data

Engine –
Standard: GM 4-53 Diesel, 252 BHP
Optional: None

Transmission –
Main: 4 speed manual
Optional: None
Auxiliary: None

Suspension: Rigid

Tracks or Wheels: All-steel welded construction

Miscellaneous

Primary Use: Cargo carrier

Cost: $29,556

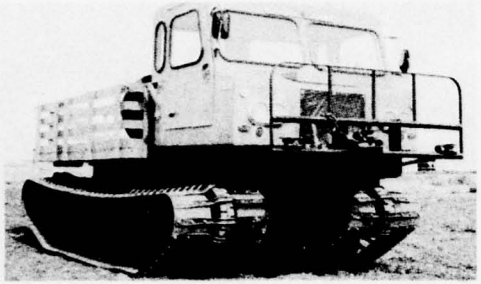
Potential Uses: Mount for small drill rig, push blade, or pull plow

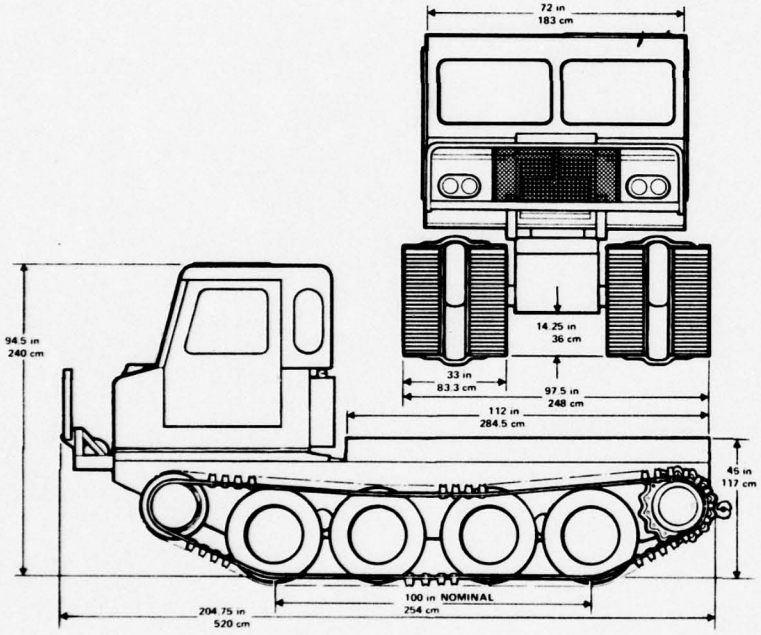
Available: Yes

Index of Group III Vehicles, 3- to 7-1/2-Ton Payload

Vehicle No.	Vehicle Identification
III-1	FN 60
III-2	Muskeg Carrier
III-3	FN 75
III-4	Rolligon 4460
III-5	FN WT-100
III-6	FN 100 TT
III-7	FN 110
III-8	TVS 1000
III-9	Dragline Carrier Model No. 10XT-HD-59M
III-10	ROTO-BOOM Model No. 104T-65
III-11	Amphibious Carrier Model 10XT-HD-65M

Specifications for Vehicle No. III-1
Vehicle Identification: FN 60





Vehicle Manufacturer: Flextrac Nodwell, P. O. Box 5544
Station A, 1201 42nd Ave., SE
Calgary, Alberta, Canada

General Data

Weight – Basic:	10,400 lb	Maximum Speed – Land:	12.2 mph
Payload:	6,000 lb	– Water:	0 mph
Gross Weight:	16,400 lb	Ground Clearance:	14.25 in.
Ground Pressure – Empty:	1.58 psi	Fording Depth:	42 in.
– Loaded:	2.48 psi	Maximum Slope Negotiable:	60 %
Overall – Length:	205 in.	Vehicle Cone Index (1-Pass):	6
– Width:	97.5 in.	Vehicle Cone Index (50-Pass):	10
– Height:	94.5 in.	Track or Tire Size:	33 × 100 in.
Grouser Height:	<1.5 in.		
Sprocket Pitch:	6.0 in.	Tire Pressure:	NA psi
Number of Roadwheels or Bogies per Side:	4		

Mechanical Components Data

Engine –
Standard: Ford, 240 CID, 6 cylinder, 167 BHP
Optional: Diesel

Transmission –
Main: 4 speed manual
Optional: Automatic
Auxiliary:

Suspension: Walking beams, urethane bearings.

Tracks or Wheels: Rubber belts and drop center steel grousers.

Miscellaneous

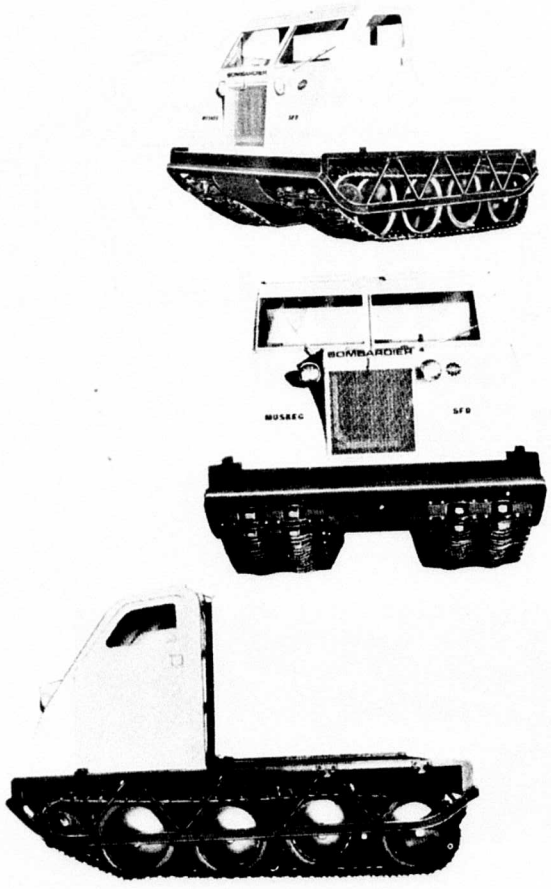
Primary Use: Cargo carrier

Cost: $80,015

Potential Uses: Mount for drill rig, push blade, or pull plow

Available: Yes

Specifications for Vehicle No. 311-F
Vehicle Identification: Muskeg Carrier



Vehicle Manufacturer: Bombardier Limited
Industrial Division
Valcourt, Quebec, Canada

General Data

Weight – Basic:	7,000 lb	Maximum Speed – Land:	14.6 mph
Payload:	5,000 lb	– Water:	0 mph
Gross Weight:	12,000 lb	Ground Clearance:	14 in.
Ground Pressure – Empty:	1.33 psi	Fording Depth:	30 in.
– Loaded:	2.89 psi	Maximum Slope Negotiable:	80 %
Overall – Length:	182.2 in.	Vehicle Cone Index (1-Pass):	7
– Width:	87 in.	Vehicle Cone Index (50-Pass):	17
– Height:	89 in.	Track or Tire Size: 28 × 9 in.	
Grouser Height:	1.5 in.		
Sprocket Pitch:	4.35 in.	Tire Pressure:	NA psi
Number of Roadwheels or Bogies per Side:	4		

Mechanical Components Data

Engine –
- Standard: Chrysler 318 CID, 187 BHP
- Optional: Perkins diesel, 88 BHP

Transmission –
- Main: 4 speed manual
- Optional: None
- Auxiliary: None

Suspension: Tandem and rubber bushings

Tracks or Wheels: Rubber and fabric with reinforcing steel wire forged spring steel cross-links

Miscellaneous

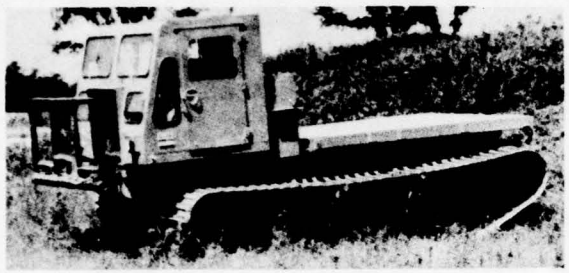
Primary Use: Cargo carrier

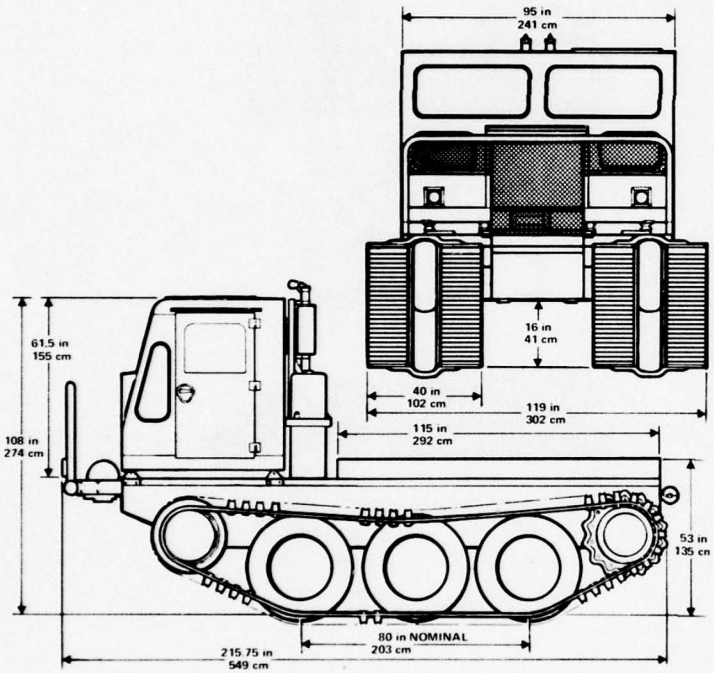
Cost: $15,400

Potential Uses: Mount for drill rig, push blade, or pull plow

Available: Yes

Specifications for Vehicle No. 111-1
Vehicle Identification: FN 75





Vehicle Manufacturer: Flextrac Nodwell, P. O. Box 5544
Station A, 1201 42nd Ave., SE
Calgary, Alberta, Canada

General Data

Weight – Basic:	15,550 lb	Maximum Speed – Land:	14.6 mph
Payload:	5,000 lb	– Water:	0 mph
Gross Weight:	20,500 lb	Ground Clearance:	16 in.
Ground Pressure – Empty:	2.48 psi	Fording Depth:	48 in.
– Loaded:	3.67 psi	Maximum Slope Negotiable:	60 %
Overall – Length:	215.75 in.	Vehicle Cone Index (1-Pass):	6
– Width:	119 in.	Vehicle Cone Index (50-Pass):	16
– Height:	113 in.	Track or Tire Size: 40 × 80 in.	
Grouser Height:	5.5 in.		
Sprocket Pitch:	6.0 in.	Tire Pressure:	NA psi
Number of Roadwheels or *Bogies* per Side:	3		

Mechanical Components Data

Engine –

Standard: Ford, 391 CID, V-8, gasoline, 187 BHP

Optional: Diesel

Transmission –

Main: 5 speed manual

Optional: Automatic

Auxiliary: None

Suspension: Crank arm with 57-lb torsion coil spring

Tracks or Wheels: Rubber belts and spring steel drop center grousers

Miscellaneous

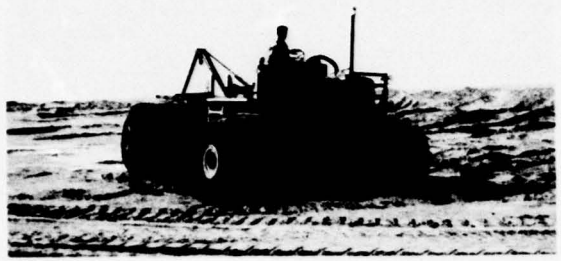
Primary Use: Cargo carrier

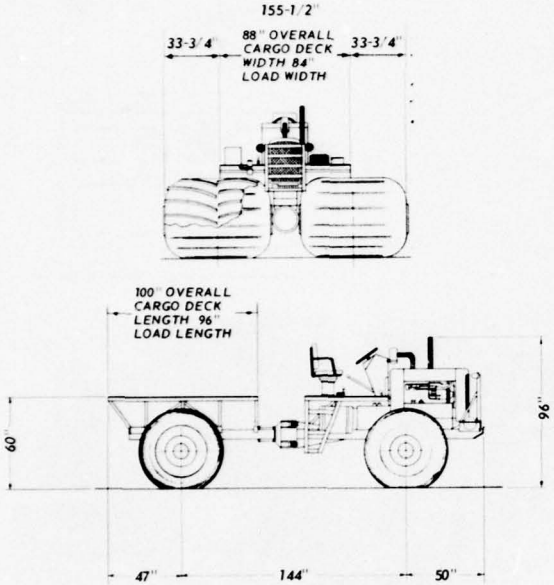
Cost: $88,215

Potential Uses: Mount for drill rig, push blade, or pull plow

Available: Yes

Specifications for Vehicle No. III-4
Vehicle Identification: Rolligon 4460





Vehicle Manufacturer: The Rolligon Corporation
10635 Brighton Lane
Stafford, TX 77477

General Data

Weight – Basic:	7,500 lb	Maximum Speed – Land:	22 mph
Payload:	10,000 lb	– Water:	3 mph
Gross Weight:	17,500 lb	Ground Clearance:	25 in.
Ground Pressure – Empty:	____ psi	Fording Depth:	AMP in.
– Loaded:	____ psi	Maximum Slope Negotiable:	60 %
Overall – Length:	241 in.	Vehicle Cone Index (1-Pass):	9
– Width:	122.5 in.	Vehicle Cone Index (50-Pass):	20
– Height:	96 in.	Track or Tire Size:	54 × 68-in. Rolligon
Nominal Tire Diameter:	54 in.		
Nominal Tire Width:	68 in.	Tire Pressure:	6 psi

Mechanical Components Data

Engine –
Standard: Ford Model 362, 6 cylinder, diesel, 101 BHP
Optional: None

Transmission –
Main: 4 speed manual
Optional: None
Auxiliary: None

Suspension: Rigid

Tracks or Wheels: 54 × 68-in. cleated Rolligon tires on 16-in.-diameter rim

Miscellaneous

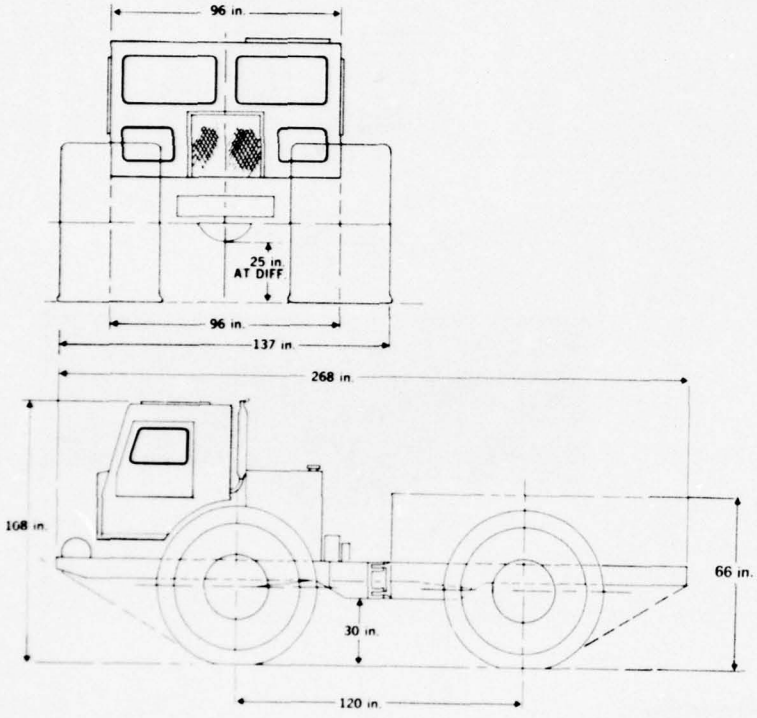
Primary Use: Cargo carrier

Cost: $30,000

Potential Uses: Mount for drill rig, push blade, or pull plow

Available: Yes





Specifications for Vehicle No. III-6
Vehicle Identification: FN WT-100

Vehicle Manufacturer: Flextrac Nodwell, P. O. Box 5544
Station A, 1201 42nd Ave., SE
Calgary, Alberta, Canada

General Data

Weight – Basic:	8,500 lb	Maximum Speed – Land:	40 m.ph
Payload:	10,000 lb	– Water:	0 mph
Gross Weight:	22,000 lb	Ground Clearance:	25 in.
Ground Pressure – Empty:	1.46 psi	Fording Depth:	in.
– Loaded:	3.36 psi	Maximum Slope Negotiable:	60 %
Overall – Length:	268 in.	Vehicle Cone Index (1-Pass):	10
– Width:	137 in.	Vehicle Cone Index (50-Pass):	20
– Height:	108 in.	Track or Tire Size:	66 × 43.00 Terra
Nominal Tire Diameter:	66 in.		
Nominal Tire Width:	43 in.	Tire Pressure:	5 psi

Mechanical Components Data

Engine –
Standard: Ford, V-8, 330 CID, 150 BHP
Optional: GM 4-53 diesel engine

Transmission –
Main: Clark 285V, 5 speed
Optional: Fuller Transmission, 5 speed
Allison CT-3341 powershift
Auxiliary: New process 200 series, 2 speed

Suspension: Rigid

Tracks or Wheels: Terra tire 66 × 43.00, 6-ply mounted on 25-in. rim

Miscellaneous

Primary Use: Cargo carrier

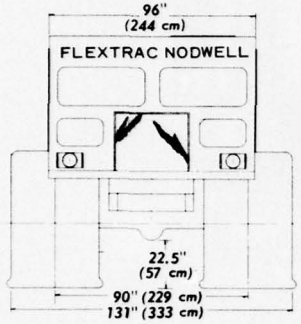
Cost: $30,718

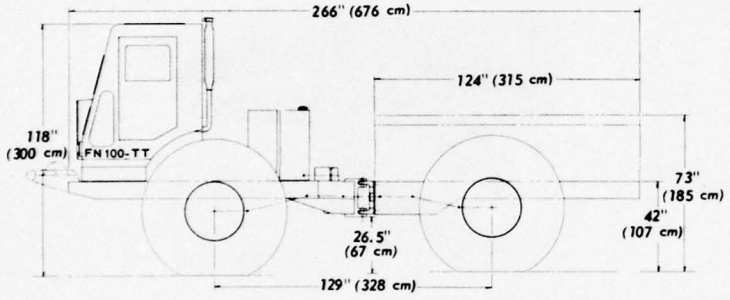
Potential Uses: Mount for drill rig, push blade, or pull plow

Available: Yes

Specifications for Vehicle No. III-6
Vehicle Identification: FN 100 TT







Vehicle Manufacturer: Flextrac Nodwell, P. O. Box 5544
Station A, 1201 42nd Ave., SE
Calgary, Alberta, Canada

General Data

Weight – Basic:	15,000	lb	Maximum Speed – Land:	30	mph
Payload:	10,000	lb	– Water:	0	mph
Gross Weight:	25,000	lb	Ground Clearance:	22.5	in.
Ground Pressure – Empty:	2.16	psi	Fording Depth:	--	in.
– Loaded:	4.2	psi	Maximum Slope Negotiable:	60	%
Overall – Length:	266	in.	Vehicle Cone Index (1-Pass):	13	
– Width:	131	in.	Vehicle Cone Index (50-Pass):	31	
– Height:	118	in.	Track or Tire Size:	66 × 43 Terra	
Nominal Tire Diameter:	66	in.			
Nominal Tire Width:	43	in.	Tire Pressure:	6	psi

Mechanical Components Data

Engine –

Standard: Ford V-8, 391 CID, 187 BHP

Optional: GM 4-53 diesel, 126 BHP

Transmission –

Main: 5 speed manual

Optional: None

Auxiliary: None

Suspension: Rigid

Tracks or Wheels: 66 × 43 Terra tires on 25-in. rim

Miscellaneous

Primary Use: Cargo carrier

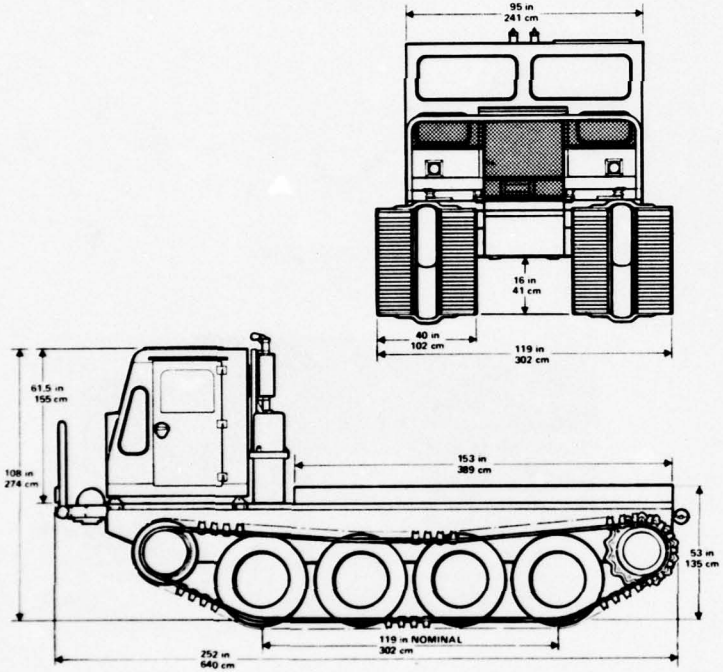
Cost: $30,718

Potential Uses: Mount for drill rig, push blade, or pull plow

Available: Yes

Specifications for Vehicle No. 111-7
Vehicle Identification: FN 110





Vehicle Manufacturer: Flextrac Nodwell, P. O. Box 5544
Station A, 1201 44nd Ave., SE
Calgary, Alberta, Canada

General Data

Weight – Basic:	18,200 lb	Maximum Speed – Land:	14.6 mph
Payload:	12,000 lb	– Water:	0 mph
Gross Weight:	30,200 lb	Ground Clearance:	16 in.
Ground Pressure – Empty:	1.91 psi	Fording Depth:	48 in.
– Loaded:	3.17 psi	Maximum Slope Negotiable:	60 %
Overall – Length:	222 in	Vehicle Cone Index (1-Pass):	6
– Width:	119 in	Vehicle Cone Index (50-Pass):	15
– Height:	108 in.	Track or Tire Size: 40 × 119 in.	
Grouser Height:	<1.5 in		
Sprocket Pitch:	6 in	Tire Pressure:	34 psi
Number of Roadwheels or Bogies per Side:	4		

Mechanical Components Data

Engine –

Standard: Ford, 391 CID, gasoline, 187 BHP

Optional: Diesel

Transmission –

Main: 5 speed manual

Optional: Automatic

Auxiliary: None

Suspension: Crank arm with 57-lb torsion coil spring

Tracks or Wheels: Rubber belt and spring steel drop center grousers

Miscellaneous

Primary Use: Drill rig platform

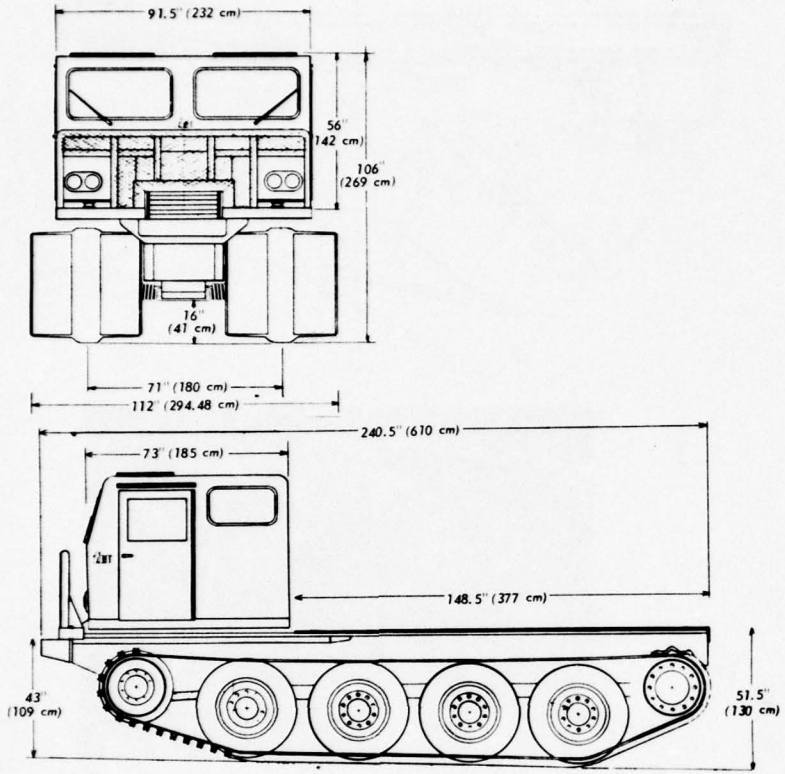
Cost: $31,194

Potential Uses: Mount for small dragline, drill rig, push blade, or pull plow

Available: Yes

Specifications for Vehicle No. 111-8
Vehicle Identification: TVS 1000

Vehicle Manufacturer: Foremost International Industries, Ltd.
1616 Meridian Road, NE
Calgary, Alberta, Canada



General Data

Weight – Basic:	18,600 lb	Maximum Speed – Land:	30 mph
Payload:	12,000 lb	– Water:	2 mph
Gross Weight:	30,600 lb	Ground Clearance:	16 in.
Ground Pressure – Empty:	1.97 psi	Fording Depth:	48 in.
– Loaded:	3.24 psi	Maximum Slope Negotiable:	60 %
Overall – Length:	304.5 in.	Vehicle Cone Index (1-Pass):	7
– Width:	318 in.	Vehicle Cone Index (50-Pass):	17
– Height:	106 in.	Track or Tire Size: 40 × 118 in.	
Grouser Height:	<1.5 in.		
Sprocket Pitch:	6 in.	Tire Pressure:	NA psi
Number of Roadwheels or Bogies per Side:	4		

Mechanical Components Data

Engine –

Standard: Ford 391 CID, 187 BHP

Optional: GM 6V53, Cummins 504C

Transmission –

Main: Spicer 5 speed manual

Optional: Fuller 5 speed manual

Auxiliary: None

Suspension: Heavy-duty springs

Tracks or Wheels: 4-ply rayon/nylon fabric with spring steel grousers

Miscellaneous

Primary Use: Cargo carrier

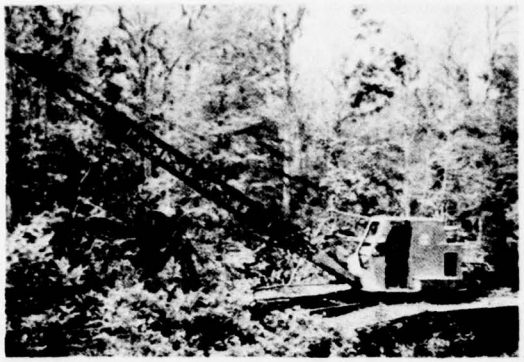
Cost: $37,000

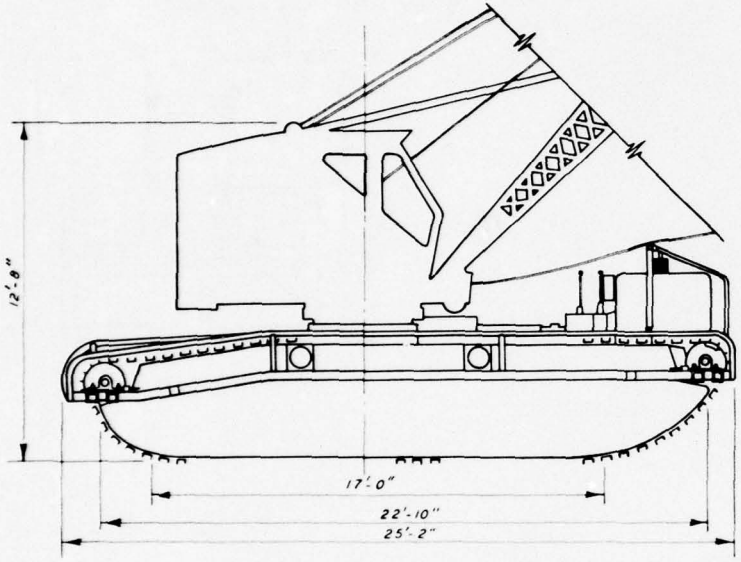
Potential Uses: Mount for small dragline, drill rig, push blade, or pull plow

Available: Yes

Specifications for Vehicle No. 111-2

Vehicle Identification: Dragline Carrier Model No. 10XT-HD-59M





Vehicle Manufacturer: Quality Marsh International Corp.
P. O. Box 406
Thibodaux, LA 70301

General Data

Weight – Basic:	20,000 lb	Maximum Speed – Land:	4-5 mph
Payload:	12,000 lb	– Water:	3-4 mph
Gross Weight:	32,000 lb	Ground Clearance:	38 in.
Ground Pressure – Empty:	0.82 psi	Fording Depth:	AMP in.
– Loaded:	1.31 psi	Maximum Slope Negotiable:	60 %
Overall – Length:	302 in.	Vehicle Cone Index (1-Pass):	0
– Width:	204 in.	Vehicle Cone Index (50-Pass):	0
– Height:	152 in.	Track or Tire Size: 60 × 204 in.	
Grouser Height:	5½ in.		
Sprocket Pitch:	8 in.	Tire Pressure:	NA psi
Number of Roadwheels or Bogies per Side:	4		

Mechanical Components Data

Engine –

Standard: Ford, 206 CID, 4 cylinder, 82 BHP

Optional: GM 3-53 diesel, 78 BHP

Transmission –

Main: 4 speed manual

Optional: None

Auxiliary: None

Suspension: Rigid

Tracks or Wheels: 3 strands of heavy-duty track chain with 4-in. aluminum channel cleats

Miscellaneous

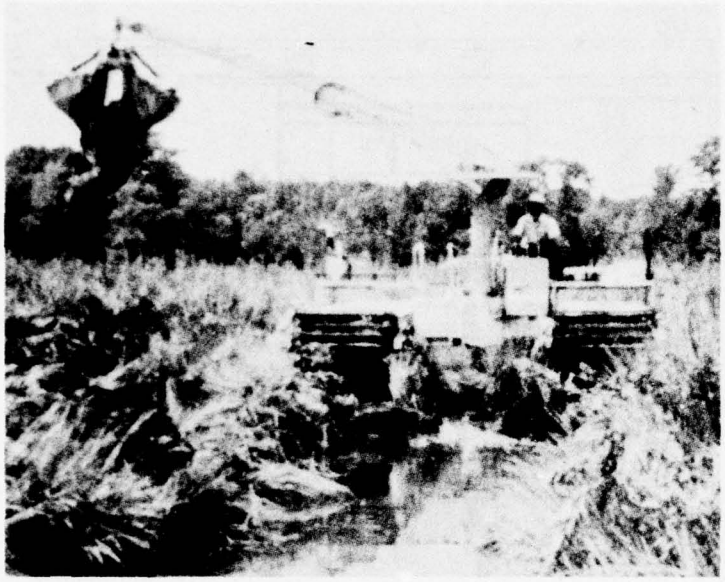
Primary Use: Dragline carrier

Cost $33,843

Potential Uses: Mount for hydrocrane, drill rig, push blade, or pull plow

Available: Yes

Specifications for Vehicle No. 111-10
Vehicle Identification: ROTO-BOOM Model 104T-65



SKETCH NOT AVAILABLE

Vehicle Manufacturer: Quality Marsh International Corp.
P. O. Box 406
Thibodaux, LA 70301

General Data

Weight – Basic:	12,000 lb	Maximum Speed – Land:	5 mph
Payload:	1,500 lb	– Water:	3-4 mph
Gross Weight:	16,500 lb	Ground Clearance:	38 in.
Ground Pressure – Empty:	0.82 psi	Fording Depth:	AMP in.
– Loaded:	1.01 psi	Maximum Slope Negotiable:	60 %
Overall – Length:	329 in.	Vehicle Cone Index (1-Pass):	0
– Width:	166 in.	Vehicle Cone Index (50-Pass):	0
– Height:	134 in.	Track or Tire Size: 48 × 190 in.	
Grouser Height:	<1.5 in.		
Sprocket Pitch:	8 in.	Tire Pressure:	NA psi
Number of Roadwheels or Bogies per Side:	4		

Mechanical Components Data

Engine –

Standard: Ford, 300 CID, gasoline, 165 BHP

Optional: GM 4-53 diesel

Transmission –

Main: 4 speed manual

Optional: None

Auxiliary: None

Suspension: Rigid

Tracks or Wheels: Two strands of heavy-duty track with chain with 4-in. aluminum channel cleats

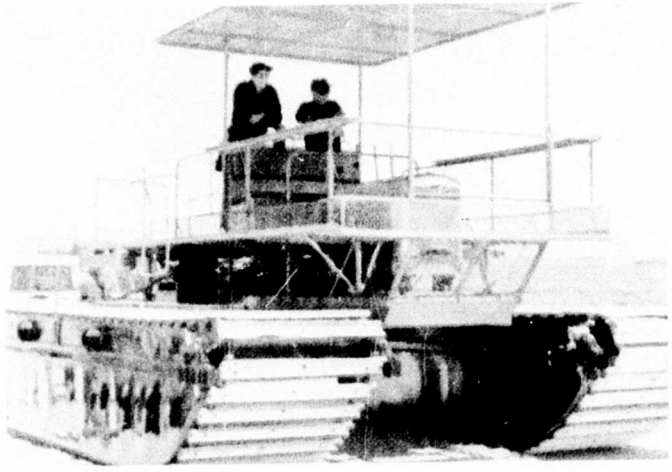
Miscellaneous

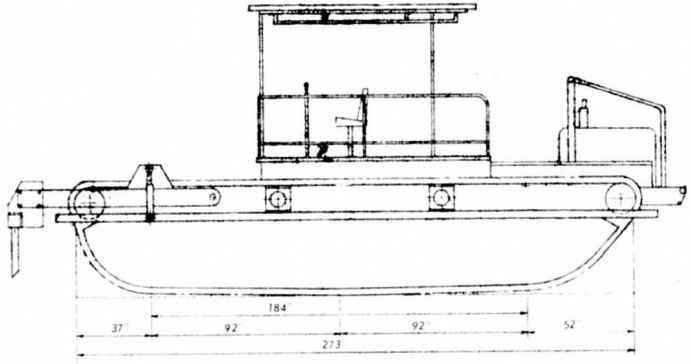
Primary Use: Small dragline (clam shell) Cost: _____

Potential Uses: Mount for drill rig, push blade, or pull plow

Available: Yes

Specifications for Vehicle No. III-13
Vehicle Identification: Amphibious Carrier Model 10XT-HD-65M





Vehicle Manufacturer: Quality Marsh International Corp.
P. O. Box 406
Thibodaux, LA 70301

General Data

Weight – Basic:	20,000 lb	Maximum Speed – Land:	4-5 mph
Payload:	12,000 lb	– Water:	3-4 mph
Gross Weight:	32,000 lb	Ground Clearance:	48 in.
Ground Pressure – Empty:	0.91 psi	Fording Depth:	AMP in.
– Loaded:	1.45 psi	Maximum Slope Negotiable:	60 %
Overall – Length:	273 in	Vehicle Cone Index (1-Pass):	—
– Width:	219 in	Vehicle Cone Index (50-Pass):	—
– Height:	— in	Track or Tire Size: 60 × 184 in.	
Grouser Height:	<1.5 in		
Sprocket Pitch:	2 in	Tire Pressure:	NA psi
Number of Roadwheels or Bogies per Side:	4		

Mechanical Components Data

Engine –
Standard: Ford, 256 CID, 4 cylinder, 82 BHP
Optional: Ford, 380 CID, 120 BHP, GM 3-53 diesel, 78 BHP

Transmission –
Main: 4 speed manual
Optional: None
Auxiliary:

Suspension: Rigid

Tracks or Wheels: Three strands of heavy-duty track chain with 4-in. aluminum cleats

Miscellaneous

Primary Use: Personnel or cargo carrier

Cost: $35,000

Potential Uses: Mount for push blade, pull plow, drill rig, or roto boom.

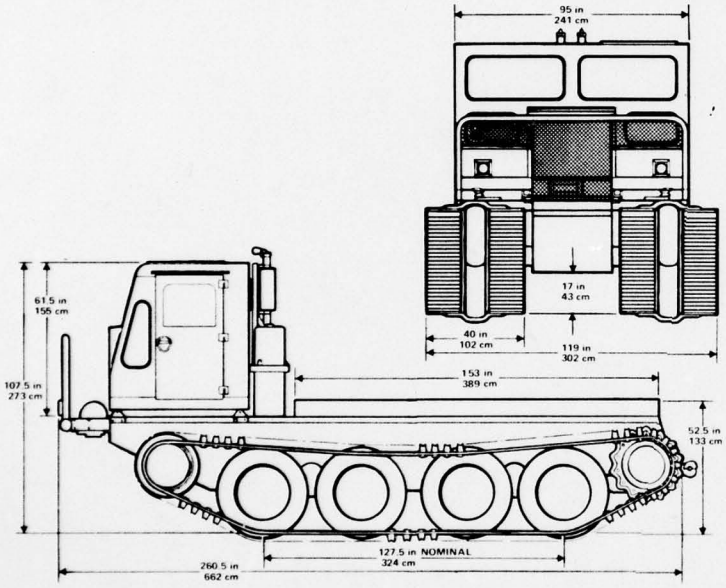
Available: Yes

Index of Group IV Vehicles, 8- to 15-Ton Payload

Vehicle No.	Vehicle Identification
IV-1	FN 160
IV-2	Rolligon 6660
IV-3	FN Norcan 200
IV-4	Dawson Five
IV-5	FN 240
IV-6	Rolligon 8860
IV-7	Muskeg Tracked Transporter
IV-8	Delta Three

Specifications for Vehicle No. IV-1
Vehicle Identification: FN 160





Vehicle Manufacturer: Flextrac Nodwell, P. O. Box 5544
Station A, 1201 42nd Ave., SE
Calgary, Alberta, Canada

General Data

Weight – Basic:	19,200 lb	Maximum Speed – Land:	12.5 mph
Payload:	16,000 lb	– Water:	0 mph
Gross Weight:	35,200 lb	Ground Clearance:	17 in.
Ground Pressure – Empty:	1.88 psi	Fording Depth:	48 in.
– Loaded:	3.46 psi	Maximum Slope Negotiable:	60 %
Overall – Length:	127.5 in.	Vehicle Cone Index (1-Pass):	6
– Width:	119 in.	Vehicle Cone Index (50-Pass):	10
– Height:	107.5 in.	Track or Tire Size:	40 × 127.5 in.
Grouser Height:	<1.5 in.		
Sprocket Pitch:	6.0 in.	Tire Pressure:	NA psi
Number of Roadwheels or Bogies *per* Side:	4		

Mechanical Components Data

Engine –
Standard: Ford, 391 CID, V-8 gasoline, 187 BHP
Optional: Diesel

Transmission –
Main: 5 speed forward
Optional: Automatic
Auxiliary: None

Suspension: One-piece cast steel walking beams with urethane bearings

Tracks or Wheels: Rubber belt and spring steel drop center grousers

Miscellaneous

Primary Use: Drill rig

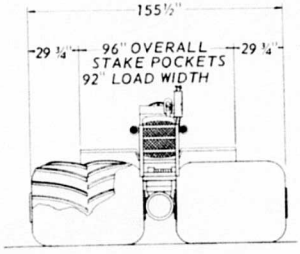
Cost: $37,174

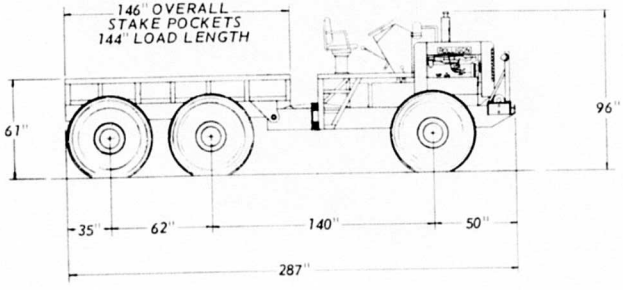
Potential Uses: Mount for dragline, push blade, or pull plow

Available: Yes

Specifications for Vehicle No. IV-2
Vehicle Identification: Rolligon 6660







Vehicle Manufacturer: The Rolligon Corporation
10635 Brighton Lane
Stafford, TX 77477

General Data

Weight – Basic:	11,000 lb	Maximum Speed – Land:	24 mph
Payload:	20,000 lb	– Water:	2 mph
Gross Weight:	31,000 lb	Ground Clearance:	22 in.
Ground Pressure – Empty:	psi	Fording Depth:	AMP in.
– Loaded:	psi	Maximum Slope Negotiable:	60 %
Overall – Length:	287 in.	Vehicle Cone Index (1-Pass):	10
– Width:	155.5 in.	Vehicle Cone Index (50-Pass):	24
– Height:	96 in.	Track or Tire Size:	54 × 68-in. Rolligon
Nominal Tire Diameter:	54 in.		
Nominal Tire Width:	68 in.	Tire Pressure:	2 psi

Mechanical Components Data

Engine –
Standard: Ford, 380 CID, 6 cylinder, 112 BHP, diesel
Optional: Gasoline

Transmission –
Main: 4 speed manual
Optional: None
Auxiliary: None

Suspension: Rigid

Tracks or Wheels: 54 × 68-in. cleated Rolligon tire with 18-in. rim

Miscellaneous

Primary Use: Cargo carrier

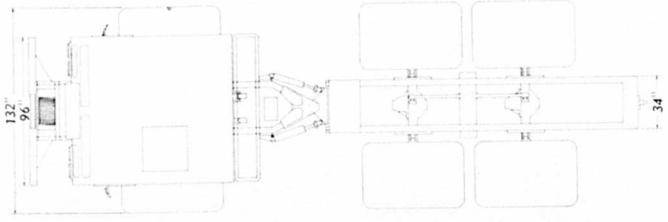
Cost: $39,960

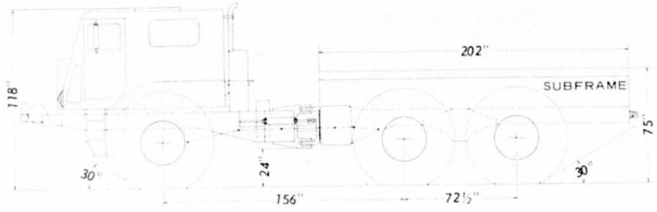
Potential Uses: Mount for dragline, drill rig, push blade, or pull plow

Available: Yes

Specifications for Vehicle No. IV-3
Vehicle Identification: FN Norcan 200







Vehicle Manufacturer: Flextrac Nodwell, P. O. Box 5544
Station A, 1201 46nd Ave., SE
Calgary, Alberta, Canada

General Data

Weight – Basic:	27,500 lb	Maximum Speed – Land:	27 mph
Payload:	20,000 lb	– Water:	5 mph
Gross Weight:	47,500 lb	Ground Clearance:	19 in.
Ground Pressure – Empty:	8.64 psi	Fording Depth:	in.
– Loaded:	4.56 psi	Maximum Slope Negotiable:	60 %
Overall – Length:	400 in.	Vehicle Cone Index (1-Pass):	26
– Width:	130 in.	Vehicle Cone Index (50-Pass):	57
– Height:	118 in.	Track or Tire Size: 66 × 43-in. Terra tires	
Nominal Tire Diameter:	66 in.		
Nominal Tire Width:	43 in.	Tire Pressure:	12 psi

Mechanical Components Data

Engine –
Standard: Detroit diesel 6V53, 195 BHP
Optional: None

Transmission –
Main: Allison powershift
Optional: None
Auxiliary: None

Suspension: Hendrickson 72.5 in. with side guide

Tracks or Wheels: 66 × 43-in. Terra tires on 25-in. rim

Miscellaneous

Primary Use: Cargo carrier

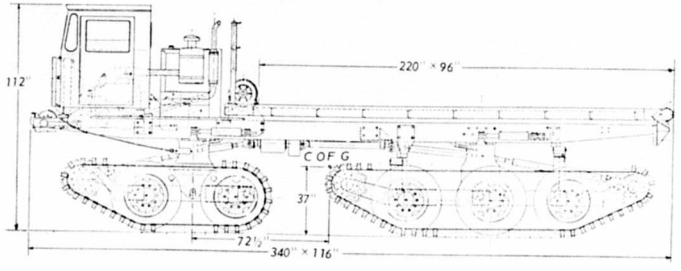
Cost: $66,683

Potential Uses: Mount for drill rig, dragline, push blade, or pull plow

Available: Yes

Specifications for Vehicle No. IV-4
Vehicle Identification: Dawson Five





Vehicle Manufacturer: Foremost International Industries, Ltd.
1616 Meridian Road, NE
Calgary, Alberta, Canada

General Data

Weight – Basic:	28,000 lb	Maximum Speed – Land:	25 mph
Payload:	22,000 lb	– Water:	– mph
Gross Weight:	50,000 lb	Ground Clearance:	17 in.
Ground Pressure – Empty:	1.97 psi	Fording Depth:	– in.
– Loaded:	3.52 psi	Maximum Slope Negotiable:	60 %
Overall – Length:	329 in.	Vehicle Cone Index (1-Pass):	6
– Width:	116 in.	Vehicle Cone Index (50-Pass):	15
– Height:	128 in.	Track or Tire Size:	2 units (1) 48 × 50 in., (1) 48 × 98 in.
Grouser Height:	4.5 in.		
Sprocket Pitch:	7.15 in.	Tire Pressure:	NA psi
Number of Roadwheels or Bogies per Side:	5		

Mechanical Components Data

Engine –

Standard: Ford, 391 CID, V-8, gasoline, 187 BHP
Optional: Detroit diesel 6V53
Cummins diesel V8-504C

Transmission –

Main: Spicer 5 speed manual
Optional: Allison MT41
Auxiliary: None

Suspension: Heavy-duty springs

Tracks or Wheels: Rayon/nylon 6-ply with 3/8 × 3-1/2-in. grousers

Miscellaneous

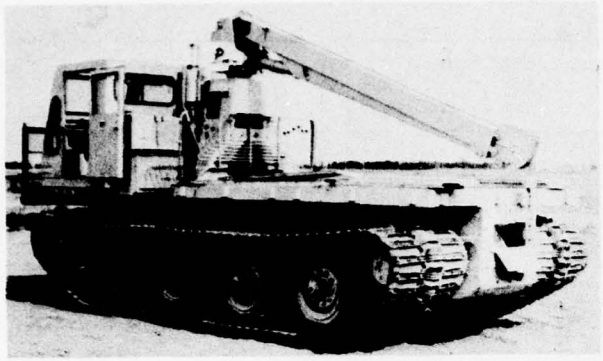
Primary Use: Cargo carrier

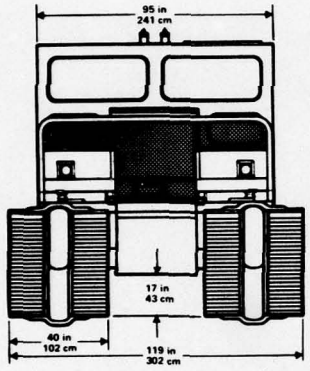
Cost: $16,800

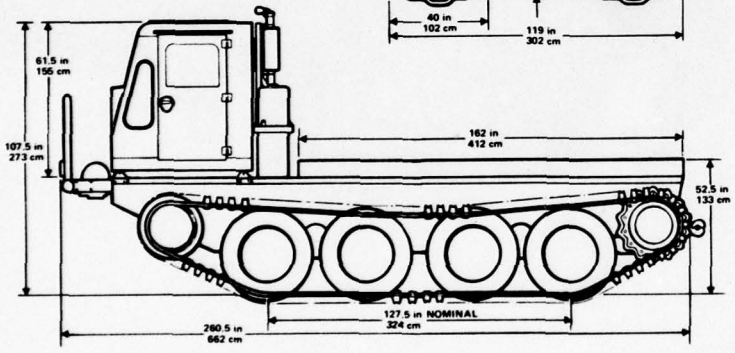
Potential Uses: Mount for drill rig, dragline, push blade, or pull plow

Available: Yes

Specifications for Vehicle No. IV-5
Vehicle Identification: FN 240







Vehicle Manufacturer: Flextrac Nodwell, P. O. Box 5544
Station A, 1201 42nd Ave., SE
Calgary, Alberta, Canada

General Data

Weight – Basic:	19,800 lb	Maximum Speed – Land:	12.5 mph
Payload:	24,000 lb	– Water:	0 mph
Gross Weight:	43,800 lb	Ground Clearance:	17 in.
Ground Pressure – Empty:	1.24 psi	*Fording Depth*:	48 in.
– Loaded:	4.89 psi	Maximum Slope Negotiable:	60 %
Overall – Length:	260.5 in.	Vehicle Cone Index (1-Pass):	7
– Width:	119 in.	Vehicle Cone Index (50-Pass):	17
– Height:	107.5 in.	Track or Tire Size:	40 × 127.5 in.
Grouser Height:	<1.5 in.		
Sprocket Pitch:	6.0 in.	Tire Pressure:	NA psi
Number of Roadwheels or Bogies per Side:	4		

Mechanical Components Data

Engine –
Standard: Ford, 391 CID, V-8, gasoline, 187 BHP
Optional: Diesel

Transmission –
Main: 5 speed manual
Optional: Automatic
Auxiliary: None

Suspension: One-piece cast steel walking beams with urethane bearings

Tracks or Wheels: Rubber belt and spring steel drop center grousers with reinforcing bars

Miscellaneous

Primary Use: Cargo carrier with roto boom

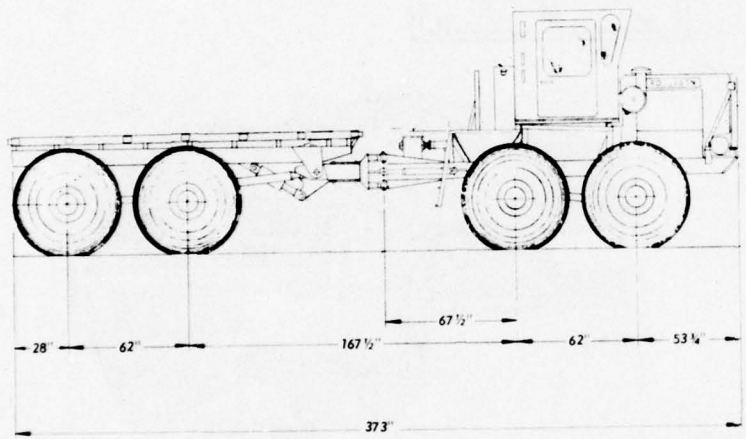
Cost: $38,190

Potential Uses: Mount for drill rig, dragline, push blade, or pull plow

Available: Yes

Specifications for Vehicle No. IV-6
Vehicle Identification: Rolligon 8860

PHOTOGRAPH NOT AVAILABLE



Vehicle Manufacturer: The Rolligon Corporation
10635 Brighton Lane
Stafford, TX 77477

General Data

Weight – Basic:	16,000	lb	Maximum Speed – Land:	24	mph
Payload:	30,000	lb	– Water:	2	mph
Gross Weight:	46,000	lb	Ground Clearance:	27	in.
Ground Pressure – Empty:		psi	Fording Depth:	AMP	in.
– Loaded:		psi	Maximum Slope Negotiable:	60	%
Overall – Length:	373	in.	Vehicle Cone Index (1-Pass):	10	
– Width:	155.5	in.	Vehicle Cone Index (50-Pass):	24	
– Height:	118	in.	Track or Tire Size:	54-in.-diameter × 68-in.-wide Rolligon	
Nominal Tire Diameter:	54	in.			
Nominal Tire Width:	68	in.	Tire Pressure:	2	psi

Mechanical Components Data

Engine –
Standard: Ford, Model 401T, 6 cylinder diesel engine
Optional: None

Transmission –
Main: Automatic powershift
Optional: None
Auxiliary: None

Suspension: Rigid

Tracks or Wheels: 54-in.-diameter × 68-in.-wide cleated Rolligon tire mounted on aluminum rim

Miscellaneous

Primary Use: Cargo carrier

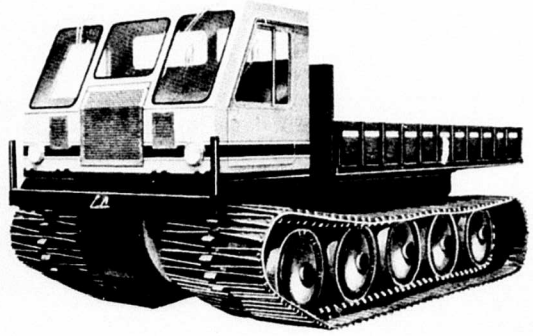
Cost: $53,610

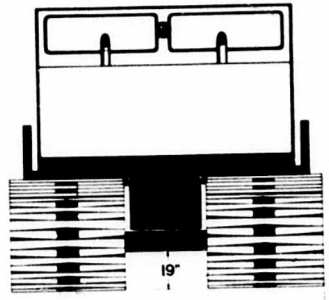
Potential Uses: Mount for dragline, drill rig, push blade, or pull plow

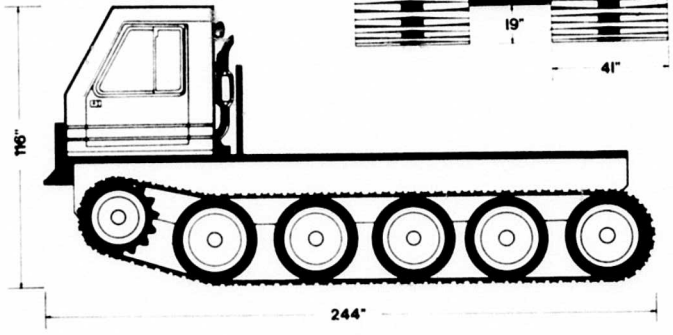
Available: Yes

Specifications for Vehicle No. IV-7

Vehicle Identification: Muskeg Tracked Transporter







Vehicle Manufacturer: Bombardier Limited
Industrial Division
Valcourt, Quebec, Canada

General Data

Weight – Basic:	24,000 lb	Maximum Speed – Land:	15 mph
Payload:	30,000 lb	– Water:	0 mph
Gross Weight:	54,000 lb	Ground Clearance:	19 in.
Ground Pressure – Empty:	1.76 psi	Fording Depth:	52 in.
– Loaded:	3.97 psi	Maximum Slope Negotiable:	75 %
Overall – Length:	244 in.	Vehicle Cone Index (1-Pass):	8
– Width:	130 in.	Vehicle Cone Index (50-Pass):	20
– Height:	116 in.	Track or Tire Size:	41 × 166 in.
Grouser Height:	<1.5 in.		
Sprocket Pitch:	6.25 in.	Tire Pressure:	NA psi
Number of Roadwheels or Bogies per Side:	5		

Mechanical Components Data

Engine –

Standard: GM 6V-53, diesel, 195 BHP

Optional: None

Transmission –

Main: Allison Torquematic MT650, 5 speed manual

Optional: None

Auxiliary: 2 speed

Suspension: Crank arm with hollow rubber spring

Tracks or Wheels: Rubber and fabric belt reinforced with steel wire with cross-links of spring steel

Miscellaneous

Primary Use: Cargo carrier

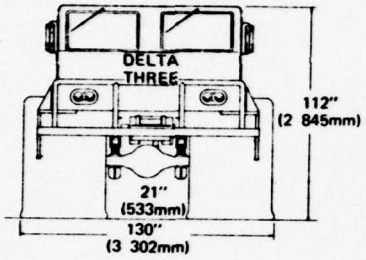
Cost: $60,500

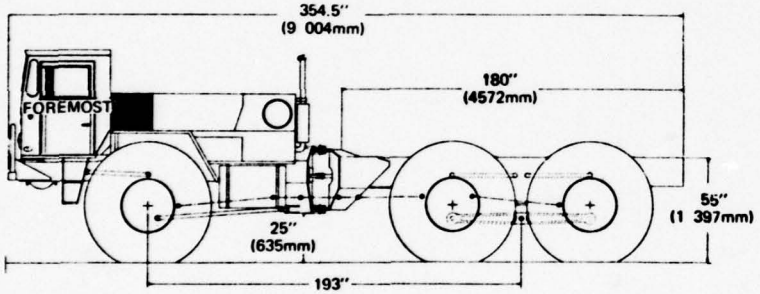
Potential Uses: Mount for dragline, drill rig, push blade, or pull plow

Available: Yes

Specifications for Vehicle No. IV-B
Vehicle Identification: Delta Three







Vehicle Manufacturer: Foremost International Industries, Ltd.
1616 Meridian Road, NE
Calgary, Alberta, Canada

General Data

Weight – Basic:	28,000 lb	Maximum Speed – Land:	32 mph
Payload:	30,000 lb	– Water:	-- mph
Gross Weight:	58,000 lb	Ground Clearance:	24 in.
Ground Pressure – Empty:	____ psi	Fording Depth:	-- in.
– Loaded:	____ psi	Maximum Slope Negotiable:	60 %
Overall – Length:	449 in.	Vehicle Cone Index (1-Pass):	18
– Width:	130 in.	Vehicle Cone Index (50-Pass):	42
– Height:	112 in.	Track or Tire Size:	66 × 43-in. Terra
Nominal Tire Diameter:	66 in.		
Nominal Tire Width:	43 in.	Tire Pressure:	3 psi

Mechanical Components Data

Engine –

Standard: Cummins V-504C, 190 BHP

Optional: 6V-53 Detroit diesel

Transmission –

Main: 4 speed powershift

Optional: None

Auxiliary: None

Suspension: Coil springs

Tracks or Wheels: 66- × 43-in., 6-ply Terra tires mounted on 25-in. rims

Miscellaneous

Primary Use: Cargo carrier

Cost: $63,400

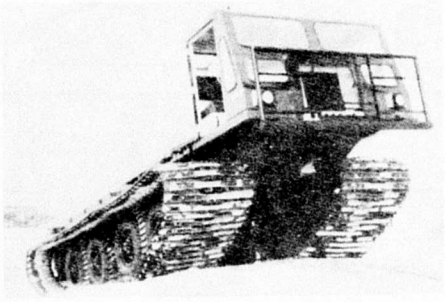
Potential Uses: Mount for dragline, drill rig, push blade, or pull plow

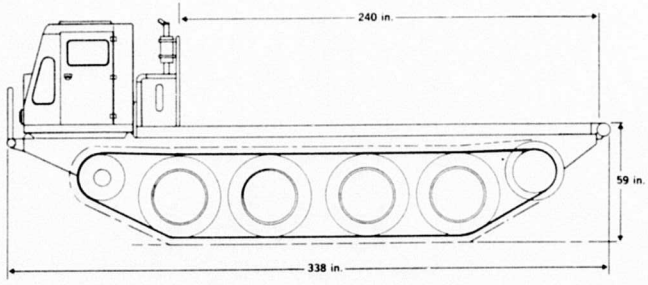
Available: Yes

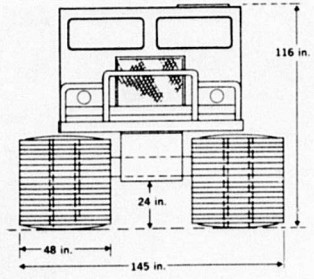
Index of Group V Vehicles, >15-Ton Payload

Vehicle No.	Vehicle Identification
V-1	FN 360
V-2	Super Yukon
V-3	Dawson Seven
V-4	FN 400
V-5	Musk-Ox
V-6	FN 600
V-7	Husky 8
V-8	Dragline Carrier Model 16XT-HD-2E-73

Specifications for Vehicle No. V-1
Vehicle Identification: PN 360







Vehicle Manufacturer: Flextrac Nodwell, P. O. Box 5944
Station A, 1201 42nd Ave., SE
Calgary, Alberta, Canada

General Data

Weight – Basic:	32,000 lb	Maximum Speed – Land:	10.4 mph
Payload:	36,000 lb	– Water:	0 mph
Gross Weight:	68,000 lb	Ground Clearance:	24 in.
Ground Pressure – Empty:	2.01 psi	Fording Depth:	56 in.
– Loaded:	4.27 psi	Maximum Slope Negotiable:	60 %
Overall – Length:	338 in.	Vehicle Cone Index (1-Pass):	4
– Width:	145 in.	Vehicle Cone Index (50-Pass):	20
– Height:	116.5 in.	Track or Tire Size:	48 × 166 in.
Grouser Height:	1.5 in.		
Sprocket Pitch:	6.0 in.	Tire Pressure:	NA psi
Number of Roadwheels or Bogies per Side:	4		

Mechanical Components Data

Engine –
Standard: Ford, 534 CID, V-8, 266 BHP
Optional: Diesel

Transmission –
Main: 5 speed manual
Optional: Automatic
Auxiliary: None

Suspension: Steel walking beams with urethane bearings

Tracks or Wheels: Rubber belts and spring steel flat grousers with cast nodular iron guides

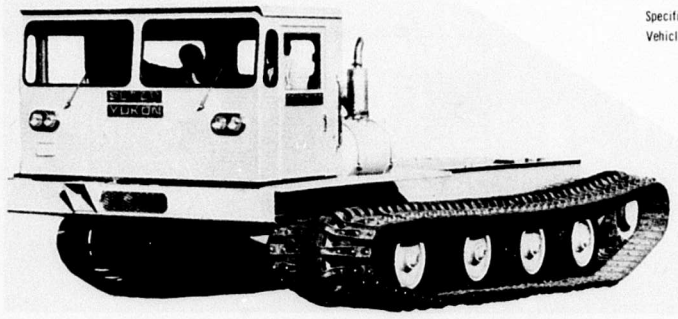
Miscellaneous

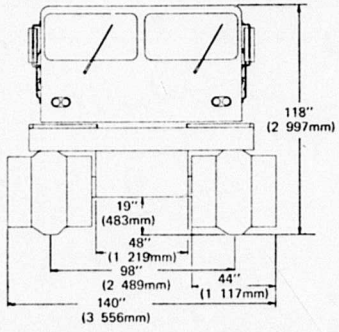
Primary Use: Cargo carrier

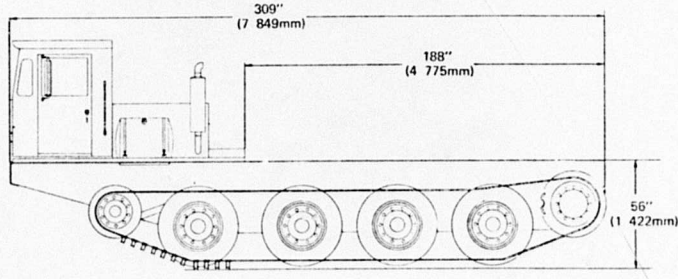
Cost: $61,045

Potential Uses: Mount for drill rig, dragline, push blade, or pull plow

Available: Yes







Specifications for Vehicle No. V-2
Vehicle Identification: Super Yukon

Vehicle Manufacturer: Foremost International Industries, Ltd.
1616 Meridian Road, NE
Calgary, Alberta, Canada

General Data

Weight – Basic:	31,000 lb	Maximum Speed – Land:	10 mph
Payload:	36,000 lb	– Water:	0 mph
Gross Weight:	67,000 lb	Ground Clearance:	19 in.
Ground Pressure – Empty:	2.28 psi	Fording Depth:	-- in.
– Loaded:	4.92 psi	Maximum Slope Negotiable:	60 %
Overall – Length:	309 in.	Vehicle Cone Index (1-Pass):	9
– Width:	140 in.	Vehicle Cone Index (50-Pass):	22
– Height:	118 in.	Track or Tire Size:	42 × 162 in.
Grouser Height:	≤1.5 in.		
Sprocket Pitch:	6.0 in.	Tire Pressure:	NA psi
Number of Roadwheels or Bogies per Side:	4		

Mechanical Components Data

Engine –
- Standard: GM 6V53, 190 BHP
- Optional: None

Transmission –
- Main: Power shift 4 speed
- Optional: None
- Auxiliary: None

Suspension: Individual torsional coil spring on each wheel

Tracks or Wheels: 42 × 162-in. track with 7/16 × 4-in. steel grousers

Miscellaneous

Primary Use: Cargo carrier

Cost: $74,900

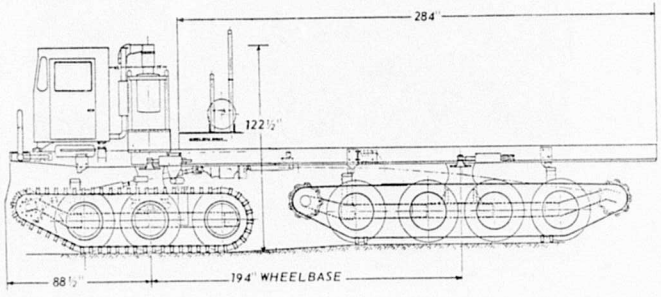
Potential Uses: Mount for drill rig, dragline, push blade, or pull plow

Available: Yes

Specifications for Vehicle No. V-3
Vehicle Identification: Dawson Seven

Vehicle Manufacturer: Foremost International Industries, Ltd.
1616 Meridian Road, NE
Calgary, Alberta, Canada





General Data

Weight – Basic:	34,500 lb	Maximum Speed – Land:	16 mph
Payload:	40,000 lb	– Water	9 mph
Gross Weight:	74,500 lb	Ground Clearance:	17 in.
Ground Pressure – Empty:	1.68 psi	Fording Depth:	in.
– Loaded:	3.63 psi	Maximum Slope Negotiable:	60 %
Overall – Length:	384 in.	Vehicle Cone Index (1-Pass):	6
– Width:	116 in.	Vehicle Cone Index (50-Pass):	12
– Height:	122 in.	Track or Tire Size:	2 units (1) 48 × 86 in., (1) 48 × 128 in.
Grouser Height:	<1.5 in.		
Sprocket Pitch:	6.0 in.	Tire Pressure:	NA psi
Number of Roadwheels or Bogies per Side:	7		

Mechanical Components Data

Engine –
Standard: Cummins V8-504C, 210 BHP
Optional: Detroit diesel 6V53

Transmission –
Main: Spicer 5 speed manual
Optional: None
Auxiliary: None

Suspension: Heavy-duty springs

Tracks or Wheels: Rayon/nylon fabric with 5/6 × 3-1/3-in. grousers

Miscellaneous

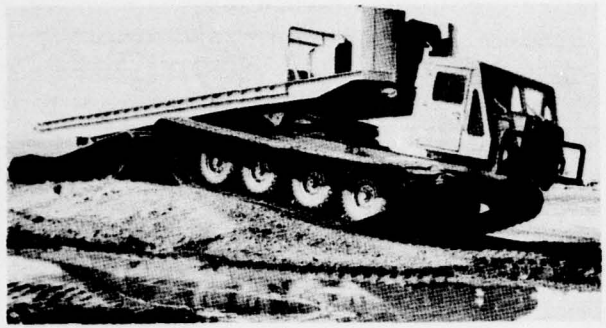
Primary Use: Cargo carrier

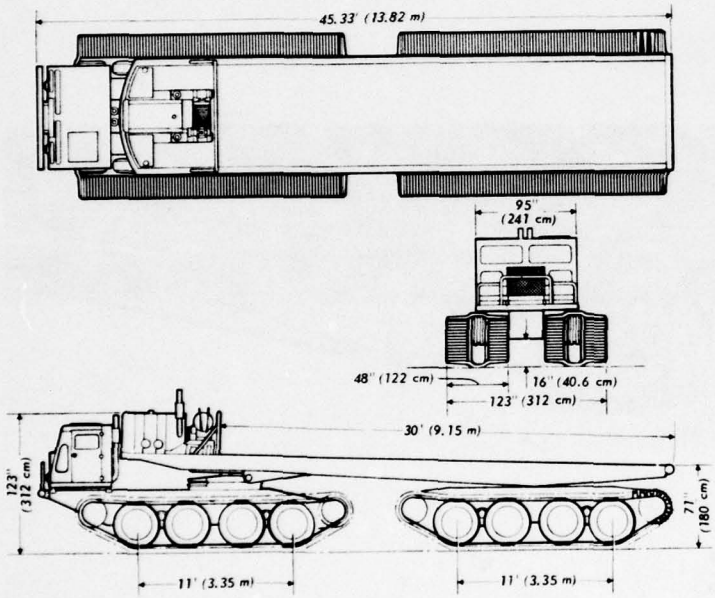
Cost: $94,303

Potential Uses: Mount for dragline, drill rig, push blade, or pull plow

Available: Yes

Specifications for Vehicle No. Y-4
Vehicle Identification: FN 400





Vehicle Manufacturer: Flextrac Nodwell, P. O. Box 5544
Station A, 1201 42nd Ave., SE
Calgary, Alberta, Canada

General Data

Weight – Basic:	54,000 lb	Maximum Speed – Land:	10.8 mph
Payload:	40,000 lb	– Water:	0 mph
Gross Weight:	84,000 lb	Ground Clearance:	16 in.
Ground Pressure – Empty:	2.32 psi	Fording Depth:	46 in.
– Loaded:	3.62 psi	Maximum Slope Negotiable:	60 %
Overall – Length:	544 in.	Vehicle Cone Index (1-Pass):	6
– Width:	123 in.	Vehicle Cone Index (50-Pass):	15
– Height:	123 in.	Track or Tire Size:	2 – 48 × 121 in.
Grouser Height:	<1.5 in.		
Sprocket Pitch:	6.0 in.	Tire Pressure:	NA psi
Number of Roadwheels or Bogies per Side:	8		

Mechanical Components Data

Engine –
Standard: (2) GM 4-53, 212 CID, 4 cylinder diesel
Optional: None

Transmission –
Main: (2) semi-automatic 4 speed
Optional: None
Auxiliary: None

Suspension: Crank arm with torsion coil spring

Tracks or Wheels: Rubber belt and spring steel drop center grousers

Miscellaneous

Primary Use: Cargo carrier

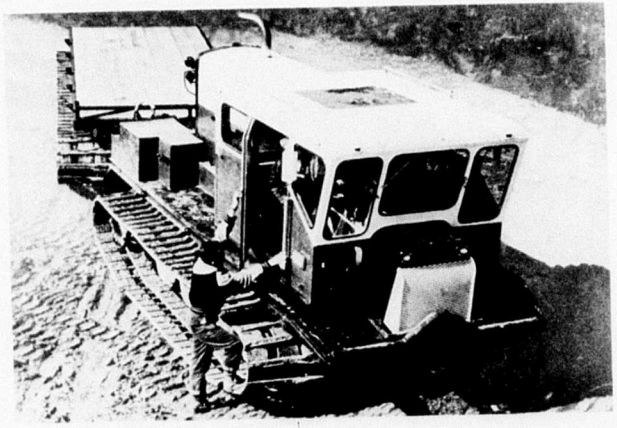
Cost: $110,878

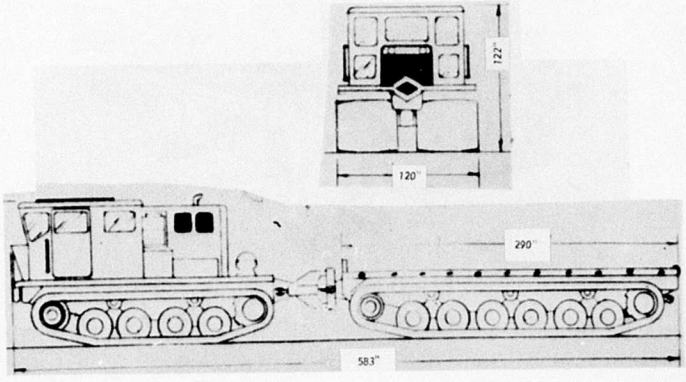
Potential Uses: Mount for dragline, drill rig, push blade or pull plow

Available: Yes

Specifications for Vehicle No. V-9
Vehicle Identification: Musk-Ox

Vehicle Manufacturer: Manufactured for the U. S. Army





General Data

Weight – Basic:	50,000 lb	Maximum Speed – Land:	15 mph
Payload:	40,000 lb	– Water:	0 mph
Gross Weight:	90,000 lb	Ground Clearance:	28 in.
Ground Pressure – Empty:	1.74 psi	Fording Depth:	-- in.
– Loaded:	3.14 psi	Maximum Slope Negotiable:	30 %
Overall – Length:	583 in.	Vehicle Cone Index (1-Pass):	9
– Width:	120 in.	Vehicle Cone Index (50-Pass):	13
– Height:	122 in.	Track or Tire Size:	Front unit 52 × 108 in. Rear unit 52 × 168 in.
Grouser Height:	<1.5 in.		
Sprocket Pitch:	7.15 in.	Tire Pressure:	NA psi
Number of Roadwheels or Bogies per Side:	10		

Mechanical Components Data

Engine –
- Standard: Cummins, diesel, 375 BHP
- Optional: None

Transmission –
- Main: Allison Torquematic
- Optional: None
- Auxiliary: None

Suspension: Walking beams

Tracks or Wheels: Nylon/rayon rubber belts with cast manganese steel track shoes

Miscellaneous

Primary Use: Cargo carrier

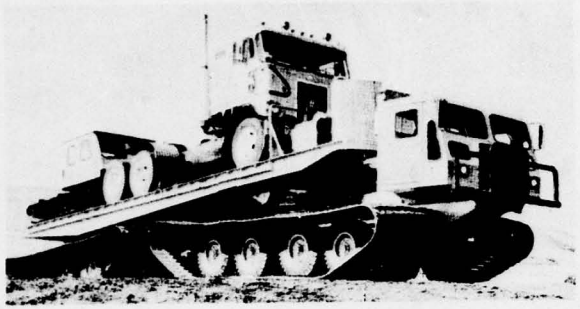
Cost: _____

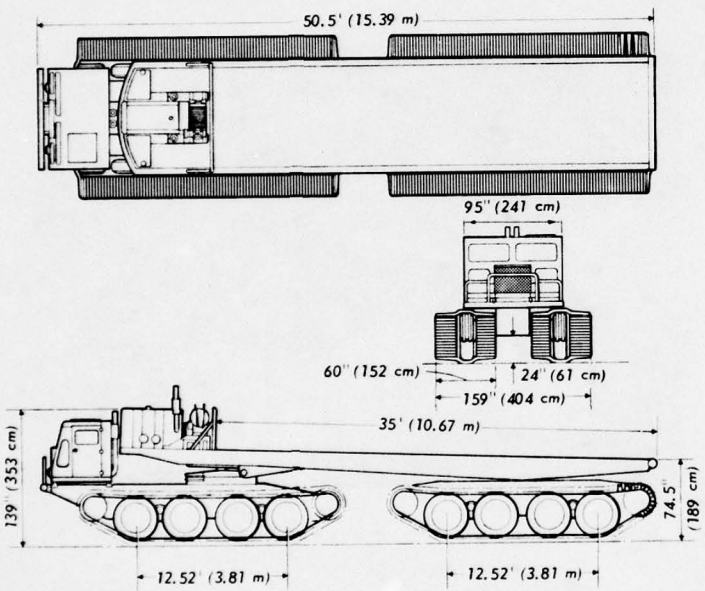
Potential Uses: Mount for dragline, drill rig, push blade, or pull plow

Available: Possibly on surplus

Specifications for Vehicle No. V-6
Vehicle Identification: FN 600

Vehicle Manufacturer: Flextrac Nodwell, P. O. Box 5544
Station A, 1201 42nd Ave., SE
Calgary, Alberta, Canada





General Data

Weight – Basic:	83,000 lb	Maximum Speed – Land:	9.5 mph
Payload:	60,000 lb	– Water:	0 mph
Gross Weight:	143,000 lb	Ground Clearance:	24 in.
Ground Pressure – Empty:	2.31 psi	Fording Depth:	46 in.
– Loaded:	3.97 psi	Maximum Slope Negotiable:	60 %
Overall – Length:	606 in.	Vehicle Cone Index (1-Pass):	7
– Width:	159 in.	Vehicle Cone Index (50-Pass):	17
– Height:	139 in.	Track or Tire Size:	2 sections 60 × 150 in.
Grouser Height:	<1.5 in.		
Sprocket Pitch:	6.0 in.	Tire Pressure:	NA psi
Number of Roadwheels or Bogies per Side:	8		

Mechanical Components Data

Engine –
Standard: (2) GM 6V-53, 318 CID, diesel
Optional: None

Transmission –
Main: (2) semi-automatic 4 speed
Optional:
Auxiliary: None

Suspension: One-piece cast walking beams with urethane bearings

Tracks or Wheels: Rubber belt and flat grousers

Miscellaneous

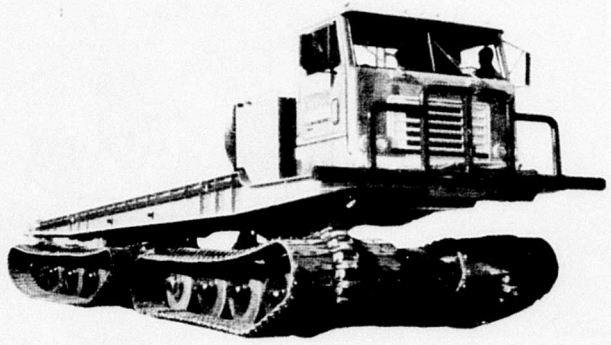
Primary Use: Cargo carrier

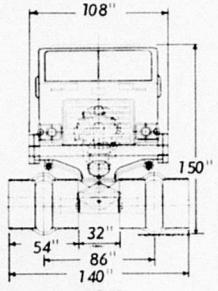
Cost: $146,110

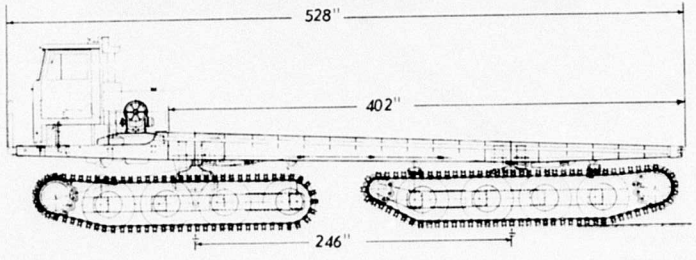
Potential Uses: Mount for dragline, drill rig, push blade, or pull plow

Available: Yes

Specifications for Vehicle No. V-7
Vehicle Identification: Husky 8







Vehicle Manufacturer: Foremost International Industries, Ltd.
1616 Meridian Road, NE
Calgary, Alberta, Canada

General Data

Weight – Basic:	90,000 lb	Maximum Speed – Land:	12.5 mph
Payload:	80,000 lb	– Water:	0 mph
Gross Weight:	170,000 lb	Ground Clearance:	16 in.
Ground Pressure – Empty:	2.98 psi	Fording Depth:	-- in.
– Loaded:	5.62 psi	Maximum Slope Negotiable:	60 %
Overall – Length:	528 in.	Vehicle Cone Index (1-Pass):	9
– Width:	140 in.	Vehicle Cone Index (50-Pass):	22
– Height:	150 in.	Track or Tire Size:	2 units each 54 × 140 in.
Grouser Height:	<1.5 in.		
Sprocket Pitch:	6.0 in.	Tire Pressure:	NA psi
Number of Roadwheels or Bogies per Side:	8		

Mechanical Components Data

Engine –
Standard: Cummins NT, 855 BHP, 318 CID
Optional: Detroit 8V71

Transmission –
Main: Automatic 12 speed
Optional: None
Auxiliary: None

Suspension: Coil springs and crank levers

Tracks or Wheels: Heavy-duty nylon rubber belt with spring steel grouser bars

Miscellaneous

Primary Use: Cargo carrier

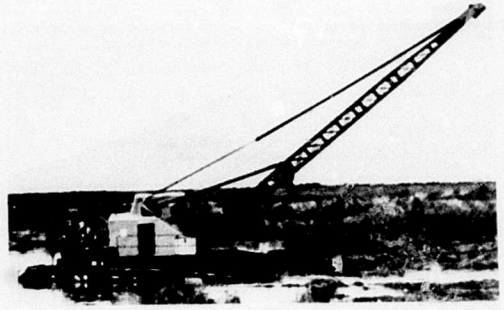
Cost: $147,220

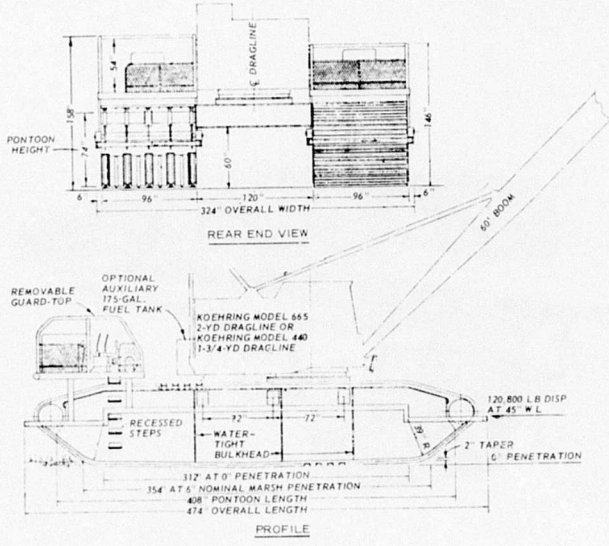
Potential Uses: Mount for dragline, drill rig, push blade, or pull plow.

Available: Yes

Specifications for Vehicle No. V-8

Vehicle Identification: Dragline Carrier Model 16XT-HD-2E-73





Vehicle Manufacturer: Quality Marsh International Corp.
P. O. Box 406
Thibodaux, LA 70301

General Data

Weight – Basic:	50,700 lb	Maximum Speed – Land:	3-4 mph
Payload:	40,000 lb	– Water:	2-3 mph
Gross Weight:	90,700 lb	Ground Clearance:	60 in.
Ground Pressure – Empty:	0.85 psi	Fording Depth:	AMP in.
– Loaded:	1.53 psi	Maximum Slope Negotiable:	60 %
Overall – Length:	474 in.	Vehicle Cone Index (1-Pass):	0
– Width:	324 in.	Vehicle Cone Index (50-Pass):	2
– Height:	____ in.	Track or Tire Size:	96 × 312 in.
Grouser Height:	<1.5 in.		
Sprocket Pitch:	2.0 in.	Tire Pressure:	NA psi
Number of Roadwheels or Bogies per Side:	4		

Mechanical Components Data

Engine –

Standard: (2) Ford, 380 CID, 6 cylinder, 120 BHP each

Optional: (2) GM 4-53, 126 BHP each

Transmission –

Main: Hydrostatic

Optional:

Auxiliary:

Suspension: Rigid

Tracks or Wheels: 4 strands of heavy-duty track chain with 4-in. heavy-duty aluminum cleats

Miscellaneous

Primary Use: Dragline carrier

Cost: _____

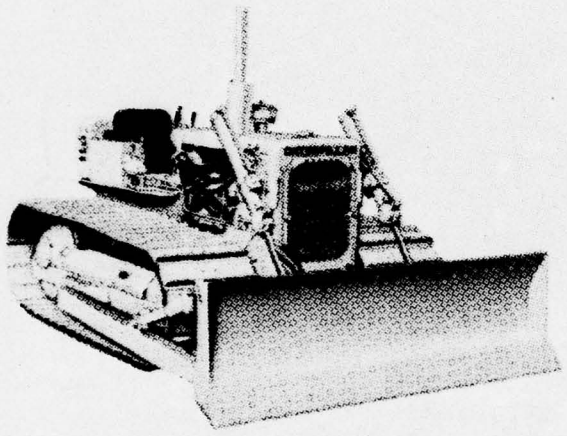
Potential Uses: Mount for drill rig, push blade, or pull plow

Available: Yes

Index of Group VI Vehicles, 0 Payload, Bulldozers

Vehicle No.	Vehicle Identification
VI-1	D4D LGP
VI-2	D5 LGP
VI-3	D6C LGP

Specifications for Vehicle No. VI-1
Vehicle Identification: D4D LGP



SKETCH NOT AVAILABLE

Vehicle Manufacturer: Caterpillar Tractor Co.
Peoria, IL 61602

General Data

Weight – Basic:	20,300 lb	Maximum Speed – Land:	5.9 mph
Payload:	0 lb	– Water:	0 mph
Gross Weight:	20,300 lb	Ground Clearance:	14 in.
Ground Pressure – Empty:	3.84 psi	Fording Depth:	-- in.
– Loaded:	____ psi	Maximum Slope Negotiable:	-- %
Overall – Length:	169 in.	Vehicle Cone Index (1-Pass):	7 *
– Width:	120 in.	Vehicle Cone Index (50-Pass):	17 *
Height:	95 in.	Track or Tire Size: 30 × 87 in.	____
Grouser Height:	>1.5 in.		____
Sprocket Pitch:	6.5 in.	Tire Pressure:	NA psi
Number of Roadwheels or Bogies per Side:	5		

* Estimated from available data

Mechanical Components Data

Engine –
Standard: Caterpillar, D-330, 4 cylinder, 75 HP
Optional:

Transmission –
Main: 5 speed powershift
Optional:
Auxiliary:

Suspension: Rigid

Tracks or Wheels:

Miscellaneous

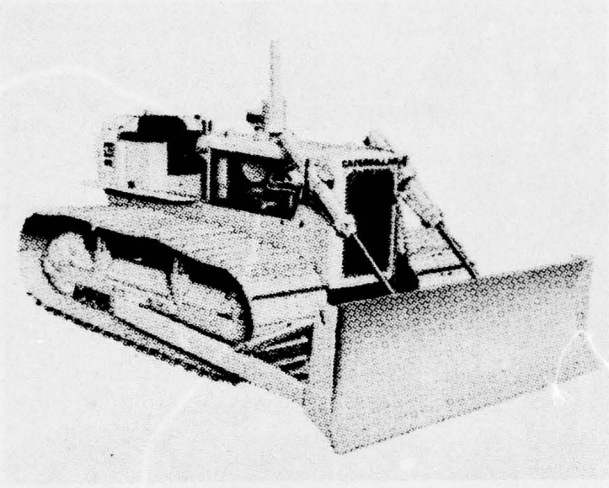
Primary Use: Bulldozer

Cost: ____

Potential Uses:

Available: Yes

Specifications for Vehicle No. VI-2
Vehicle Identification: D5 LGP



SKETCH NOT AVAILABLE

Vehicle Manufacturer: Caterpillar Tractor Co.
Peoria, IL 61602

General Data

Weight – Basic:	29,800 lb	Maximum Speed – Land:	6.2 mph
Payload:	0 lb	– Water:	0 mph
Gross Weight:	29,800 lb	Ground Clearance:	18.5 in.
Ground Pressure – Empty:	29,800 psi	Fording Depth:	____ in.
– Loaded:	____ psi	Maximum Slope Negotiable:	____ %
Overall – Length:	196.5 in.	Vehicle Cone Index (1-Pass):	7 *
– Width:	138.0 in.	Vehicle Cone Index (50-Pass):	17 *
– Height:	115.5 in.	Track or Tire Size:	34 × 111 in.
Grouser Height:	2.5 in.		
Sprocket Pitch:	6.5 in.	Tire Pressure:	NA psi
Number of Roadwheels or Bogies per Side:	7		

* Estimated from available data

Mechanical Components Data

Engine –
Standard: Caterpillar D333, 6 cylinder, 105 HP
Optional:

Transmission –
Main: 5 speed powershift
Optional:
Auxiliary:

Suspension: Rigid

Tracks or Wheels:

Miscellaneous

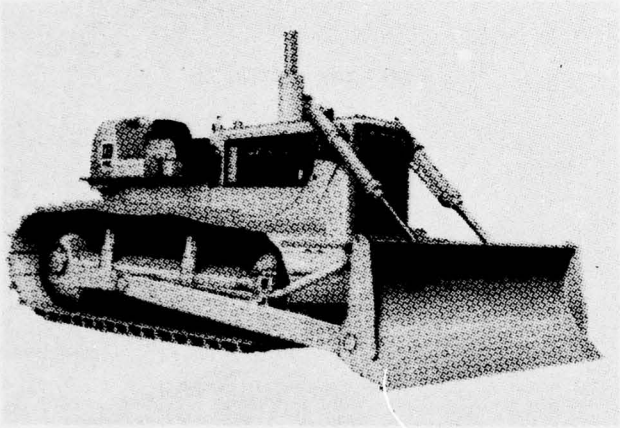
Primary Use: Bulldozer

Cost: ____

Potential Uses:

Available: Yes

Specifications for Vehicle No. VI-3
Vehicle Identification: D6C LGP



SKETCH NOT AVAILABLE

Vehicle Manufacturer: Caterpillar Tractor Co.
Peoria, IL 61602

General Data

Weight – Basic:	34,100 lb	Maximum Speed – Land:	6.9 mph
Payload:	0 lb	– Water:	0 mph
Gross Weight:	34,100 lb	Ground Clearance:	14.6 in.
Ground Pressure – Empty:	4.18 psi	Fording Depth:	____ in.
– Loaded:	____ psi	Maximum Slope Negotiable:	____ %
Overall – Length:	____ in.	Vehicle Cone Index (1-Pass):	7 *
– Width:	146 in.	Vehicle Cone Index (50-Pass):	17 *
– Height:	127.5 in.	Track or Tire Size: 36.5 × 113.4 in.	
Grouser Height:	>1.5 in.		
Sprocket Pitch:	6.5 in.	Tire Pressure:	NA psi
Number of Roadwheels or Bogies per Side:	7		

* Estimated from available data

Mechanical Components Data

Engine –
Standard: Caterpillar, D333
6 cylinder, 140 HP
Optional:

Transmission –
Main: 5 speed powershift
Optional:
Auxiliary:

Suspension: Rigid

Tracks or Wheels:

Miscellaneous

Primary Use: Bulldozer

Cost: ____

Potential Uses:

Available: Yes

APPENDIX D: NOTATION

AMP	Amphibious
BHP	Brake horsepower
CH	Inorganic clays of high plasticity, fat clays
CI	Cone index
$\overline{CI}$	Average before-traffic cone index
CI_j	Before-traffic CI for soil at a depth z
CID	Cubic inch displacement
CL	Inorganic clays of low to medium plasticity, gravelly clays, sandy clay, silty clays, lean clays
DBP/W	Drawbar pull divided by vehicle weight
j	Summation index
MH	Inorganic silts or sandy silts
MI	Mobility index
ML	Inorganic silts and very fine sands, rock flour, silty or clayey fine sands or clayey silts with slight plasticity
MR_s	Towed-motion resistance (soil), lb
n	Number of equal divisions in critical layer used for measurement purposes
RCI	Rating cone index
RCI_x	Difference between RCI and VCI
RI	Remolding index
RI_j	RI at depth z
SP	Poorly graded sands or gravelly sands, little or no fines
U	Maximum slope negotiable
VCI	Vehicle cone index
VCI_1	Vehicle cone index for 1 pass in fine-grained soils
VCI_{50}	Vehicle cone index for 50 passes in fine-grained soils
VCIS	Vehicle cone index for 1 pass in coarse-grained soils
Y	Towed motion resistance coefficient
W	Gross vehicle test weight, lb
z_1, z_2	Depth boundaries of critical layer

In accordance with ER 70-2-3, paragraph 6c(1)(b), dated 15 February 1973, a facsimile catalog card in Library of Congress format is reproduced below.

Green, Charles E
Low-ground-pressure construction equipment for use in dredged material containment area operation and maintenance - equipment inventory, by Charles E. Green [and] Adam A. Rula. Vicksburg, U. S. Army Engineer Waterways Experiment Station, 1977.
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Includes bibliography.

1. Construction equipment. 2. Dredged material disposal. 3. Soft soils. 4. Soil strength. 5. Vehicles. I. Rula, Adam A., joint author. II. U. S. Army. Corps of Engineers. (Series: U. S. Waterways Experiment Station, Vicksburg, Miss. Technical report D-77-1)
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