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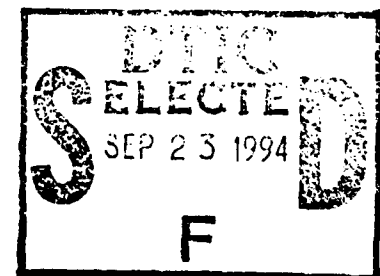
Digital Mapping, Charting, and Geodesy Analysis Program Technical Review of Interim Terrain Analysis Data Set Prototype 1

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13. Abstract (Maximum 200 words). The Digital Mapping, Charting, and Geodesy Analysis Program has performed a technical review of the Interim Terrain Analysis Data Set (TADS). This review focuses on general prototype quality issues, individual features, and product specification errors and concerns. TADS uses the Interim Terrain Data (ITD) product, so particular attention is given to the quality and quantity of information found in the ITD database. A conclusions section completes this product review. DTIC QUALITY ASSURANCE STATEMENT				
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Digital Mapping, Charting, and Geodesy Analysis Program Technical Review of Interim Terrain Analysis Data Set Prototype 1

1.0 Introduction

Draft MIL-I-89014A, dated 25 February 1993, is a product specification for the Terrain Analysis Data Set (TADS). TADS uses the Interim Terrain Data (ITD) product. The TADS is a vector-based digital product that portrays selected military geographic information of tactical military significance. The TADS is a special purpose database designed to support tactical military and Geographic Information System (GIS) applications.

1.1 ITD Content

The ITD product implements TADS in a specific area: Killeen, TX. These ITD data were used to examine the TADS product and product specification. There are seven thematic layers in the ITD specification: Slope/Surface Configuration, Soil/Surface Materials, Vegetation, Surface Drainage, Transportation, Obstacles, and Data Quality. The Data Quality thematic layer is missing from the ITD.

1.2 Methods of Review

This product review first discusses the general prototype quality issues identified by the review. The next section discusses the individual features and specification errors/concerns page by page. A conclusions section completes this product review.

2.0 Prototype Quality

The TADS evaluation is of necessity incomplete since one of the primary methods of implementing TADS, a GIS, is not usable at this point in time. Conversion software is needed to translate ITD from Vector Product Format (VPF) to a GIS format (e.g., ARC/INFO, GRASS, etc.). The program VPFVIEW is not sufficient to fully display the data as users would see it. In addition, we have no information about the target hardware that will use TADS. As a result, we cannot properly evaluate the product for the individual user. Ease of use and suitability of the product to Navy needs cannot be fully analyzed since only part of the TADS product (the ITD database) is available. Conversion software for converting ITD to a GIS format must be made available before a full review of ITD is possible.

2.1 Missing Components in ITD

Before a complete review of TADS is possible, a complete ITD database must be provided. The present ITD is missing the table SMCAREA.RAT and the entire Data Quality thematic layer. The table is necessary to interpret the Surface Roughness feature. Without this table, there is no way to determine trafficability using ITD. It is not possible to fully evaluate the quality and accuracy of the ITD database and TADS without having an estimate of the quality of the data.

The specification must define how the different ranges (i.e., Soil Depth Category) for attributes were decided upon. This decision making process must be documented, and this information should be provided in the specification.

2.2 VPFVIEW Problems

During the evaluation of TADS, several problems arose with the program VPFVIEW. While these problems are not related to the TADS, they are mentioned here in order to document the program bugs.

Error messages of various kinds appear in the program window (where VPFVIEW is launched). These error messages do not contain much explanatory information, and usually the operator is not even aware that the error occurred. Notification of an error condition should be given in one of the VPFVIEW windows so the operator is aware of the condition. In addition, there should be a troubleshooting guide in the VPFVIEW manual.

VPFVIEW crashes with a segmentation fault if one of the themes is deleted. No specific prior steps relating to this problem could be identified. This bug does not occur every time a theme is deleted.

Under some circumstances, data that are different from those defined by a theme expression are displayed. Usually a related feature is displayed in place of (using the specified color and pattern) the feature defined in the theme expression.

3.0 Specification Content and Consistency Issues

Our recommendations for changes to the TADS are given below. The order of the recommendations is not important.

- It is recommended that the title of the specification be changed to TADS specification vice Interim Terrain Data Set.

- The source information for the ITD must be documented. For routine use specific chart numbers, and appropriate information on any other sources should be provided with each TADS product.
- The specification describes the Data Quality Table as missing in ITD. The data quality issue is a priority. With the VPF topological structure, often it is very difficult to determine whether an inaccuracy is the result of accidental feature omission, a digitizing or implementation error, or the fact that topology is not maintained between coverages. This important part of the TADS review could not be completed since this table is unavailable.
- The method for deriving the ranges of values as in the Soil Depth Category should be stated in the specification.

3.1 Feature Choices

The major issue examined in this TADS review is the choice of features. The major military use of TADS is trafficability.

- It is recommended that a "Boundary" feature coverage be created with the following features:
 BA010 Coastline/Shoreline
 FA000 Administrative Boundary
 FA020 Armistice Line
 FA030 Cease-fire Line
 FA070 Demilitarized Zone
 FA170 Zone of Occupation
- The following features should be added to ITD/TADS:
 AP050 Trail
 BH120 Rapids
 BH180 Waterfall
 EC020 Oasis

The Naval Research Laboratory Digital Mapping, Charting, and Geodesy Analysis Program (DMAP) office has recently conducted a detailed survey of the dMC&G requirements for the Navy and Marine Corps. The results of this survey have been compared to the TADS specification. The survey identified those feature classes and features that the Navy and Marine Corps need and compared these to the feature classes and features present in TADS. A general conclusion that can be drawn from the missing features and attributes is that data relevant to new sensors are required by the Navy and Marine Corps but not provided in TADS. Tables 1 and 2 list the present and future respectively feature classes and features that are required but not available in TADS.

Table 1. Current requirements not met by ITD

FEATURE CLASS	FEATURES	ATTRIBUTES
ELEVATION	Depth Contour, Land Contour, Regular Spaced Grid, Triangular Irregular Network, Irregular Network, Spot Elevation, Depression, Berm/Barricade, Ridge Line, Shaded Relief	Height Accuracy, Lineage, Emissivity, Min/Max/Medial, RMS Variability, Standard Deviation, Shadowing, Location, Albedo, Radar reflectivity
TRANSPORTATION	Trail, Interchange, Culvert, RR Turntable, Tramway, Aerial Cableway, Control Tower, Distance Marker, Rest Area, Route Marker, Vehicle Storage, Aircraft Facility, Aircraft Facility Beacon, Apron/Hardstand, Overrun, Mooring Mast, Anchorage, Dry Dock, Pier/Wharf, Lighthouse, Snowshed/Rock Shed, DFAD, Fueling Areas	No. of Lanes, No. of Tracks, Bridge Opening, Slope, Orientation to North, Name, Rte. Number, Lineage, Miles Covered, Radar reflectivity, Albedo, Emissivity, FLIP/DAFIF, DFAD, Location
VEGETATION	Nursery, Firebreak/Cleared Way, Oasis, Tundra, Bog, Hummock, DFAD features	Orientation to North, Name, Subsurface material, Terraced, Height Accuracy, Lineage, Emissivity, IR&NVG, Albedo, Winter % density, Radar reflectivity
POPULATED PLACE	Building, Fort, Plaza/City Square, Park, Religious Shrine/Mosque, Hut, Shanty Town, Tent Dwelling, Underground Dwelling, Trailer Park, Cemetery, Athletic field, Campground, Drive-in Theater, Fairgrounds, Amusement Park, Outdoor Theater/Amphitheater, Golf Course, Race Track, Ski Jump, Stadium, Swimming Pool, Zoo, Monument, Ruins	Orientation to North, Density of Roof Cover, Entrance/Exit, Window-specific, Window-general, Interior Floor Plan, Name, Address, Occupant, Type of building activity, Height accuracy, Lineage, City Name, Population, Emissivity, IR&NVG, Albedo, Radar reflectivity, Location, Radio frequency, Building traits
INDUSTRY	Processing/Treatment Plant, Chimney/Smokestack, Cooling Tower, Tower (noncommunication), Disposal Site/Waste Pile, Wrecking/Scrap Yard, Catalytic Cracker, Settling Basin, Conveyor, Crane, Flare Pipe, Tank, Water Tower, Nuclear Accelerator, Windmill, Feedlot/Stockyard, Grain Bin, Grain Elevator, Silo, Storage Bunker, Mine, Quarry, Filtration/Aeration Bed, Fish Hatchery, Flume, Salt Evaporator, Cistern, Blast Furnace, Fish Industry	Roof Type, Orientation to North, Density of Roof Cover, Entrance/Exit, Window-specific, Window-general, Interior Floorplan, Name, Address, Occupant, Type of Processing Industry, Methods (nets, traps, etc.), Surface material, Emissivity, IR&NVG, Albedo, Radar reflectivity, Location

SOIL	Rocky terrain, Plain dirt	Confidence of Interpretation, Lineage, Acoustic, Magnetic, Pressure, IR&NVG, Albedo, Radar reflectivity
PHYSIOGRAPHIC	Mountain Pass, Rock Formation, Bluff/Cliff, Crevice/Crevasse, Cave, Glacial Moraine, Asphalt Lake, Salt Pan, Cut Line, Esker, Fault, Geothermal Feature, Sand Dunes/Hills, Glacier, Ice Cliff, Ice Peak/Nunatak, Ice Shelf, Pack Ice, Polar Ice, Snow/Ice Field, Sabka, Volcano, Void Collection Area, Ridgeline	Orientation to North, Name, Height Accuracy, Lineage, Emissivity, IR&NVG, Albedo, Radar reflectivity, Location, Acoustic, Magnetic, Pressure, Thickness, Age
UTILITY	Power Plant, Water Treatment Plant, Transformer Substation, Pumping Station, Power Transmission Line, Telephone Line, Utility Line, Tower (communication), Underground Pipeline, Solar Panel, Communication nodes, Condensation line, Steam line, Telephone station	Roof Type, Orientation to North, Density of Roof Cover, Entrance/Exit, Window-specific, Window-general, Interior Floor Plan, Name, Address, Occupant, Type of Utility/Line, Composition of Tower, Style of Tower, No. of cables in conduit, Height Accuracy, Lineage, KVA, Surface material, Emissivity, IR&NVG, Albedo, Radar reflectivity
BOUNDARY	Administrative Boundary, De Facto Boundary, Coastal Shoreline, International Dateline, Armistice Line, Cease-Fire Line, Fence, Cairn, Restricted airspace, Low intensity conflict areas, Sensitivity areas, Demilitarized zones, Key tracking	Height Accuracy, Orientation to North, Name, Emissivity, Albedo, Radar reflectivity, Location, Surface material, Software boundary, Acoustic, Magnetic, Pressure, Boundary conditions (i.e., barbed wire fence), Controller of boundary, Location

Table 2. Future requirements not met by ITD

FEATURE CLASS	FEATURES	ATTRIBUTES
ELEVATION	Depth Contour, Land Contour, Regular Spaced Grid, Triangular Irregular Network, Irregular Network, Spot Elevation, Depression, Berm/Barricade, Ridge Line, Shaded Relief	Height Accuracy, Lineage, Emissivity, Radar Reflectivity, Min/Max/Medial, RMS Variability, Standard Deviation, Shadowing, Location, Location Accuracy, Albedo
TRANSPORTATION	Trail, Interchange, Culvert, RR Turntable, Tramway, Aerial Cableway, Control Tower, Distance Marker, Rest Area, Route Marker, Vehicle Storage, Aircraft Facility, Aircraft Facility Beacon, Apron/Hardstand, Overrun, Mooring Mast, Anchorage, Dry Dock, Pier/Wharf, Lighthouse, Snowshed/Rock Shed, Subways, Fueling Areas, DFAD	No. of lanes, No. of tracks, Bridge opening, Slope, Orientation to north, Name, Rte. number, Lineage, Miles covered, Radar reflectivity, Emissivity, IR&NVG, Albedo, Location, FLIP/DAFIF, DFAD
VEGETATION	Nursery, Firebreak/Cleared Way, Oasis, Tundra, Bog, Hummock, DFAD features	Orientation to North, Name, Subsurface material, Terraced, Height Accuracy, Lineage, Radio Frequency, IR&NVG, Albedo, Emissivity, Radar reflectivity
POPULATED PLACE	Building, Fort, Plaza/City Square, Park, Religious Shrine/Mosque, Hut, Shanty Town, Tent Dwelling, Underground Dwelling, Trailer Park, Cemetery, Athletic field, Campground, Drive-in Theater, Fairgrounds, Amusement Park, Outdoor Theater/Amphitheater, Golf Course, Race Track, Ski Jump, Stadium, Swimming Pool, Zoo, Monument, Ruins	Orientation to North, Density of Roof Cover, Entrance/Exit, Window-specific, Window-general, Interior Floor Plan, Name, Address, Occupant, Type of building activity, Height accuracy, Lineage, Size of exterior walls on large buildings, Population, City name, Radar reflectivity, Location, Emissivity, Cross sectional area, Albedo, Building traits, IR&NVG
INDUSTRY	Processing/Treatment Plant, Chimney/Smokestack, Cooling Tower, Tower (non-communication), Disposal Site/Waste Pile, Wrecking/Scrap Yard, Catalytic Cracker, Settling Basin, Conveyor, Crane, Flare Pipe, Tank, Water Tower, Nuclear Accelerator, Windmill, Feedlot/Stockyard, Grain Bin, Grain Elevator, Silo, Storage Bunker, Mine, Quarry, Filtration/Aeration Bed, Fish Hatchery, Flume, Salt Evaporator, Cistern,	Roof Type, Orientation to North, Density of Roof Cover, Density of Tree Cover, Entrance/Exit, Window-specific, Window-general, Interior Floorplan, Name, Address, Occupant, Type of Processing Industry, Methods (nets, traps, etc), Location, IR&NVG, Albedo, Emissivity, Radar reflectivity

	Blast Furnace, Fish Industry, Well	
SOIL	Rocky Terrain, Beach, Plain dirt	Confidence of Interpretation, Lineage, Acoustic, Magnetic, Pressure, Location, IR&NVG, Albedo, Emissivity, Radar reflectivity, Thermal mass, conductance
PHYSIOGRAPHIC	Mountain Pass, Rock Formation, Bluff/Cliff, Crevice/Crevasse, Cave, Glacial Moraine, Asphalt Lake, Salt Pan, Cut Line, Pinnacles, Esker, Fault, Geothermal Feature, Sand Dunes/Hills, Glacier, Ice Cliff, Ice Peak/Nunatak, Ice Shelf, Pack Ice, Polar Ice, Snow/Ice Field, Sabka, Volcano, Void Collection Area, Ridgeline	Orientation to North, Name, Height Accuracy, Lineage, Location, IR&NVG, Albedo, Emissivity, Radar reflectivity, Acoustic, Magnetic, Pressure, Age, Location, Thickness
UTILITY	Power Plant, Water Treatment Plant, Transformer Substation, Pumping Station, Power Transmission Line, Telephone Line, Utility Line, Tower (communication), Underground Pipeline, Solar Panel, Condensation line, Steam line, Telephone station, Communication nodes	Roof Type, Orientation to North, Density of Roof Cover, Entrance/Exit, Window-specific, Window-general, Interior Floor Plan, Name, Address, Occupant, Type of Utility/Line, Composition of Tower, Style of Tower, No. of cables in conduit, Height accuracy, Lineage, Probability to kill, Radar cross-section, Location, IR&NVG, Albedo, Emissivity, Radar reflectivity, KVA
BOUNDARY	Administrative Boundary, De Facto Boundary, Coastal Shoreline, International Dateline, Armistice Line, Cease-Fire Line, Fence, Cairn, Low intensity conflict areas, Sensitivity area, Restricted airspace, Demilitarized zones, Key tracking	Height Accuracy, Orientation to North, Name, Location, IR&NVG, Albedo, Emissivity, Radar reflectivity, Software boundary, Acoustic, Magnetic, Pressure, Boundary conditions (i.e., barbed wire fence), Controller of boundary, Location

3.2 Features

The following problems have been identified in features included in the various coverage.

- The attributes for the features chosen for TADS do not sufficiently describe the features. The features are not sufficiently well described to decide if they are significant to a TADS user. Simply showing a "Cut" or "Embankment" is not sufficient information. The attributes must provide

enough information to enable the user (or a GIS) to estimate the effect that feature has on the user. One of the few cases where such information is available is in AQ040 (Bridge) with attribute BCC (Bypass Condition Category).

- It is recommended that the ITD database extend beyond just displaying a series of objects, and provide sufficient practical information, either raw information (dimensions, content, material, etc.) or processed information (BCC), so that conclusions could be drawn from the information presented.
- The word "Table" in the "Slope/Surface Configuration Water Area Feature Table" label is misspelled. This label appears when the area option of a spatial query is selected.
- TAD is used instead of TADS from p. 6, 3.9 through p. 7, 3.12.
- In the Library, Coverage, and Feature Class listings, TRNNODE.PFT should not precede TRBDGND.PFT to maintain alphabetic order.
- The SMCAREA.RAT, TRNAREA.AFT, and OBSNODE.PFT listed on p. A-10 are missing from the prototype with no discussion (as provided for the missing Data Quality Table). When will these be implemented?
- The Common Open Water feature (SA010) is defined in the following four Feature Classes:

SLWAREA	SMWAREA
VGWAREA	SDRAREA

Data are found in SLWAREA, VEGAREA, and SDRAREA. When SA010 is plotted, some of the resulting open water areas do not appear in all coverage. There are approximately 30 features found only in SDRAREA. For example, a small lake (0.4 miles long, 0.1 miles wide) appears only in SDRAREA at 31° 8' 0.7" N, 97° 36' 36.8" W.

The problem appears to be primarily due to the definition of "Open Water." In the surface drainage coverage, where Rivers are stored, certain wide areas in the rivers are defined as "Open Water," while in other coverages both of these areas and the Rivers are not defined. This results in a difficult to interpret set of coverages. For instance, if SA010 in VEGAREA is used to display lakes and BH140 (Rivers) are displayed from SDRAREA, there will be gaps in some of the Rivers. Examples of this problem are shown in Figs. 1 and 2. Note that in Fig. 2 not only are several lakes missing but the Rivers (BH140) now have unexplained gaps in them.

- The Road feature, AP030, has attributes that do not seem to be well or correctly defined. The attribute FCO, Feature Configuration, is defined on page A-68 for the feature AP030 (Road) as 0, 5, 6, 7 (Unknown, Divided same widths, Divided different widths, nondivided). All AP030

features in the ITD database except two have the attribute FCO = 3. The two exceptions (primitive # 733 and 629) have FCO = 1. The only use of an FCO = 3 in the specification is to define a single line railroad.

- On page A-56 of the appendix, the attribute FCO is incorrectly defined as "Figure Configuration" for the Feature GB055 (Runway).
- VEG=51 has two definitions in two places. In Table A-24 on page A-28, 51 means "Reeds, sedges," and on p. A-24 51 it means "Marsh."
- On page A-11 ZD012 is "Geographic Information Point," on p. A-13 it is "Misc. Geographic Point." According to FACC DIGEST, "Geographic Information Point" is correct.
- On p. A-22 the feature "Brush/Shrub" is mentioned. It should be "Scrub/Brush" according to FACC DIGEST.
- On p. A-22 the feature "Bamboo/Wild Cane" is mentioned. It should be "Bamboo/Cane" according to FACC DIGEST.
- On p. A-32, "Float Bridge Site" (AQ111) is missing from the line features.
- On page A-81 "Bluff/Cliff/Escarpment" is missing from the glossary.
- On p. 31, Table 17 should be TRNNODE.PFT instead of TRNODE.PFT.
- On p. 43, OBSTACLES is misspelled.
- On p. A-5, Table 3, the coverage names of IDs 2 and 3 should be reversed.
- On p. A-13 Table 12, p. A-17 Table 16, and p. A-83 Table 47 the F_CODE should be listed as an FACS instead of a FACC reference.
- On p. A-19 Table 18, and p. A-25 Table 23 need to have the order of F_CODE and FAC_ID swapped to remain consistent with all other tables.
- On p. A-65, the last table entry ID of 148 has no information.
- In the Appendices, Vegetation should come after Soil Surface.
- On page A-87 the Feature Name Disturbed Soil is misspelled.

- All Bank slopes (BGL and BGR) for BH140 (Rivers) have one of two values, 80 (>60%) almost all cases, or 52 (45-60%) for small sections of some rivers. If there is no information on the bank gradient, then Unknown should be stored.
- All BH140 (Rivers) in line feature class have the same depth WDA=1 (<0.8 m). If there is no information on the water depth, then Unknown should be stored.
- In SDCLINE.LFT F_code - BH140, the attribute EXS is not shown in ITD even though it is called for in the specification.
- For BH140, the explanation of the attribute HYC is not correct in the ITD dictionary. A value of 8 is defined in the specification as Perennial not Perennial/Permanent.
- We recommend that the attribute NAM (Names) be added to the feature AP030 (Roads).
- The attributes WID and HGT should be added to all features in the Obstacles coverage.
- The attribute BHL, BHR (Bank Height Left and Right) with a value of 30 is incorrect in the ITD. The definition of 30 should be (>1.0 to <=5.0 m), not (>10 to <=50 m).
- In the feature BH140 the attribute WD3 (Military Gap Width), explanation for a value of 113 should be (>4.5 to <= 18 m) not (> 45 to <= 180 m).
- In general there seems to be confusion about meter and decimeters in the ITD database. Many, but not all attributes in the ITD, are in decimeters. The correct unit labels should always be shown with the explanation of the attribute codes in the ITD. Frequently the numbers imply decimeters, but the unit label is m (meters).
- There is a database error in the Built-up Areas table. When the feature Built-up Areas is displayed, the following face appears:
 Face 34:
 VGWAREA.AFT
 ID-Row Identifier: 7
 FAC-ID-34
 F_CODE- SA010.
 In fact, it is a lake that is displayed, but it appears with other Built-up Areas. This is shown in Figure 3. The feature AL020 (Built-up Areas) from VGWAREA.AFT is displayed in red.
- The numerical value of the attribute WVA (Water Velocity Average) is defined in the specification with a 1: <= 1.5 m/s and a 2: > 1.5 m/s. It is recommended that the break point be

set to a value less than 3 kt (1.5 m/s). While a 1.5 m/s current may be the limit of safe crossing, lower speeds will have a significant effect on the difficulty of crossing a river.

- In SDRAREA.AFT, the feature SA010 in ITD is missing the attributes EXS and LEN.
- It is recommended that in the specification of any given feature that appears in more than one feature class, such as SA010, have the same set of attributes.
- It is not clear when a river is a line or area feature. As shown in Figure 4, there is a significant river area feature among the river line features. It is recommended that the criteria for coding river features be specified.
- In SDRNODE.PFT, the feature BH070 (ford) is missing the following attributes: EXS, HGT, LEN, MCC, WD5, WID, and TXT as called for in the specification.
- In SDRNODE.PFT, the feature BI020 (Dam) is missing the following attributes: EXS, HGT as called for in the specification.
- In SDRPOINT.PFT, the feature BI020 (Dam) is missing the following attributes: EXS, HGT, LEN, MCC, and WD5 as called for in the specification.
- The locations of BI020 (Dam) in SDRLINE.LFT do not correspond with the locations of BI020 in either SDRNODE or SDRPOINT.
- In SDRPOINT.PFT the only feature code is BI020 (Dam). This feature class has only a few of the Dams found in SDRNODE. PTF. When this feature class is displayed, there are seven locations displayed. ID_ROW Identifiers 5, 6, and 7 are BI020 and ID_ROW Identifiers 1, 2, 3, and 4 have an F_CODE of BH070 (Ford), which is not in this feature class. The fords occur in the vicinity of 31° 12' N, 97° 37' W.
- The table SMCAREA.RAT is required to evaluate the Surface/Materials Feature Class. The specification states that this table is not available. The ITD should not be sent out for evaluation until all essential pieces of the database are available. Without SMCAREA.RAT, there is no way to determine the trafficability of the terrain displayed in ITD.
- In OBSLINE.LFT the feature DB010 (Bluff/Cliff/Escarpment) in ITD shows an attribute of USE (Usage). This is not listed in the specification and does not seem to make any sense for a natural feature such as a cliff. However, this F_CODE appears with a search expression of F_CODE=AL260 (Wall).

- In TRBDGRND.PFT, the feature AQ040 (Bridge) is missing the following attributes: ACC, MCC, UBC.
- In the specification for AQ040 (Bridge) the only defined value for the attribute MCC is - MAXINT (Null). MCC applies to the other features in the class and has a full range of possible values. It is recommended that either this attribute be dropped from the AQ040 feature or the number of possible values be expanded to the full list given in the specification for MCC.
- In TRBLINE.LFT, the feature AQ040 (Bridge) is missing the following attributes: ACC, MCC, UBC.

4.0 Conclusions

The TADS product specification contains a set of coverages and features intended to support tactical military applications. The feature set mostly accomplishes this, but additional features are required to make the specification comprehensive. In addition, the attribute list must be expanded to include information sufficient to allow the user to draw meaningful conclusions about the features that are present. In general, this information is not available in the specification.

Numerous quality control errors were detected in the ITD prototype. A major source of errors was not providing all the attributes called for in the specification for all features. It appears that ad hoc editing was done during ITD creation as to what attributes are appropriate for each feature. These decisions should be made during the design of the specification and the databases should follow the specification.

5.0 Acknowledgments

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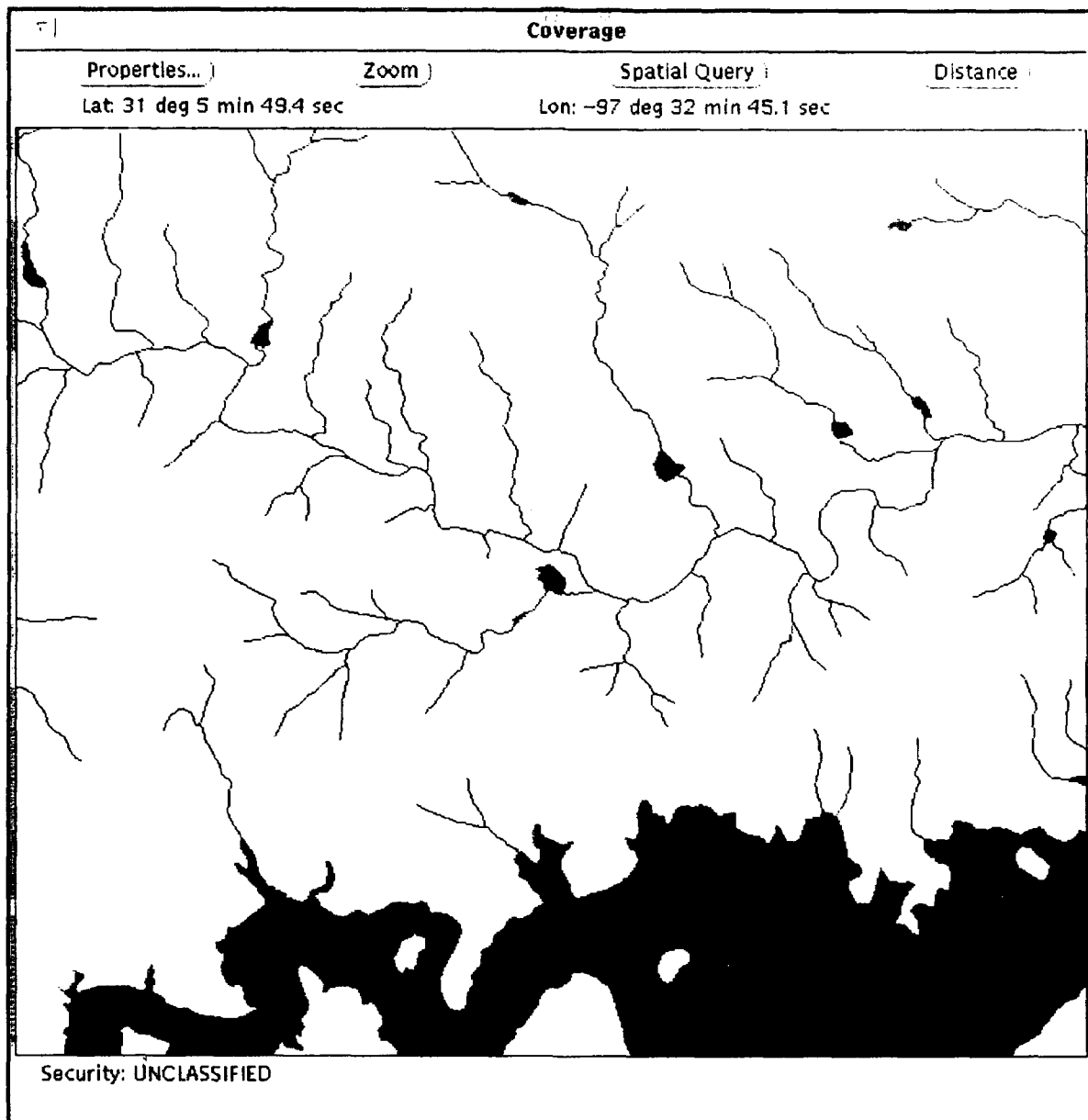


Figure 1. Common Open Water (SA010) from SDRAREA.AFT

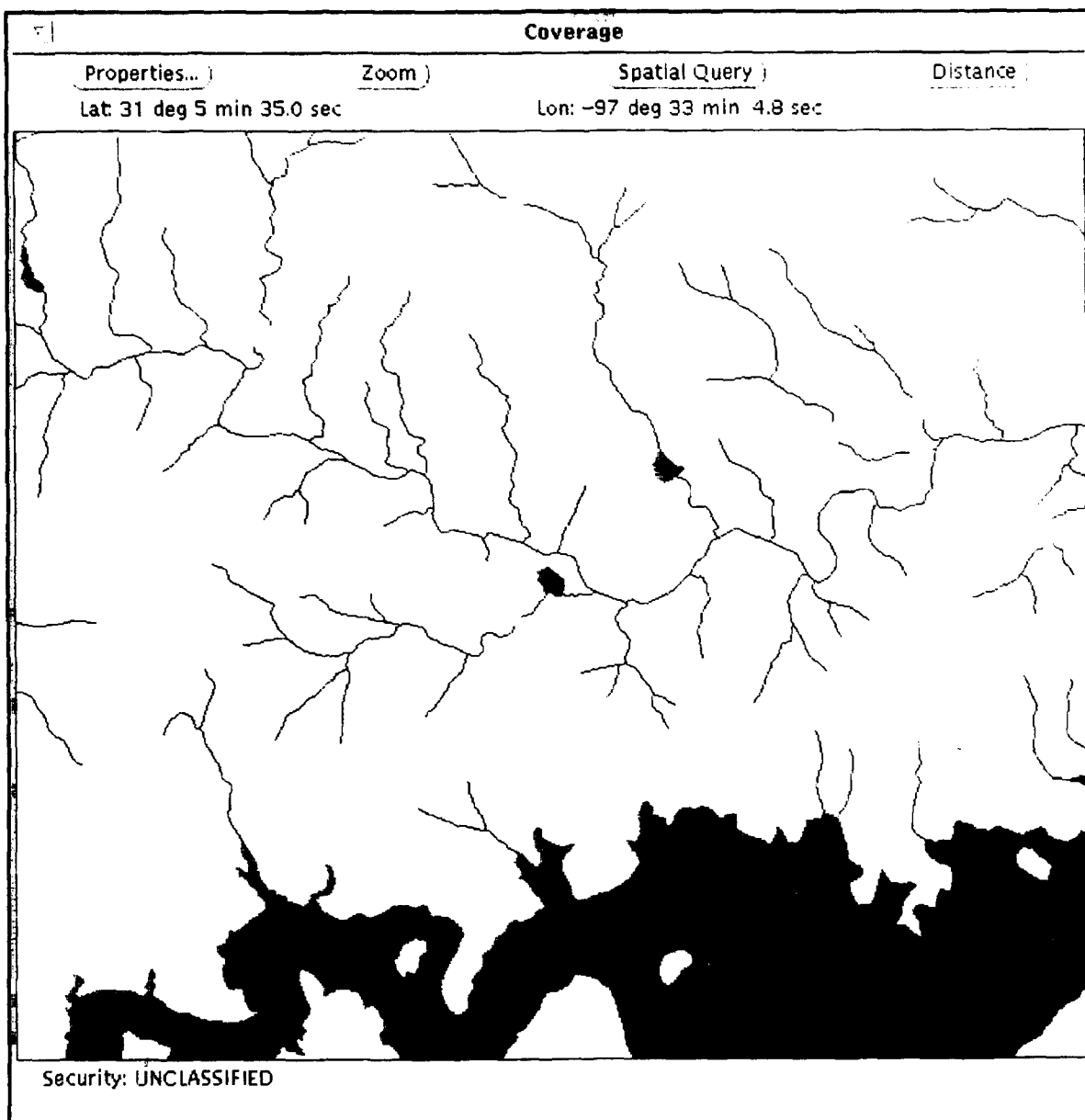


Figure 2. Common Open Water (SA010) from SMWAREA.AFT

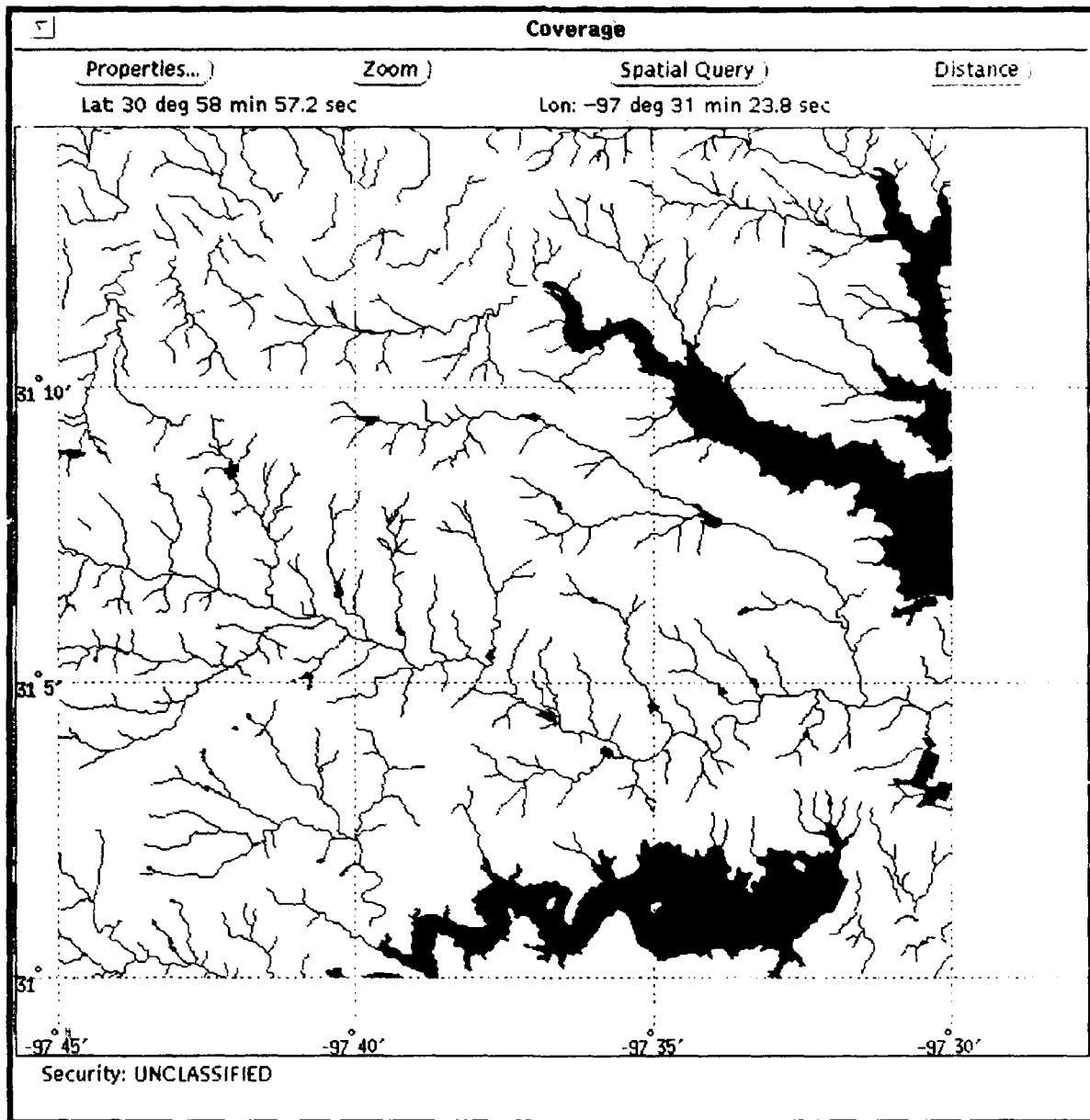


Figure 3. Built-up Areas (AL020) in Red

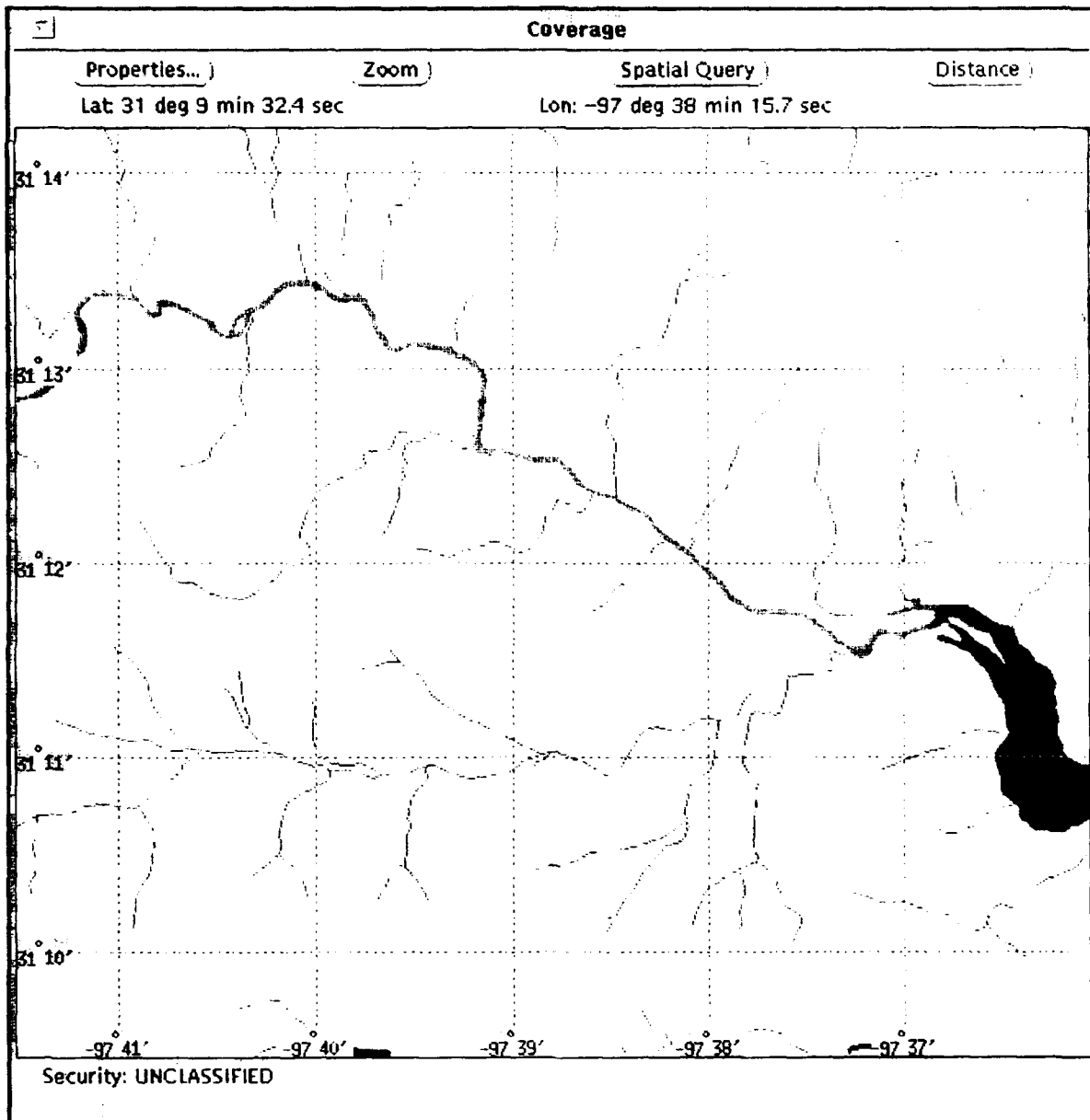


Figure 4. Rivers in Area and Line Feature Classes