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AN ASSESSMENT OF REMOTE SENSOR IMAGERY
IN THE DETERMINATION OF HOUSING QUALITY DATA

by

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ABSTRACT

TITLE: An Assessment of Remote Sensor Imagery
in the Determination of Housing Quality
Data

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SUBJECT: An examination of the suitability of aerial
photography for measurement of housing qual-
ity and neighborhood condition by assessing
the observable characteristics of structure
and environmental factors.

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ABSTRACT: Selected census tracts in the metropolitan
Washington area were examined using vary-
ing scales of aerial photography. Observ-
able characteristics of housing and
neighborhoods were assessed to determine
feasibility of providing data on housing
stock and quality and neighborhood condi-
tion from the imagery. Small scale imagery
is shown to be of relatively marginal
value in providing much of the data in
the detail required, but can be useful for
general survey purposes.

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AN ANALYSIS OF REMOTE SENSOR IMAGERY
IN THE DETERMINATION OF HOUSING QUALITY DATA

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INTRODUCTION

This study is one of a group of research tasks undertaken as part of the Metropolitan Washington Council of Governments' series of investigations of the potential applications of remote sensing data in support of urban and regional planning information requirements. The work is conducted under contractual arrangements with the Geographic Applications Program, U. S. Geological Survey.

The principal purpose of this study has been to assess the extent to which pertinent and useful data bearing on the determination of housing quality and neighborhood condition in the Washington metropolitan area could be extracted from small scale aerial photographic imagery.

This work is important to the Metropolitan Washington Council of Governments because a number of previous reports and studies pointing out the critical aspects of the housing problem in the metropolitan Washington, D.C. area prompted the Board of Directors of the Council of Governments in early 1969 to accord the housing problem its highest priority. These studies indicated that substandard housing and overcrowding are present major problems and issues. The Council of Governments, therefore, has a high priority objective, with its participating local jurisdictions, to overcome some of the obstacles in solving this pressing metropolitan problem. In order to assist in meeting these objectives, COG is presently engaged in maintaining an inventory of housing in the Washington metropolitan area, and forecasting

future housing demand and supply characteristics.

To help meet the requirements implied in this role, many aspects of information bearing on the housing problem are needed. Two essential information areas, for example, involve the analysis of housing location and neighborhood condition.

1. Housing Location. As a part of the efforts to provide an inventory of housing information services, the Council of Governments will attempt to assist local jurisdictions in locating public housing sites and in encouraging responsible siting of private housing through zoning and other land controls. To provide a continuing determination of housing needs, COG is also involved in the assessment of elements of the housing stock; for example, substandard and overcrowded units, vacant or abandoned units, newly constructed units, and so forth.

2. Housing and Neighborhood Condition. Information about housing and neighborhood condition is essential to housing analysis and for planning and programming for community improvement. The type, value, age, and condition of structures (including plumbing and necessary services), numbers of deteriorating or dilapidated units, status of neighborhood facilities, and so forth, as indicators of the general character and condition of the area, are primary data needed for the assessment of the quality of existing housing stock.

Assessments of housing stock and condition are currently developed from analysis of information contained in existing basic data. Graphic materials in the form of illustrative

maps and charts are compiled as requested, from basic data.

Currently, the principal data sources for COG's housing information are the U. S. Census, home interview studies, and other data bases and studies; the base data of several of these sources are of local origin (COG Parcel File, Community Renewal Plans, Workable Program for Community Improvement, and the "Section 701 Housing Element" reports).

Since data acquisition through conventional means is sometimes costly, time consuming, and not always current, alternative and supplemental data sources need to be investigated. An increasing number of investigators have been examining the potential of remote sensor imagery, derived from airborne platforms or from the planned NASA earth resources satellites to provide information for urban data bases, to improve such data bases, to monitor growth and change in residential and other areas, and to observe and record environmental conditions as they occur. The consensus is that data from remote sensing sources, when used in conjunction with other information, would be invaluable in providing support to programs involving urban and regional area analysis.

At present, aerial photography is used relatively infrequently as a means of providing housing and neighborhood quality information, though planners and local officials are becoming increasingly interested in testing potential applications. Most work reported on is largely research oriented at this time. Investigators such as Horton, Marble, Moore, Wellar, Johnson, and others, * by a correlation of

* 5, 6, 8, 9, 10, 11, 12

"ground data" and remote sensing information, have studied and evaluated certain parameters identified with neighborhood condition and housing quality. Some of this work has been done on sampled districts in Chicago and Los Angeles. It has been pointed out that remote sensors are capable of providing much useful data in this substantive area. Several investigators have also stated that the constraints imposed by small scale and low resolution remote sensing data may seriously limit its use for housing and neighborhood quality analysis.

In an attempt to assess the observability and possible application of remote sensing data to local data needs in the metropolitan Washington area, this study was undertaken by the Council of Governments' Remote Sensing team. The analytical work fell into two parts. The first consisted of an analysis undertaken to count, by imagery analysis, visible (and presumably available) housing stock (single-family detached dwelling units, semi-detached, and row units) within four designated census tracts in the District of Columbia and one in Prince George's County in Maryland. Following the imagery analysis, to provide a measure of ground control, the team visited the tracts, and by block-by-block "windshield survey" noted and counted the number of single-family units within each tract. Ground photographs were taken and several illustrative ones are shown in this report. The second part, capitalizing upon the familiarity gained during the first phase of the work, and using smaller scale photography,

attempted to observe and record all possible factors which would be indicative of the conditions of the housing and neighborhood within the same census tracts.

An assessment was conducted of a range of variables in photo scale and film filter combinations against the visible housing quality and condition parameters. The results of that work are presented in this report.

1. ANALYSIS

In the first portion of the analysis, imagery of large (1:13,000) and smaller (1:50,000) scales were examined; in the second, small scale imagery was used (1:100,000 and 1:382,000). Two sets of analytical data by two persons working independently were compiled. Mono and stereoscopic modes of viewing were utilized. Color, color infrared, and six bands of multispectral imagery were available and examined. Equipment consisted of: 2X stereoscope, 7X tube magnifier, and a Bausch and Lomb stereo microscope with magnifications up to 30X.

a. Housing Count Analysis

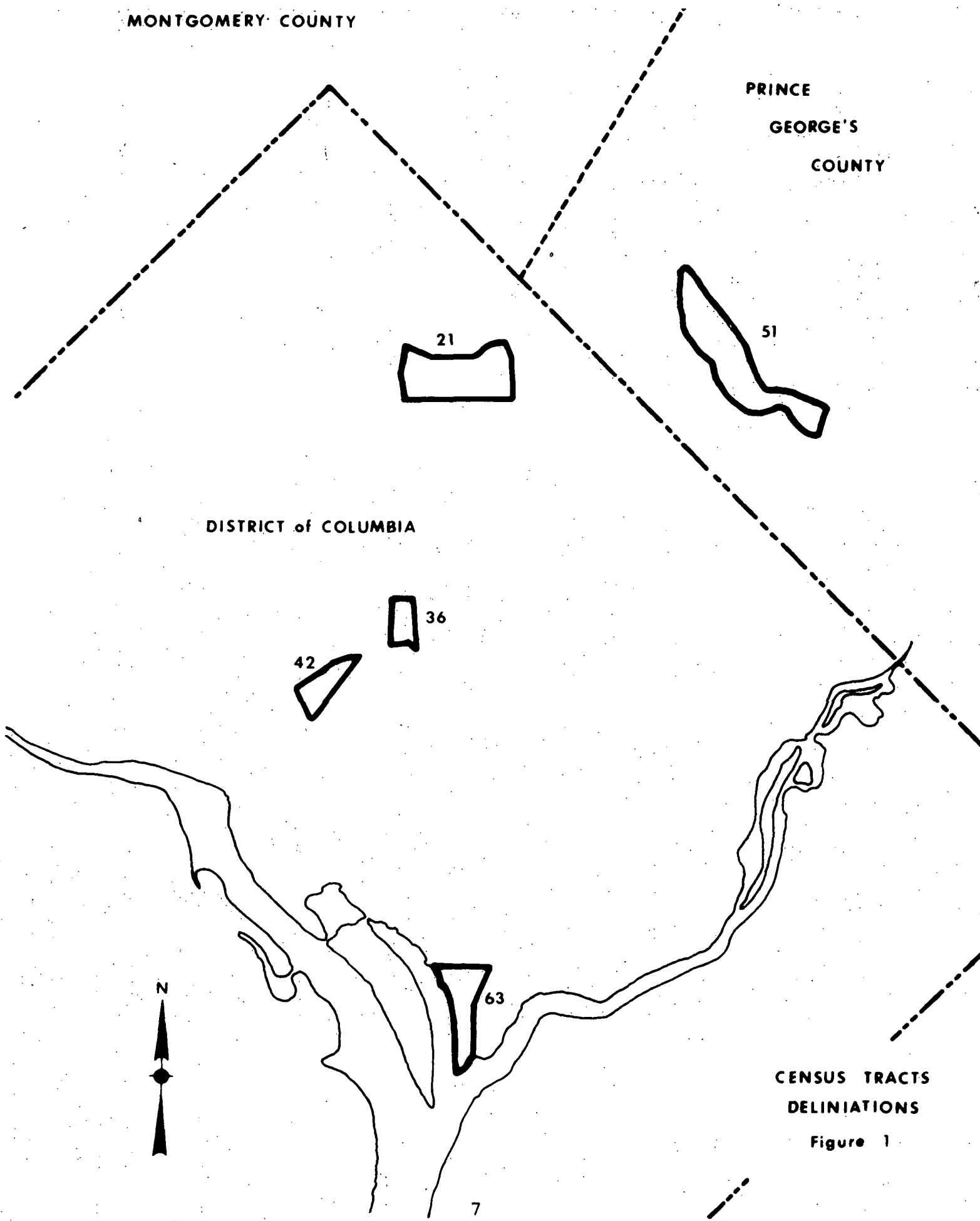
This specific research task was undertaken initially at the request of the Geographic Applications Program staff, USGS, to provide an independent analysis in support of work being done within the Institute of Urban and Regional Research at the University of Iowa.

The sampled areas comprise approximately 175 blocks within Census Tracts #21, #36, #42, and #63 in the District of Columbia, and #51 within Prince George's County just over the District line to the northeast. See Figure 1. Imagery used in this test included color negatives at the relatively large scale of 1:13,000 (1968) and color infrared transparencies at a scale of 1:50,000, the latter being a part of the Census Cities coverage (NASA Mission #128D) flown for the Geographic Application Program, USGS, June 28, 1970. The census tract outlines reflect the 1960 and 1970 delineations, which, in these cases, were

MONTGOMERY COUNTY

PRINCE
GEORGE'S
COUNTY

DISTRICT of COLUMBIA



CENSUS TRACTS
DELINATIONS

Figure 1

essentially unchanged. Upon completion of the photo analysis, the Council of Governments' Remote Sensing team visited several of the tracts by auto and conducted a field survey. On this survey, a count of all single-family dwellings (or those appearing to be) was made block by block until the tracts were covered. One full day was required for two observers to cover tracts #36 and #42. Tract #21 required another full day with one person performing the count. Traffic survey counters secured to clip boards provided the means of counting by the single analyst. The field results were then compiled and compared with the imagery-derived totals. Results are shown in Table 1.

Within the tracts in downtown Washington, D. C., the identification by imagery analysis as well as by auto survey of residential buildings with single-family occupancy was not always clearly observable. The bulk of the residential houses in these tracts are row houses, two to three stories in height. Many of these buildings in tracts #36 and #42, for example, have experienced a history of change. Many were built originally as single-family dwellings; considerable numbers are still so used. Others have been modified and converted over the years (100 or so) into small apartments and rooming houses. As observed from the ground, entrances with double entries, multiple mail boxes and power service meters, fire escapes, and so forth, indicate current multi-family occupancy. So, while the socio-economic factors have modified the occupancy patterns in these areas, the essential

physical appearance of these buildings in the aerial photo imagery does not entirely reflect those changes. Hence, there are levels of uncertainty in the data so derived, even when judgements have been made as to building type on the basis of knowledge gained by visits to these areas.

As an additional set of values for comparison, data from the 1960 and 1970 Censuses giving the numbers of single-family dwelling units within these tracts are shown in Table No. 1.

In two cases, for tracts #36 and #42, the imagery-derived data were at some variance with the ground data. The photo counts were then repeated by both analysts. For tract #42, a second field trip with a third observer was undertaken because of the apparent difference in the two ground data sets. Both recounts undoubtedly introduced an element of analytical bias. The reason for low count on the initial photo count is not clear, except that a partial explanation might be attributable to self-imposed restraint by the analysts, viewing a very heterogeneous area within the District, to count as single-family only those buildings clearly identifiable as such.

The decline in the number of single-family units within tracts #21, #36, and #42, as reported in the Census data for 1960 and 1970, is probably due to several causes, including: conversion to multi-family units and to physical removal of this type housing stock by deterioration and other factors.

The disparity in the figures observed for Census Tract #63, which embraces Fort Leslie J. McNair and portions of the adjoining S.W. Urban Renewal area is probably due to two factors: One: (the smaller factor) the duplex character of about a third of the residential quarters for military personnel based on the installation; and two: the relatively large number of single-family dwelling units located amongst the complex of multi-family, multi-story buildings within the renewal area. In the latter case, the initial imagery analysis failed to detect the identifying features of these new, contemporary-design, single-family modules. A field check was subsequently undertaken to identify the general character and location of these units. Several ground photographs taken are shown in Figures 13-16. A recount was then undertaken on the 1:50,000 scale imagery and the data recorded. Clearly, some units are still unaccounted for in the imagery analysis (see 1970 Census data).

The numbers of single-family houses in Census Tract #51, as reported for the 1960 and 1970 censuses, suggest uniformity and stability in the housing stock in this area. The imagery analysis generally confirms this.

TABLE 1

Counts of Single-Family Dwelling Units Within Listed Census Tracts

Census Tract	Remote Sensing Date				Field Check		Census Data	
	Test #1		Test #2		#1	#2	1960	1970
	1:13,000	1:50,000	1:13,000	1:50,000				
21	1879	2166	-	-	2041	-	2893	2287
36	355	210	457	326	444	-	519	341
42	110	177	601	650	647	470	641	503
63*	21	21	-	325***	-	-	52	470
51**	495	405	-	-	-	-	574	572

* Fort Leslie J. McNair

** Prince George's County

*** Recounted after field check

b. Housing Quality Assessment

During the field check of the housing count described in the foregoing section, notations were made as to physical appearance and conditions of individual residential buildings as well as the general area within the census tracts. Notations were made as to land use; character of the buildings and neighborhood; presence of lawns, yards, and shrubbery; trees along the streets; removal, abandonment or deterioration (boarded up doors and windows) of buildings within the block; parking on or off street; litter accumulation on streets or in alleyways; conditions of streets and sidewalks. Ground photographs were also taken.

Marble and Horton⁸ itemize certain structural and environmental variables utilized in a Los Angeles study for the assessment of housing quality. Of 37 potentially measurable variables, 21 were identified as measurable by remote sensing, and of these, seven were selected as being the most sensitive statistically

for quality classification in that area. These were: street parking, loading and parking hazards, street width, hazards from traffic, refuse, street grade, and access to buildings. The Council of Governments team's selection of visible parameters agrees with most of these. Inasmuch as color infrared imagery is presently enjoying an increasing application in urban studies⁶, and was found to be a useful indicator in the research work by the COG team, it is interesting to note that vegetation (or lack of it) was not one of the "selected" variables in the Marble and Horton study.⁸

Imagery utilized in the analysis was obtained from: NASA Mission #128D, dated June 28, 1970, flown for the USGS Census Cities Program. Coverage included: Color infrared @ scale 1:100,000 (RC-8 Camera); color infrared @ scale 1:50,000 (Zeiss Camera) and multispectral imagery from (6) matched 40 mm Hasselblad cameras @ scale 1:382,000 as follows: Film SO-278 (color pan aerial) with 2E filter; Film SO-278 with WR 3 filter; Film SO-117 (color IR) with WR 15+30 filters; Film 2402 (black and white pan) with WR 25 filter; 2402 Film with WR 58 filter; and 2424 Film (black and white IR) with WR 89B filter. With respect to equipment, the team used standard 2X stereoscopes, a 7X magnifier, and, for the very small scale (1:382,000) imagery, the Bausch and Lomb Zoom 70 Stereomicroscope with magnification up to 30X.

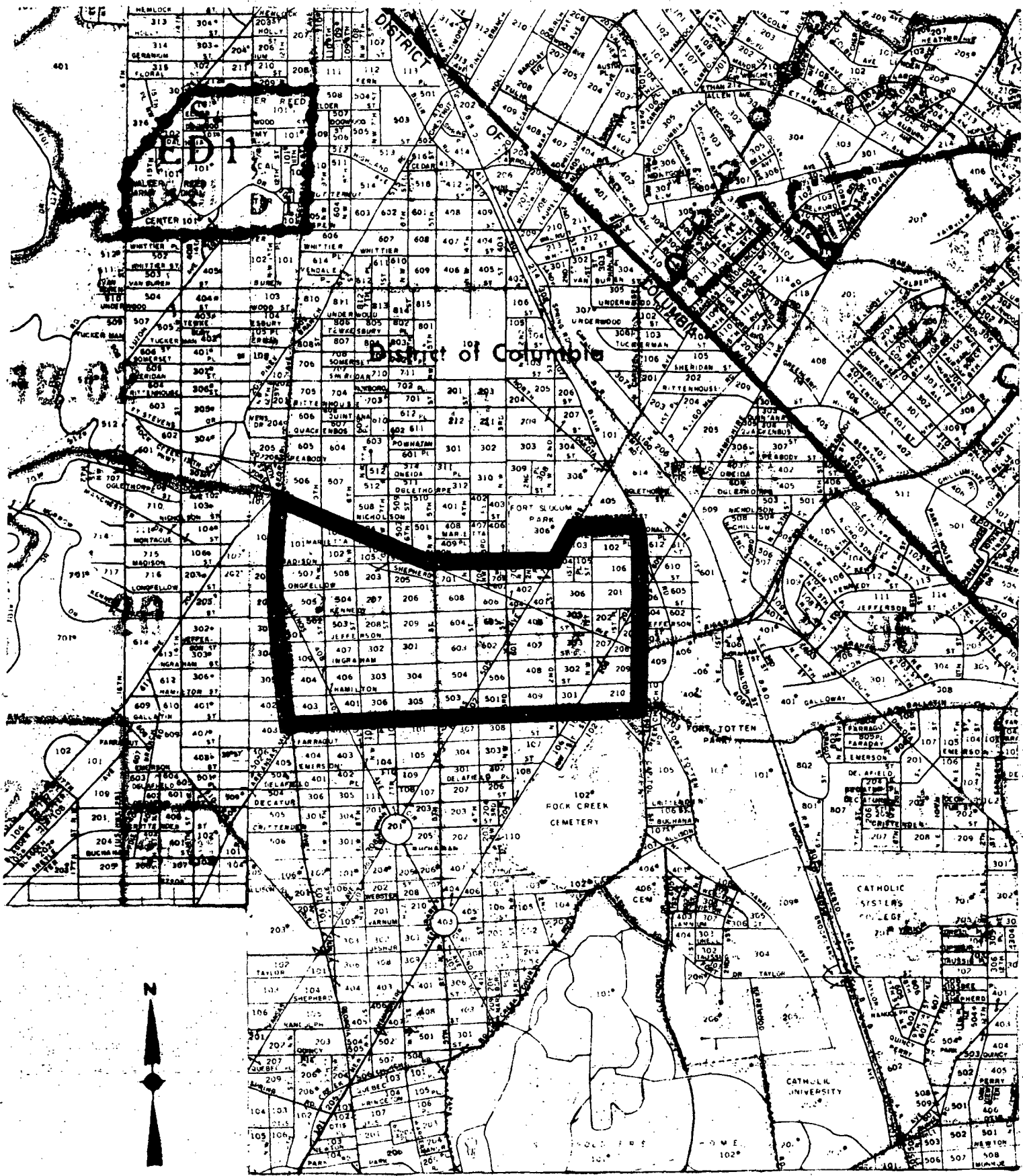
The color infrared imagery, because of clarity, haze reduction characteristics, and unique quality of information presentation, was found to be generally superior for this analysis. The other film filter combinations were either hazy, or when clear, possessed somewhat variable subject/background contrast levels,

although the B/W pan film (+ WR 25 filter) gave good subject delineation. The B/W IR film with WR 89B filter was found to be excellent for water area and drainage system delineations. Scales at 1:100,000 and 1:382,000 were examined; however, the bulk of the data reported on in this section was derived from the 1:100,000 scale color infrared imagery.

The photo analysis of the tracts was undertaken by two analysts working independently, reviewing, in turn, the same imagery. In the analysis, the variables mentioned above, as well as the following, were looked at: housing type and location, condition of buildings and general appearance of the area, presence of vegetation, existence of recreational and educational facilities, commercial areas, streets, parking areas, open areas, and other associated features.

Notations on the distinguishability of these parameters in the 1:100,000 and 1:382,000 color infrared imagery were made, as were other qualitative judgements where appropriate. A tabulation showing the results of these evaluations is given in Table 2.

Census Tract #21. District of Columbia. See Figure 2. The area is essentially residential in character. Single-family detached dwellings are located in the newer portions in the north part of the tract. The bulk of the area, however, contains semi-detached and single-family row houses. See Figure 3. Multiple-family apartment houses are distributed through the



AREA COVERED BY CENSUS

TRACT NUMBER 21

Figure 2

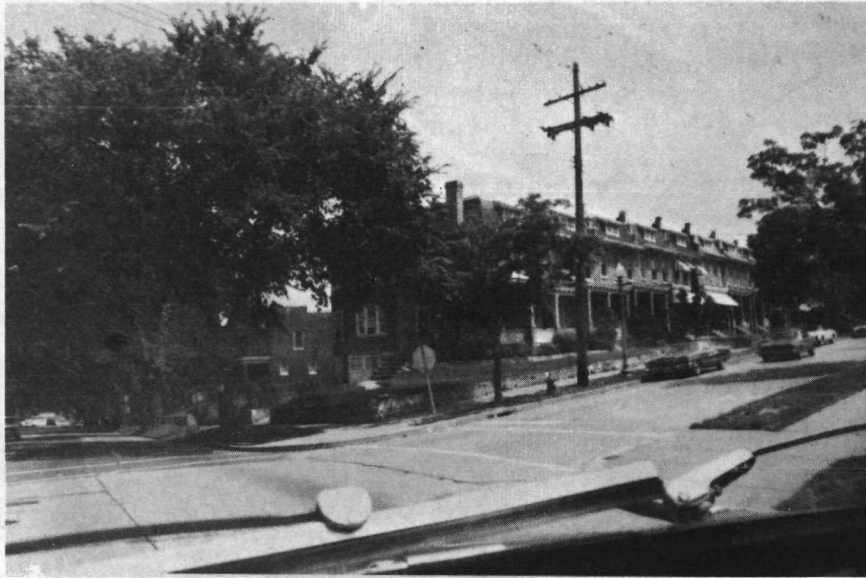
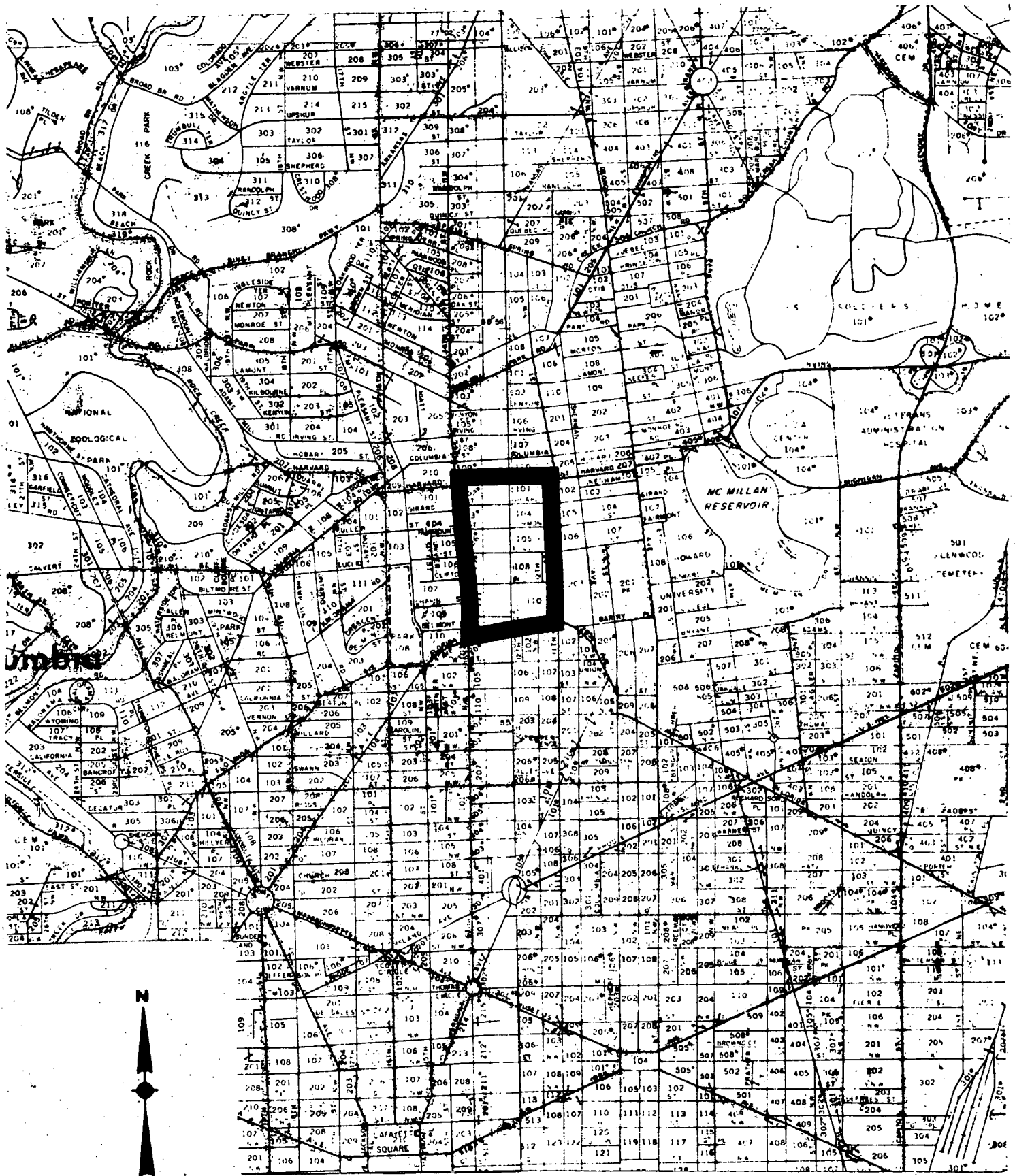


Figure 3. Census Tract #21. Row houses, single-family units.

central portions of the tract. The quality of the residential structures ranges from excellent to poor, with the bulk being generally well maintained. Those dwelling units in poorer condition are found principally along the edges of the two commercial areas; the one, a major east-west commercial district centered on Kennedy Street, and the other, along and east of Georgia Avenue.

The imagery analysis identified the types of dwelling units in this tract, the degree of spacing of the residential units, presence of vegetation (trees and yards), location of schools, playgrounds, open space and park areas, and discerned fringe differences along commercial streets.

Census Tract #36. District of Columbia. See Figure 4. The neighborhood is primarily of a residential character, though of mixed condition. The upper central part of the tract (east of 13th St.) consists of single-family dwelling units in very good state of maintenance including well kept yards, trees, shrubs, floral plots, and fencing. See Figure 5. Towards Florida Avenue to the south and to the west edges along 14th Street, respectively, the quality of housing and neighborhood generally declines. Many of the buildings in this portion of the tract are abandoned, or, when occupied, usually have boarded up entrances and windows. See Figures 6 and 7. In the poorer areas of the tract, on the occasion of the field visit, litter had accumulated along some streets and yards. Some yards were overgrown or else were dirt-covered and grassless. In the lower area of the tract, multi-family dwelling units are present in relatively greater amounts. Three large



**AREA COVERED BY CENSUS
TRACT NUMBER 36**

Figure 4



Figure 5. Census Tract #36, Row house, mixed dwelling units.



Figure 6. Census Tract #36, Abandoned multi-family unit.

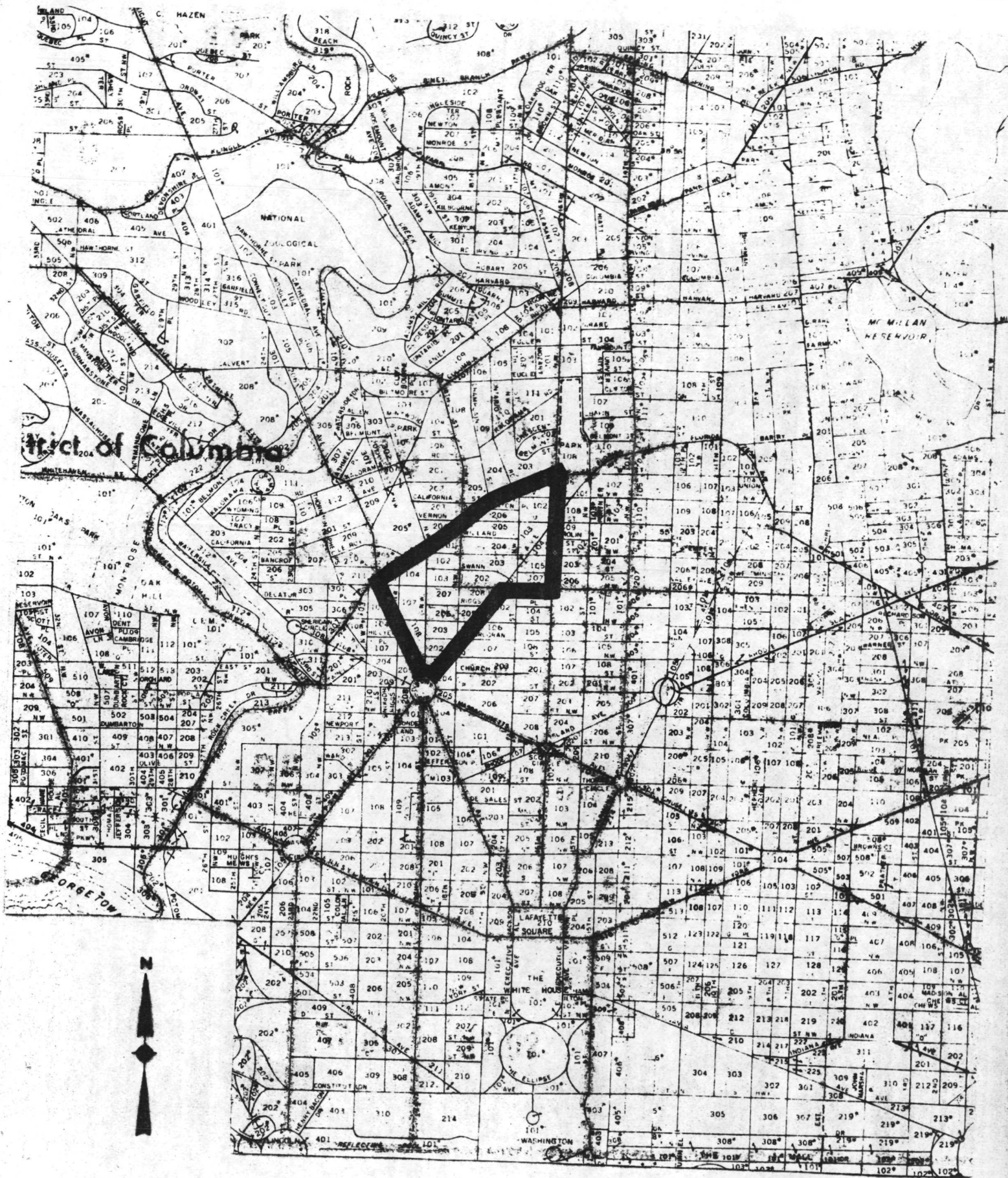


Figure 7. Census Tract #36, Single-family
Note boarded entry of empty unit.

multi-family apartment buildings are in process of rehabilitation in a group near the Cardozo High School (southern part of tract); these are being completely rebuilt as a public low-cost housing project. The vegetative cover of the tract is relatively sparse. Trees are spotty although present in some of the poorer portions.

The imagery analysis noted the very sparse tree cover and the rather tight building density pattern within the tract. The larger off-street parking in front yards of vacant apartment houses were identified after the field trip, but none of the abandoned or boarded-up buildings could be identified as such. The larger multi-family rehabilitation housing project and Cardoza High School with its associated recreational facilities were readily located. Roof coloration in this area was noted to be generally dark, and the street widths generally narrow.

Census Tract #42. District of Columbia. See Figure 8. This tract, which is principally residential in character, represents a section of the city which is in a state of change. At present, it consists of older residential buildings, many of them in delapidated condition, others abandoned and subsequently removed. See Figures 9 and 10. A considerable portion of the tract consists of well kept and tidy streets of row houses, and dwelling units which, at one time, were built as single-family units and are now apartments or rooming houses. See Figure 11. There are about five embassies within the tract along New Hampshire Avenue or near it on side streets. Several



AREA COVERED BY CENSUS

TRACT NUMBER 42



Figure 9. Census Tract #42, Row houses, single-family units. Note alley-way (vacant lot) between buildings.



Figure 10. Census Tract #42, Alley-way, site of removed building.



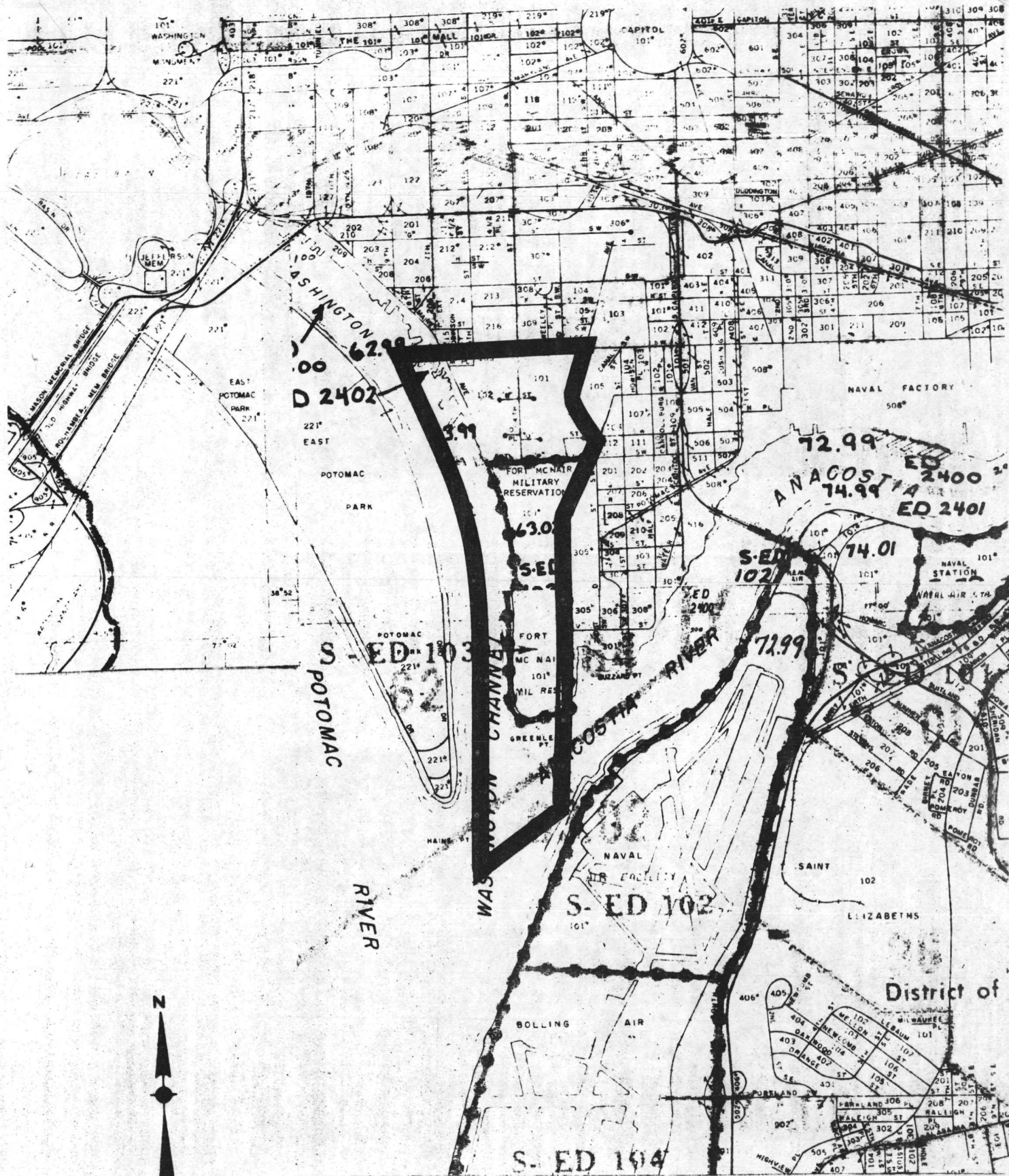
Figure 11. Census Tract #42, Row houses, mixed multi- and single-family units.

institutional buildings, schools, and "high rent" apartments are located within this tract. And, of course, the strip along Connecticut Avenue is entirely commercial, with a band of commercial and mixed residential occupancy along U Street which cuts E-W through the tract in the northern portion of it.

The initial imagery analysis of this tract gave somewhat ambiguous housing count data when compared with field data and ground checked. The very run-down condition of some of the areas within the tract was not directly observed in the imagery, nor were the buildings which were abandoned, boarded up, or structurally damaged. The high building density of the areas of poorest residential condition was observed, and does give some measure of neighborhood condition. There was some correlation of vegetative cover (lack of it) and neighborhood deterioration in a few areas. Likewise, the relatively well-kept residential sections, containing single- and multi-family buildings and the embassies, were characterized by landscaping and tree-lined streets. Commercial streets and off-street parking lots were readily located. Open spaces and yards in the rear of buildings were visible at these scales although alley-ways and vacant lots between buildings were not, nor would it have been possible to observe or monitor litter accumulations.

Census Tract #63. District of Columbia. See Figure 12.

The tract includes Fort Leslie J. McNair, which embraces the National War College, other Armed Forces academic



AREA COVERED BY CENSUS
 TRACT NUMBER 63

Figure 12



Figure 13. Census Tract #63, Town houses with ground-level parking, single-family units.



Figure 14. Census Tract #63, Town houses ("flat top"). Single-family units.



Figure 15. Census Tract #63, Town houses ("dome type). Single-family units.

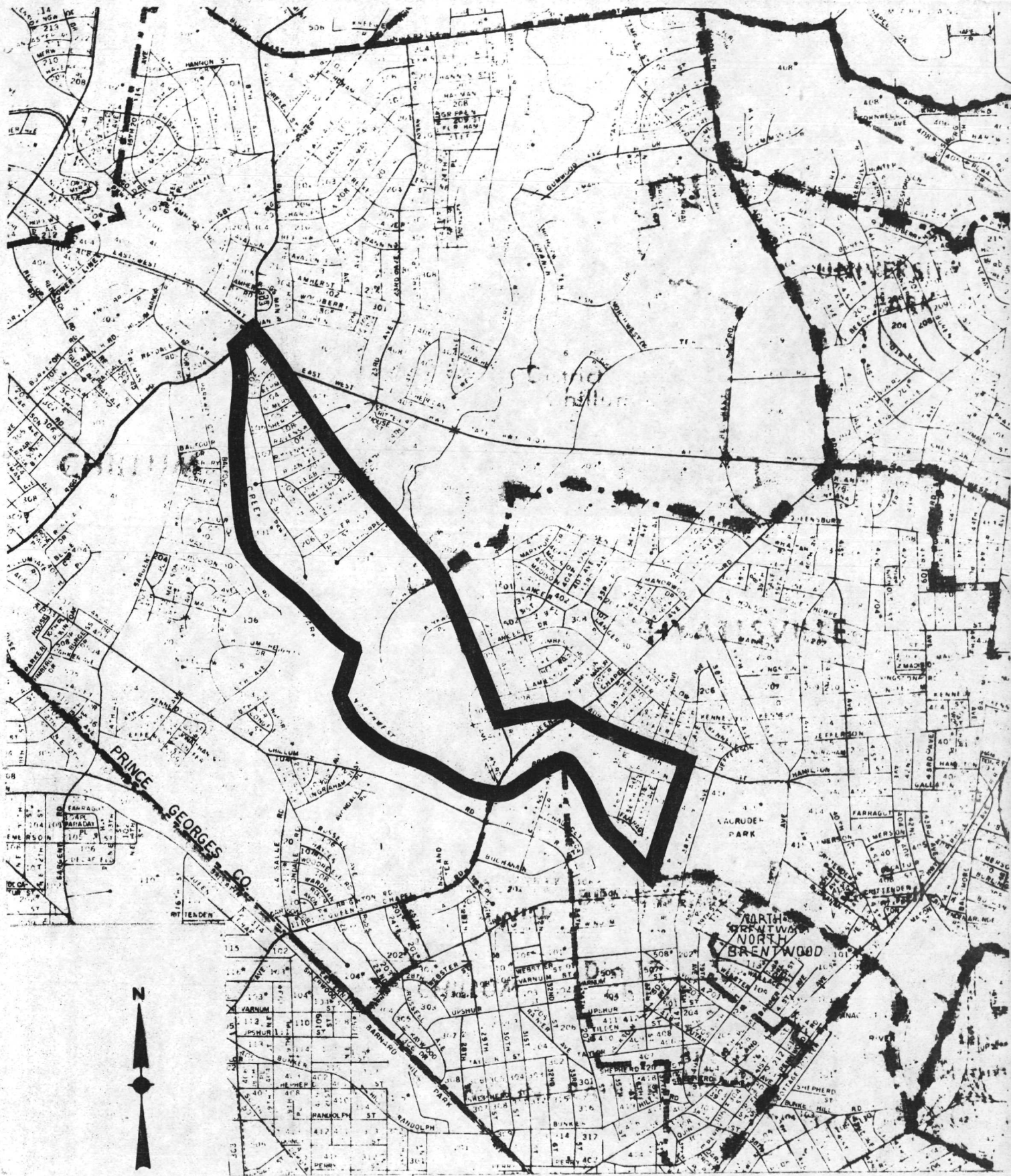


Figure 16. Census Tract #63, Single-family units. Town houses.

institutions, and other facilities, and portions of recently built residential communities in the Southwest Urban Renewal area. The character of the housing in the renewed area is new and in excellent condition, consisting of multi-story, multi-family units and many attached single-family units, some interspersed among the larger units. See Figures 13-16. Landscaping, off-street walkways and parking, playgrounds, etc., are provided. The housing facilities on the military installation are well kept, and consist of mansion-type dwellings occupied by senior commissioned and non-commissioned personnel.

The imagery reflects the contemporary character of the multi-story, multi-family residential units within the renewal area, though the single-family units are barely identifiable (initially) and only when having been identified as such by ground survey. The playground, parking, and open areas are visible as is the general planned layout of these with respect to the residences. Landscaping, design, even shrubbery, are visible. On the very small scale imagery, the entire area appears as a cluster of stepped multi-story housing units. The military residences, because of their very low building density, are readily identifiable, as is the general well-ordered appearance of the installation.

Census Tract #51. Prince George's County, Maryland. See Figure 17. The tract is located in a suburban residential area near Hyattsville. Single-family houses predominate in the tract (see Figures 18-19) with multi-family and duplex units



AREA COVERED BY CENSUS

TRACT NUMBER 51

Figure 17



Figure 18. Census Tract #51, Detached single-family units. Masonry construction; light-colored roofs.

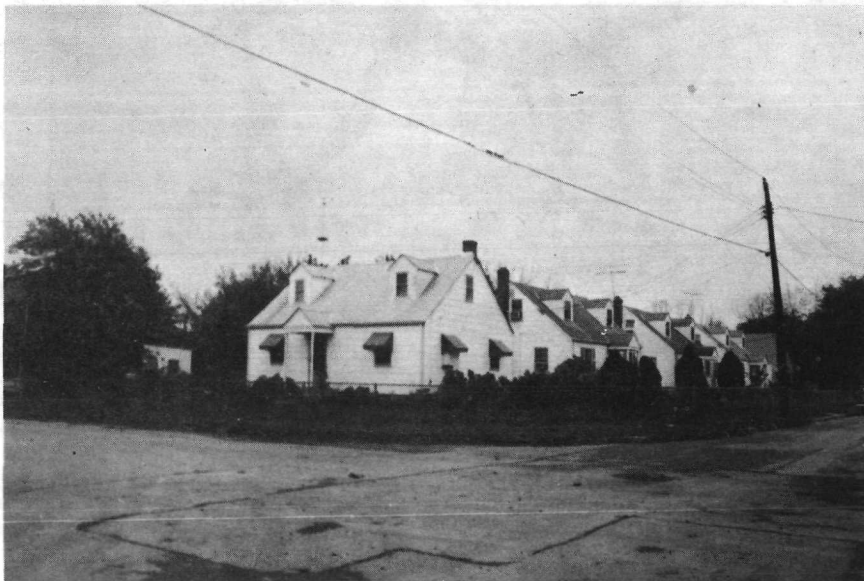


Figure 19. Census Tract #51, Small single-family houses, detached units.

located in the east-central portion. The area is open (about 50%) and contains much greenery and affords sizable recreational facilities.

The neat, homogeneous suburban character of this residential area is apparent in the imagery. The relatively low building density and the area layout reflects the community design common to the post-World War II period. Because of the light colored roofs, individual residential buildings are readily identifiable, though darker, multi-family units are also readily discernable. Playgrounds and open spaces are clearly visible as are trees and yard areas. Pavements, driveways and residential parking areas are barely visible on the 1:100,000 scale imagery, A large drive-in theatre, a commercial warehouse, and a group of tall radio masts are visible at this scale but the masts were not at the smaller scale (1:382,000).

TABLE 2

Evaluation of Housing and Neighborhood Condition Characteristics

<u>Parameter</u>	<u>Scale</u> 1:100,000	<u>Scale</u> 1:382,000 (30X)*
1. Residential Bldgs.		
Multi-family	Distinguishable. In row-house configurations, difficult to distinguish between multi- and single-family units when not detached.	Unless known or characteristic, generally indistinguishable from other large multi-story office-type buildings.
Single-family	Distinguishable.	Undistinguishable in central city areas, except as general blocks. Distinguishable when detached, as in suburban communities.
Physical appearance	Roof color; light or dark.	Roof color; light or dark.
Condition of bldgs. (roofs, walls, interiors, etc.)	Not distinguishable.	Not distinguishable.
Walkways	Distinguishable.	Not distinguishable.
2. Traffic Routes		
Major arteries	Visible and Measurable.	Visible; alignment observable; wider streets measurable.
Streets	Visible and Measurable.	Visible; alignment observable; wider streets measurable.
Alleys and small vacant lots	Not distinguishable.	Not distinguishable.
Parking (residential)	Distinguishable.	Generally not distinguishable.
Driveways	Visible.	Not distinguishable.

TABLE 2 (contd.)

3. Vegetation

Tree count	Distinguishable.	Generally distinguishable unless in thin sparse cover.
Yards and lawns (grassed over or not)	Distinguishable.	Not distinguishable in central city; visible as open vegetated areas in suburban communities.
Park areas	Distinguishable.	Distinguishable.
Open areas (with or without vegetation)	Visible.	Visible (large areas).

4. Educational and Recreational Facilities

Schools	Distinguishable.	Visible, if known.
Playgrounds (ball fields, tracks)	Distinguishable.	Barely distinguishable.
Drive-in theaters	Distinguishable.	Distinguishable, if known.

5. Other Parameters

Mixed-residential areas	Distinguishable by inference.	Not distinguishable.
Shopping centers	Distinguishable.	Distinguishable, if known. Parking lots generally visible (if large).
Office buildings	Visible.	Visible.
Accumulations of trash and litter	Not distinguishable.	Not distinguishable.

* Color infrared imagery at 1:382,000 scale (Film SO-117 with wratten 15+30 filters, camera: Hasselblad using 40 mm lens).

2. SUMMARY AND CONCLUSIONS

The results of these analyses force the authors reluctantly to conclude that small scale imagery at scales of less than 1:100,000 or so become limited and marginal for use in providing detailed and basic data on the necessary parameters of information required for the determination of the quality of urban housing stock and neighborhood condition. Large scale imagery is required.

Imagery at 1:100,000, and perhaps smaller, is useful in estimating the general layout, location, and size of housing types in metropolitan areas. This is particularly true in the suburban portions of the region where, because of building spacing, clustering, and community layout, individual single-family dwelling units, and often multi-family units, are distinguishable--even at the scales of 1:382,000. Within these areas, neighborhood condition may, however, only be conjectured from the imagery analysis by considering such variables as location, building density (as a measure of crowding), street layout, recreation areas, vegetation, shopping areas, age of community, and so forth. It is possible, also, for neighborhoods to register similar appearances in the imagery and yet to be entirely different in character and quality. It is very important in that connection, as indicated in this analysis, that imagery analysts familiarize themselves by field survey and general acquaintanceship with the neighborhoods under examination.

The condition of buildings in state of decline is not observable from imagery at these scales. The characteristics associated with deterioration (damage to doors and windows, boarded-up openings, abandonment, etc.) are just not directly visible, and reportable. As the process of worsening continues, and, as it might be interrupted by urban renewal actions, then such visible changes as building removal, overgrading, creation of large open areas, and so on, would be reportable by imagery analysis. Information on these changes would, of course, be available from other sources by this time; however, remote sensing imagery would be able to provide survey and status-change data.

It is possible that thermal sensing at low altitudes using helicopters, say, during the winter season, might be attempted to provide monitorship and identification of vacant or abandoned buildings. Research work to determine the feasibility of this remote sensing application is, of course, necessary.

In summary, on the basis of the results of imagery analysis at these scales, the determination of housing quality and neighborhood condition is not likely to encounter acceptable levels of success. Scales of much larger values, say 1:10,000 or better, 1:5000, would be required to get right in on the scene, as it were, to provide analysts the means of extracting the basic data. The cost effectiveness of such large scale-low altitude surveys would suggest such data acquisition for specific local survey purposes, spot-checking, up-dating, and similar purposes, reserving use of small scale remote sensing

data for general survey, larger area change detection, and other analysis of similar scope. In this way, selected areas requiring more attention may be flown and surveyed, thereby permitting more effective utilization of limited staff and other research and analytical resources. Also, ready and convenient accessibility of information on the availability of current imagery of the region at some central location, say the Council of Governments, would contribute materially to time and cost savings during research and analysis.

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