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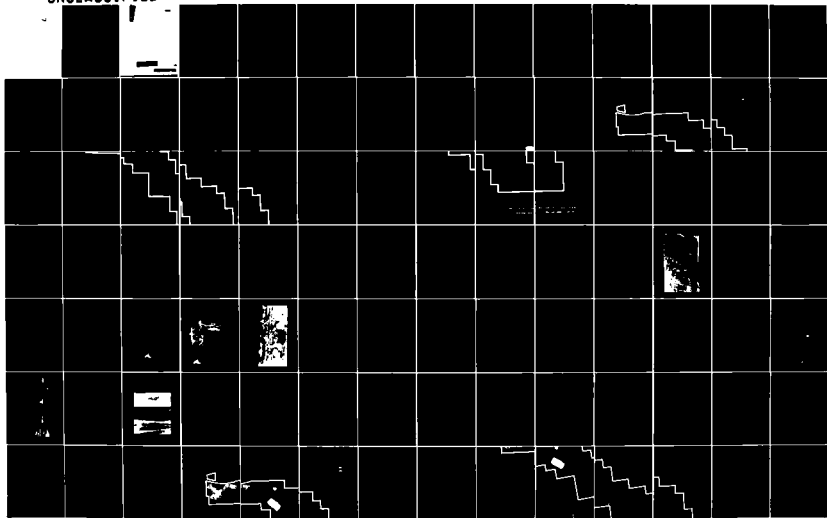
AN ARCHEOLOGICAL OVERVIEW AND MANAGEMENT PLAN FOR THE
GREEN RIVER LAUNCH COMPLEX(1) STEARNS-ROGER SERVICES
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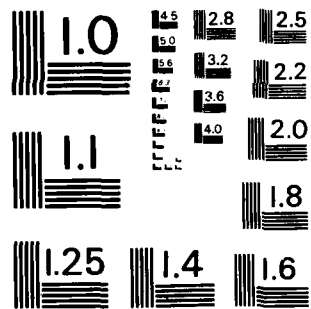
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**Final
Report No. 3**
March 1984

**An Archeological Overview and
Management Plan for the
Green River Launch Complex**

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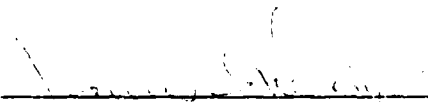
**National Park Service
U.S. Department of the Interior**
Denver, Colorado 80225

for the
U.S. Army Materiel Development and
Readiness Command

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Prepared under the Supervision of


James Grady, Principal Investigator

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|---|--|--------------------------------------|----|------------------------------|
| REPORT DOCUMENTATION PAGE | | 1. REPORT NO. | 2. | 3. Recipient's Accession No. |
| 4. Title and Subtitle | | 5. Report Date | | |
| An Archeological Overview and Management Plan for Green River Launch Complex, Utah | | March 29, 1984 | | |
| 7. Author(s) | | 8. Performing Organization Rept. No. | | |
| J. Grady, S.F. Mehls, B.J. LeFree, J.L. Dawson, D.E. Plume | | 3 | | |
| 9. Performing Organization Name and Address | | 10. Project/Task/Work Unit No. | | |
| Stearns-Roger Services Inc. 4500 Cherry Creek Drive North Denver, CO 80217 | | 26917 X17000 | | |
| | | 11. Contract(C) or Grant(G) No. | | |
| | | (C) CX-0001-2-0048 | | |
| | | (G) | | |
| 12. Sponsoring Organization Name and Address | | 13. Type of Report & Period Covered | | |
| U.S. Dept. of Interior National Park Service Rocky Mountain Regional Office 655 Parfet Street Denver, CO 80225 | | FINAL REPORT | | |
| | | 14. | | |
| 15. Supplementary Notes This report was prepared as part of the DARCOM Historical/Archeological Survey an inter-agency technical services program to develop facility-specific archeological overviews and management plans for the U. S. Army Materiel Development and Readiness Command (DARCOM) | | | | |
| 16. Abstract (Limit: 200 words) | | | | |
| <p>The Green River Launch Complex (GRLC) located in Grand County, Utah, is an installation of the U. S. Army's Materiel Development and Readiness Command (DARCOM). As stewards of approximately 3,546 acres (1,435 hectares) of public lands at GRLC, the U.S. Army has responsibility for the Management of any cultural resources located there. Two sites are known to exist on GRLC, but local geomorphology and cultural history suggest that additional cultural resources are likely to be found in undisturbed portions of the GRLC. Those sites possessing physical integrity will have high research value. In compliance with Draft Army Regulation (AR 420.XX) and in consideration of future general disturbance activities, the following recommendations are made: (1) conduct a field survey of all undisturbed areas on the installation to identify unknown cultural resource locations, (2) evaluate and nominate known cultural properties for inclusion in the National Register of Historic Places (NRHP), (3) take action to preserve properties eligible for inclusion in the NRHP. These recommendations, if implemented, together with historic architectural information would then serve as the basis for developing an installation Historic Preservation Plan.</p> | | | | |
| 17. Document Analysis | | | | |
| a. Descriptors | | | | |
| Archeological Management Army Installation Management Environmental Assessment | | | | |
| b. Identifiers/Open-Ended Terms | | | | |
| Cultural Resource Management Utah Paleoenvironments Utah Prehistory Goshuite Ethnography Utah History | | | | |
| c. COSAT Field/Group | | | | |
| 18. Availability Statement | | | | |
| For public release without appended site locational data. | | | | |
| 19. Security Class (This Report) | | 21. No. of Pages | | |
| | | xi, 96 | | |
| 20. Security Class (This Page) | | 22. Price | | |
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MANAGEMENT SUMMARY

The Green River Launch Complex (GRLC) located in Grand County, Utah, is an installation of the U.S. Army Materiel Development and Readiness Command (DARCOM). As steward of 3,546 acres (1,435 hectares) of public land at GRLC, the U.S. Army has responsibility for the management of any cultural resources located there.

Two sites are known to exist on the Complex, but local geomorphology and culture history suggest that additional cultural resources are likely to be found in the undisturbed portions of the Complex.

Those sites possessing physical integrity will have high research value. In compliance with draft Army Regulation (AR 420.XX) and with conservation of future general disturbance activities the following recommendations are made: 1) an intense archeological survey should be conducted on the undisturbed portions of the Complex; and 2) the known existing sites should be evaluated for inclusion in the National Register of Historic Places (NRHP). These recommendations, if implemented, together with historic architectural information would then serve to develop a facility Historic Preservation Plan (HPP).

PREPARERS AND QUALIFICATIONS

Dr. J. Grady, principal investigator, has 21 years' experience in archeology, has participated in eight excavations, and has over 30 years of experience in aerial photography and aerial photographic interpretation. His doctoral dissertation, published by the Bureau of Land Management (BLM) (1980), dealt with highland/lowland adaptation of prehistoric peoples in the Piceance Basin portion of the Colorado Plateau in northwest Colorado. His research interests include the solution of large-scale (areal) archeological problems using ecological modeling, statistical sampling, and sampling strategies and modeling; remote sensing and aerial photographic interpretation; and development and use of statistical techniques to integrate prehistoric spatial distributions into reconstructions of viable economic patterns. He was responsible for the Prehistorical Overview, Section 2.2.1, Archeological Research Directions, Section 2.3, Chapters 3.0, 4.0, 5.0, and 7.0, and the Management Summary of this report.

Ms. B.J. LeFree has had extensive archeological and compliance experience in Colorado as Head of Compliance for both the State Archeologist and the Colorado State Historic Preservation Officer (SHPO). She also was a staff archeologist for the Advisory Council on Historic Preservation. Ms. LeFree has studied many Native American people extensively, particularly those at the Pueblo of Santa Clara, where she worked with several potters in writing her book, Santa Clara Pottery Today. Ms. LeFree was archeological laboratory supervisor for Denver University, responsible for analyzing lithic and pottery artifacts, writing site descriptions, developing statements of significance for eligible properties, and writing reports. She currently is employed at Stearns-Roger as the Cultural Resource Manager and Archeologist. She wrote the Ethnohistory, 2.2.2, and developed the Recommended Archeological Management Plan, 6.0.

Dr. S.F. Mehls, Stearns-Roger staff historian and designated Historical Investigator for this project, has extensive academic and professional experience in the history of the American West. He has more than three years' full-time experience as a historian for cultural resources projects. Dr. Mehls has published several books, articles, book reviews, and government documents, and has given numerous oral presentations. While employed by the BLM, he received two individual special achievement awards for the quality and timeliness of his historical cultural resources work. He was responsible for writing the Historical Overview, Section 2.2.3, and contributed to Research Directions, Section 2.3, and Historic and Recent Land Use Patterns, Section 3.2.

Mr. J.L. Dawson is an ecologist specializing in terrestrial ecology and botany. He has produced baseline descriptions and environmental assessments for numerous industrial projects, including oil shale and synfuel developments, power plants, mines, and transmission and pipeline corridors. His responsibilities have included review of relevant literature, design and performance of necessary field studies, description of baseline conditions, and analysis of impacts. He has broad geographic experience with work on projects in many of the western states and in North Dakota and West Virginia. He was responsible for compiling the data for the Physical Environmental Overview, Section 2.1.

Mr. D.E. Plume, staff geologist for Stearns-Roger, has for the past 12 years been involved in field and laboratory work for preparation of archeological and geological studies throughout North America. In addition, he has contributed to several studies on the environmental effects of high-level nuclear waste storage, hazardous waste management legislation, and computer applications of numerical simulation. Mr. Plume was responsible for compiling the data for the geology and paleoenvironment portions of the Physical Environmental Overview, Section 2.1.

ACKNOWLEDGEMENTS

This project was funded by the U.S. Army Materiel Development and Readiness Command (DARCOM) and administered by the National Park Service (NPS).

We are especially grateful for the assistance and cooperation of Albert Johnson, Environmental Coordinator for White Sands Missile Range, for arranging the visit and providing the orientation, slide presentation of White Sands, maps, environmental assessments, and related material; Lou Sexton, caretaker of GRLC; Clifford Duncan, Ute Historic Preservation Officer; Dave Madsen, Utah State Archeologist and his staff, for the site forms pertinent to the study region; and Rich Fike, Bureau of Land Management (BLM) State Archeologist, and Doug Dodge, Salt Lake City District BLM Archeologist, for unpublished reports and site forms.

Our special appreciation is extended to Jack Rudy, Contracting Officer's Representative, and Joe Bolin, Contract Officer, National Park Service Rocky Mountain Region, who accompanied us to the installations in Utah. We also extend our appreciation to Yvonne Stewart and John Thomas, Washington, National Park Service.

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LIST OF ACRONYMS

| | |
|--|--------|
| Advanced Ballistics Re-Entry System | ABRES |
| Advisory Council on Historic Preservation | ACHP |
| Before Present | BP |
| Bureau of Land Management | BLM |
| Council on Environmental Quality | CEQ |
| Denver and Rio Grande Railroad | D&RG |
| Federal Land Policy Management Act | FLPMA |
| Federal Register | FR |
| Green River Launch Complex | GRLC |
| Historic Preservation Plan | HPP |
| Intermountain Antiquities Computer System | IMACS |
| National Environmental Policy Act | NEPA |
| National Historic Preservation Act | NHPA |
| National Register of Historic Places | NRHP |
| State Historic Preservation Officer | SHPO |
| U.S. Army Materiel Development and Readiness Command | DARCOM |
| White Sands Missile Range | WSMR |

FOREWARD

Stearns-Roger has developed a regionally-based prehistoric, ethnographic, and historic overview for the Green River Launch Complex (GRLC). This overview includes a realistic two-stage research design for the study area. A hierarchical model also is provided which identifies problem domains, research topics, and specific research questions, as well as the data base needed to resolve these questions. The GRLC probably contains the data necessary to resolve some of these questions.

This report represents the first synthetic overview and research design specifically applicable to the GRLC. It is felt that this design is flexible enough to accommodate any new information as it becomes available.

Stearns-Roger Services, Incorporated

James Grady
Principal Investigator

SECTION 1

CHAPTER 1.0 INTRODUCTION

1.1 PURPOSE AND NEED

This archeological study was conducted for the Green River Launch Complex (GRLC) to develop a comprehensive cultural resource management plan. This plan should be addressed in the installation Master Plan for compliance with the following federal statutes and orders regarding cultural resources:

- Antiquities Act of 1906
- Historic Sites Act of 1935
- Reservoir Salvage Act of 1960
- National Historic Preservation Act of 1966
- National Environmental Policy Act of 1969
- Executive Order 11593 of 1971
- Archeological and Historic Preservation Act of 1974
- Archaeological Resources Protection Act of 1979

1.1.1 Federal Mandates

The federal government recognizes that important archeological resources are valuable, non-renewable aspects of our cultural heritage. A myriad of federal laws, regulations, executive orders, and guidelines have been enacted to consider our cultural heritage in the federal planning process.

Federal agency archeological responsibilities began with passage of the Antiquities Act of 1906 (PL 59-209; 16 USC 431-433), which enabled the federal government to set aside and protect "historic landmarks, historic, and prehistoric structures and other objects of historic or scientific interest."

The Historic Sites Act of 1935 (PL 74-292; 16 USC 461-471) established a policy to protect nationally significant properties and expanded the role of the Department of the Interior in identifying and protecting "historic and archeological sites, buildings, and objects."

The Reservoir Salvage Act of 1960 (PL 86-523; 74 Stat. 220; 16 USC 469-469c) provided for the protection of data of "exceptional historical or archeological significance" which would be impacted by reservoir construction.

It was not until 1966, with passage of the National Historic Preservation Act (NHPA), (16 USC Sec. 470f, as amended 90 STAT.1320) that all federal agencies were mandated to consider the effects of their projects and programs on cultural properties listed on the National Register of Historic Places (NRHP). Further amendments (PL 91-243, 93-54, 94-422, 94-458, 96-199, 96-244, 96-515) require the following of all federal agencies:

1. Inventory, evaluate, and (where appropriate) nominate to the NRHP all archeological properties under agency ownership or control (Sec. 110(a)(2)).

2. Prior to the approval of any ground-disturbing activity, consider the project's effect on any property listed on the NRHP or any eligible property, and afford the Advisory Council on Historic Preservation (ACHP) a reasonable opportunity to comment on the proposed project (Sec. 106).
3. Complete an appropriate data recovery program on an eligible or listed archeological property before it is damaged or destroyed (Sec. 110(b)), as reported by the House Committee on Interior and Insular Affairs (96th Congress, 2nd Session, House Report No. 96-1457, p. 36-37).

In January 1967, to obtain the mandatory participation of the states in the NRHP program, the Secretary of the Interior sent letters to the governors requesting each to designate a representative responsible for preparing surveys, receiving grants, and working with the Department of the Interior in developing the program. The role of the states and the duties of the State Historic Preservation Officer (SHPO) were first published in the Federal Register (FR), February 1969.

The National Environmental Policy Act (NEPA) of 1969 (P.L. 91-190 83 Stat. 852, 42 USC 4321) requires that all aspects of the environment, including important historic properties, be considered during planning of any major federal action, through the preparation and review of environmental impact statements. Also, the Federal Land Policy and Management Act of 1976 (FLPMA) (P.L. 94-579; 90 Stat. 2743) declares that it is public policy to managed public lands in a manner that will protect historic resources (Section 102(a)(8)).

Executive Order 11593, "Protection and Enhancement of the Cultural Environment," was signed by President Nixon in 1971. The Order authorized federal agencies, with the advise of the Secretary of the Interior and in cooperation with the SHPO, to locate, inventory, and nominate to the Secretary of the Interior all sites, buildings, districts, and objects under their jurisdiction or control that appear to qualify for listing on the NRHP. The Order afforded protection to those properties eligible for and listed on the NRHP.

The Archeological and Historic Preservation Act of 1974 (PL 93-291; 88 Stat. 174, 16 USC 469) requires that notice of any federal project adversely affecting a significant archeological property be provided to the Secretary of the Interior; either the Secretary or the notifying agency may require a cultural resource data recovery program, if appropriate, to preserve valuable information.

The Archaeological Resources Protection Act of 1979 (PL 96-95; 93 Stat. 721; 16 USC 470aa) supersedes the Antiquities Act of 1906 (93 Stat. 225; 16 USC 431-32) and establishes provisions that allow the Secretary of the Army to issue excavation permits for archeological resources on U.S. Army Materiel Development and Readiness Command (DARCOM) lands (Sec. 4). The Act also establishes stringent fines and extended prison sentences for anyone removing artifacts from public lands without a permit.

The ACHP regulations, "Protection of Historic and Cultural Properties" 36 CFR 800, set forth procedures for compliance with Section 106 of the NHPA.

Regulations from the Department of the Interior establish procedures for determining site eligibility for the NRHP (36 CFR 60, 36 CFR 63), standards for data recovery (proposed 36 CFR 66), and procedures for implementing the Archaeological Resources Protection Act (Department of Interior, 43 CFR Part 7; Department of Defense, 32 CFR Part 229).

Guidance from the U.S. Department of the Army establishes procedures and standards for the preservation of historic properties (32 CFR 650.181-650.193; Technical Manual 5-801-1; Technical Note 78-17; Army Regulation 420.XX), (Knudsen et al. 1983:2-14).

It is the intent of DARCOM to comply with these policies and integrate into their Master Plan procedures regarding preservation of archeological and historical properties. Data have been collected and synthesized for integration into the Master Plan. Recommendations in this report for identification and preservation of those properties eligible to the NRHP will assist the DARCOM installation in their compliance responsibilities.

1.1.2 Native American Indian Legislation

In addition to federal legislation requiring agencies to consider cultural properties in their planning process, legislation also requires consideration of Native American Indian sacred and cultural values. NEPA requires that sacred areas of Native Americans be identified for potential impact; NHPA also addresses the need to identify Native American cultural resources. The American Indian Religious Freedom Act of 1978 (Public Law 95-341; 92 Stat. 469) legalizes a special status for sacred places, artifacts, animals, and plants of Native American peoples. This act guarantees Native Americans access to sacred sites, including cemeteries, required in their religion. This Act also guarantees Native Americans the freedom to use sacred resources and natural species in practicing their religion.

Council on Environmental Quality (CEQ) guidelines clarify the role of Native Americans in the NEPA process. Section 40 CFR 1501.7 allows affected Indian Tribes' participation in the early planning process to formulate issues and participate in research. The lead agency shall request the comments of affected Indian Tribes to review and comment on draft Environmental Impact Statements (40 CFR 1503.1).

Because GRLC is close to present Indian reservations, and research has identified early tribal territories to be within the boundaries of the installation, Native American values have been addressed extensively in Section 2.2.2.

The Ute tribe is actively engaged in preserving their cultural and religious heritage. The Ute Historic Preservation Officer, the research team, and National Park Service (NPS) personnel surveyed a known archeological property, DARCOM GR-1, on the GRLC. The property is discussed in Chapter 4.0. The Utes requested that the archeological site be preserved and protected from further ground disturbance and vandalism.

1.2 THE GREEN RIVER LAUNCH COMPLEX

The complex is a 3546 acre (1435 hectares) facility located 1.2 miles (2 km) east of Green River, Grand County, Utah (Figure 1-1). The range facilities are under U.S. Army control at White Sands Missile Range (WSMR)

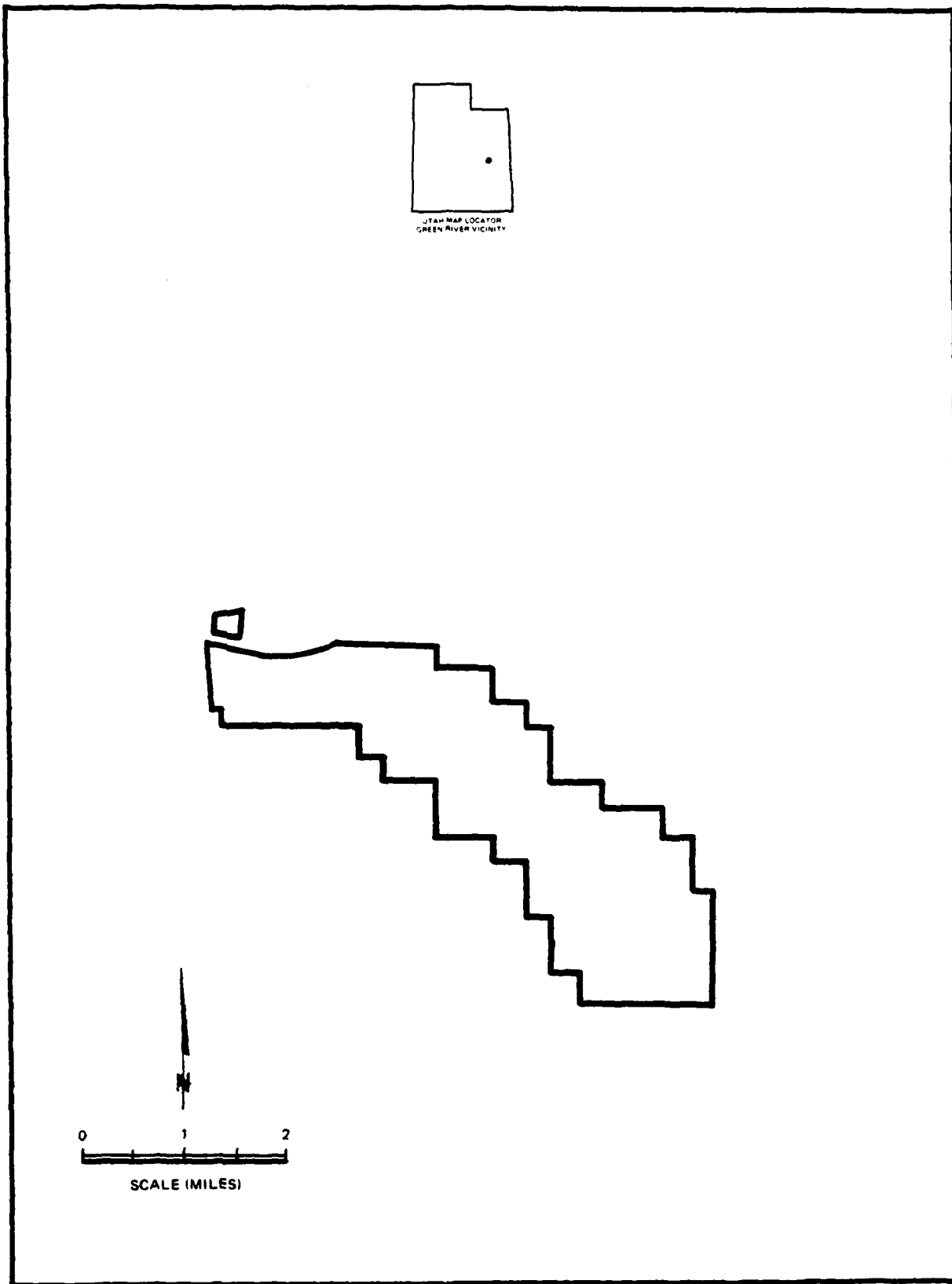


Figure 1-1. GENERAL VICINITY MAP OF THE GREEN RIVER LAUNCH COMPLEX

in New Mexico. WSMR is located 424 miles (683 km) southeast of the GRLC. The installation was acquired in 1961 by the federal government to support Advanced Ballistics Re-Entry System (ABRES) under development by the Air Force System Command.

Under the ABRES program, four-stage Athena missiles were launched from GRLC to impact WSMR. The Army determined 773,499 acres (296,843 hectares) were needed to provide launch, abort, and booster fall out areas. Most of the land was leased, allowing the military to use the land during launches as safety fall out areas, while allowing land owners to use the land during periods of non-military use.

The installation consisted of a cantonment area, and assembly and launch areas (Figure 1-2). Fifty-nine trailers for housing, offices, and dining facilities are contained in the cantonment and assembly areas. Seven prefabricated structures are used for supply, maintenance, and engineering support.

The Athena launch area, 4.5 miles (7.2 km), southeast of the cantonment area consisted of a control tower (block house), three launch complexes, meteorological facilities, and a portable climatic chamber. One hundred-forty-one Athena missiles were launched between 1964 and 1973.

The GRLC also maintained the Geyser Launch Facility, which supported the Army's Pershing Missile System. Sixty Pershing missiles impacted WSMR between 1971 and 1975 (Ludeman et al. 1982:1-2 to 1-12).

1.3 SUMMARY OF PREVIOUS ARCHEOLOGICAL WORK

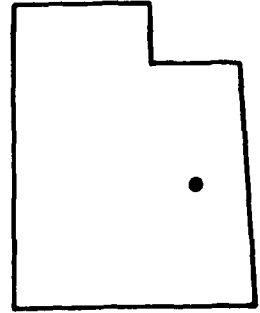
No previous archeological work has been performed on the GRLC based on a review of cultural resource inventory files, the NRHP, the office of the Utah State Archeologist and the Moab District office of the Bureau of Land Management (BLM), and from a literature review.

1.4 THE SOCIOCULTURAL CONTEXT OF THE ARCHEOLOGICAL RESOURCES ON THE GREEN RIVER LAUNCH COMPLEX

Archeological materials and data located by the research team on the GRLC may have the potential to produce useful scientific information. Furthermore, the Ute Historic Preservation Officer feels that this material may be a significant resource in understanding Ute history. The current value and interest in archeology is attested to by the presence of a public archeological display in the town of Green River.

**Figure 1-2 MASTER FACILITY MAP
OF THE
GREEN RIVER LAUNCH COMPLEX**

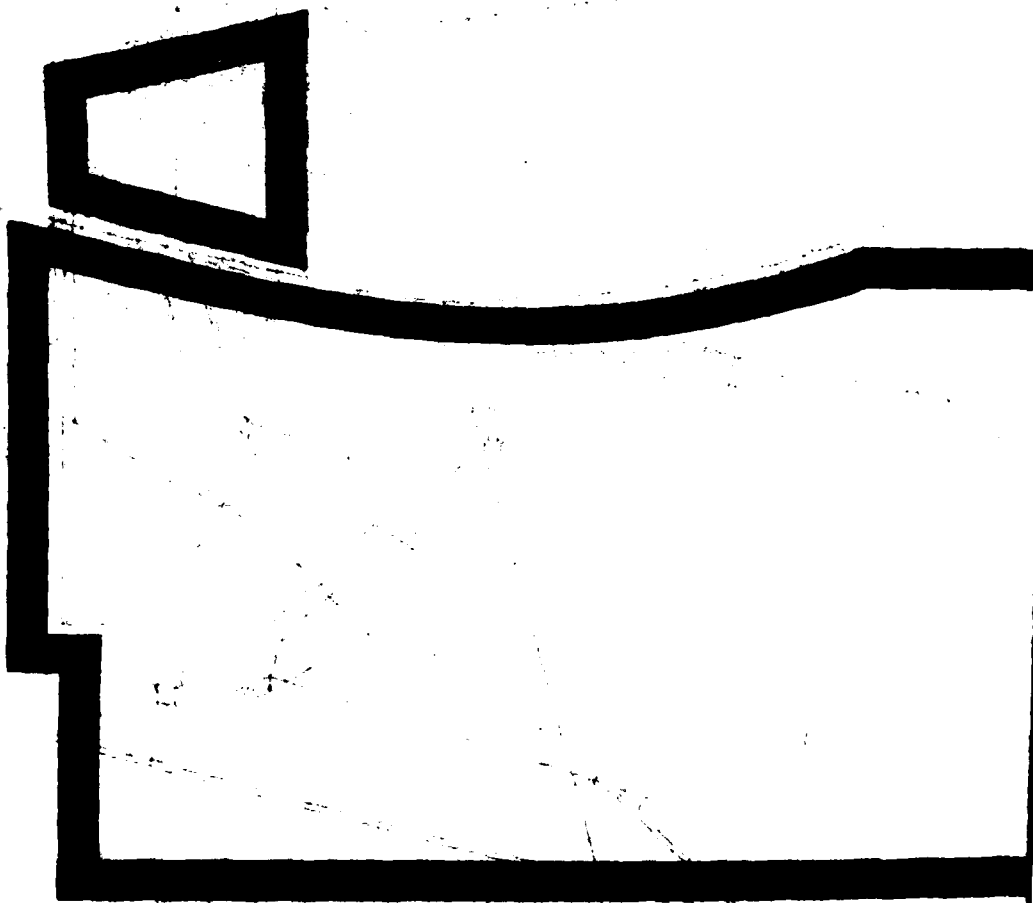
1-21S T-20S



UTAH MAP LOCATOR
GREEN RIVER VICINITY

1

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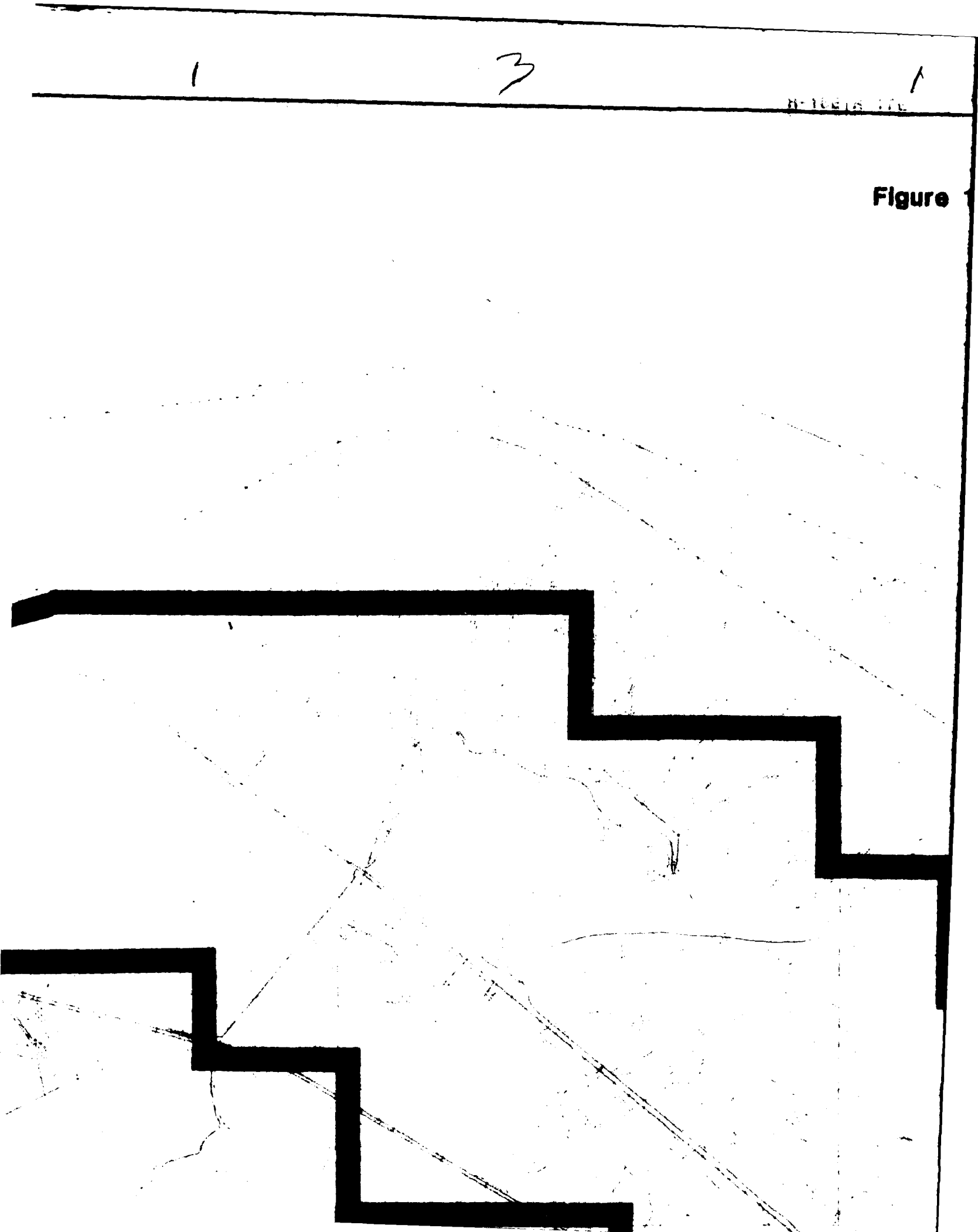
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11-10-15 11E

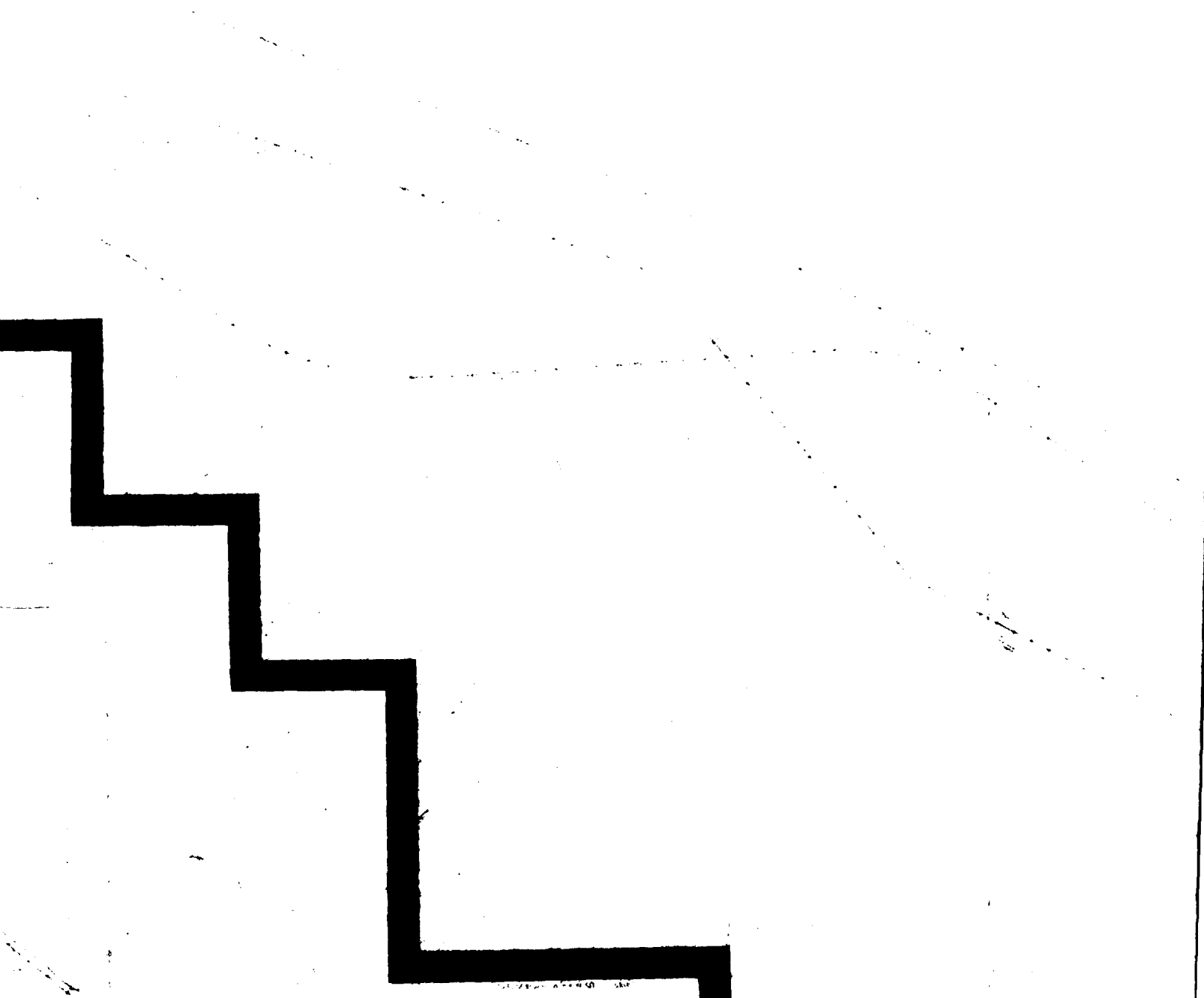
Figure 1



1 4 1

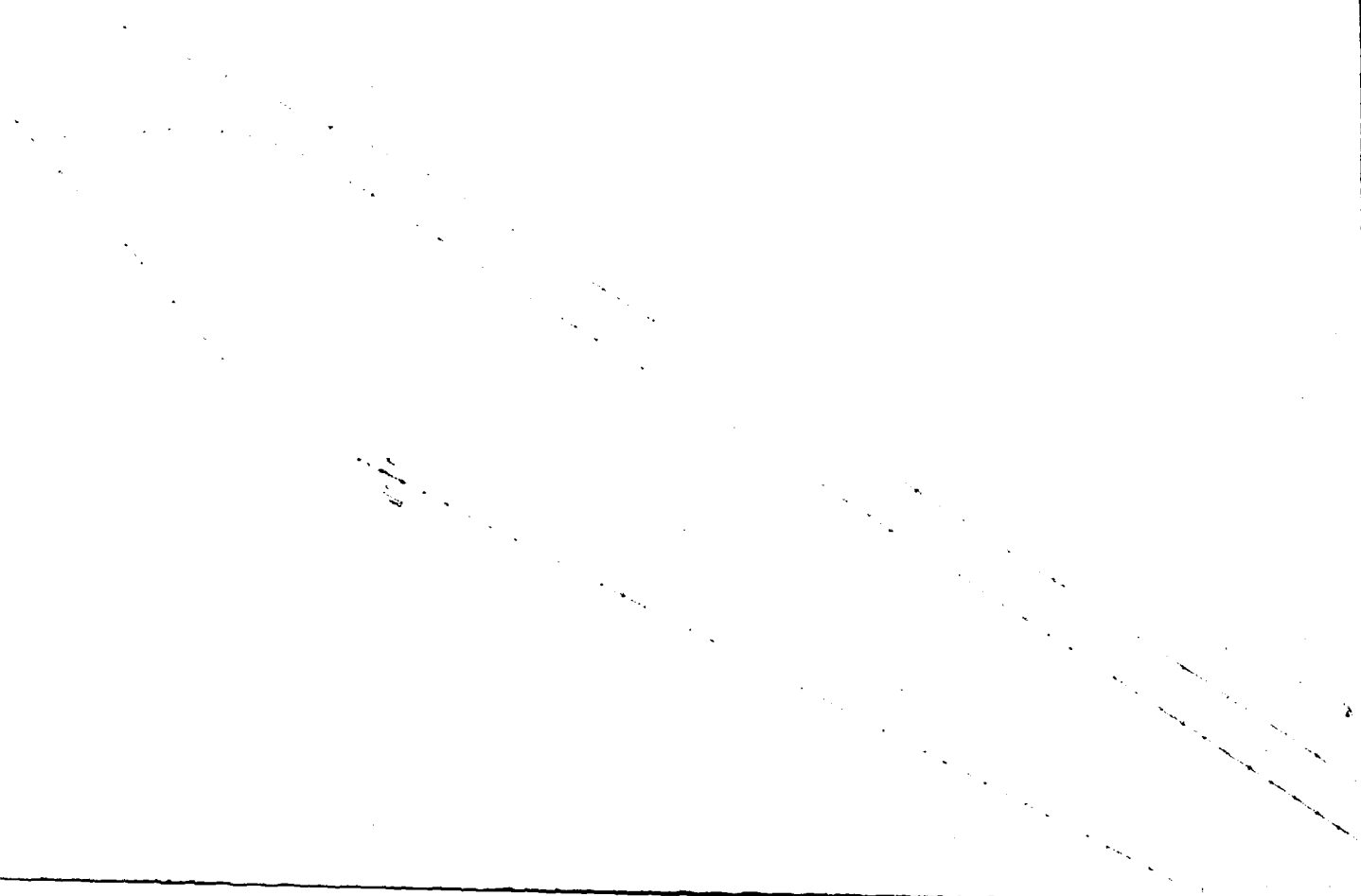
Figure 1-2. MASTER FACILITY MAP OF GREEN RIVER LAUNCH CO

 **BORDER OF STUDY AREA**



P OF GREEN RIVER LAUNCH COMPLEX, WSMR

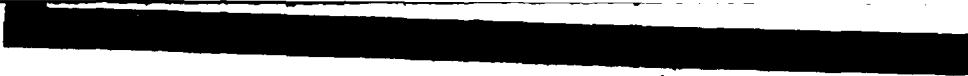
BORDER OF STUDY AREA



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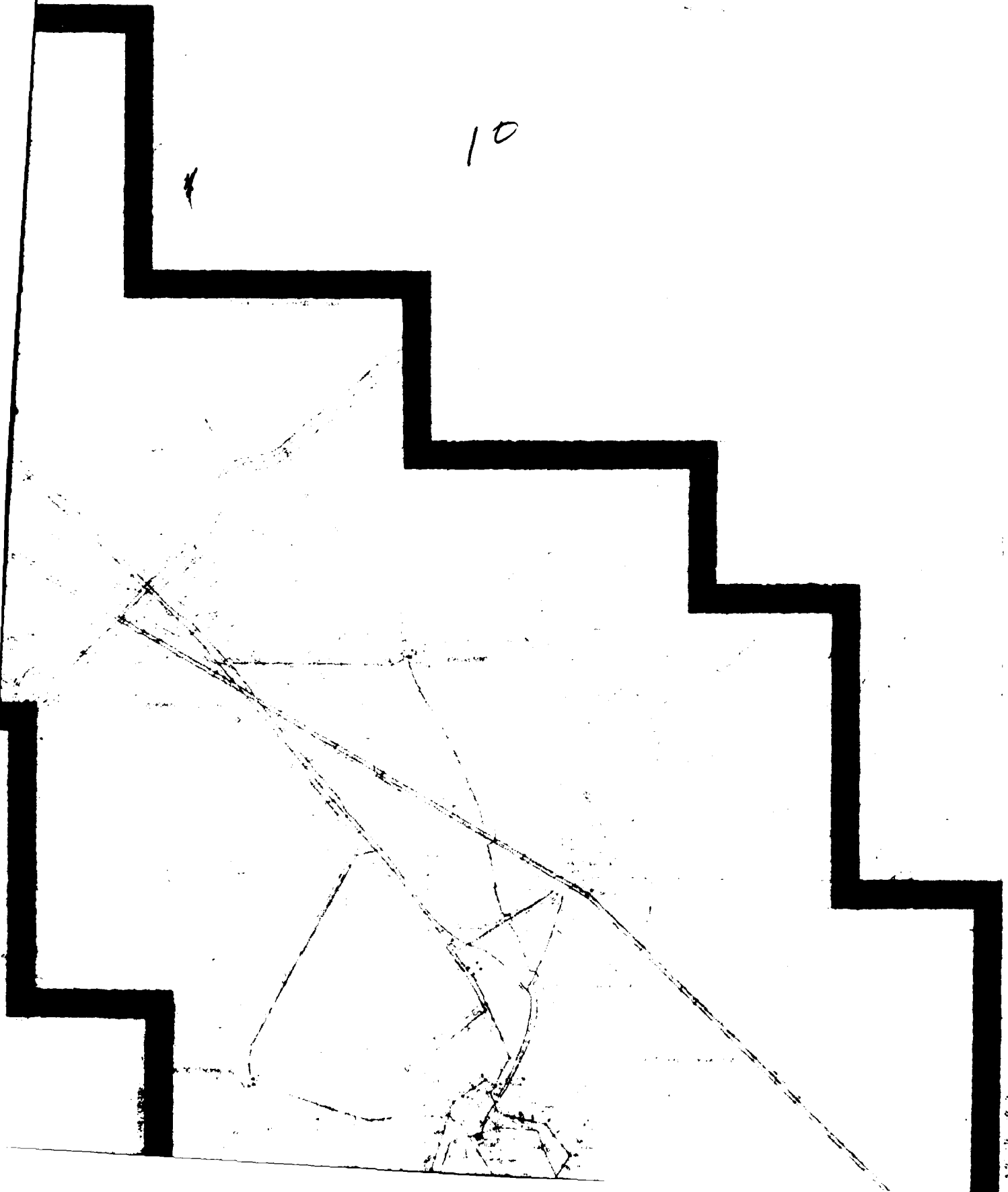
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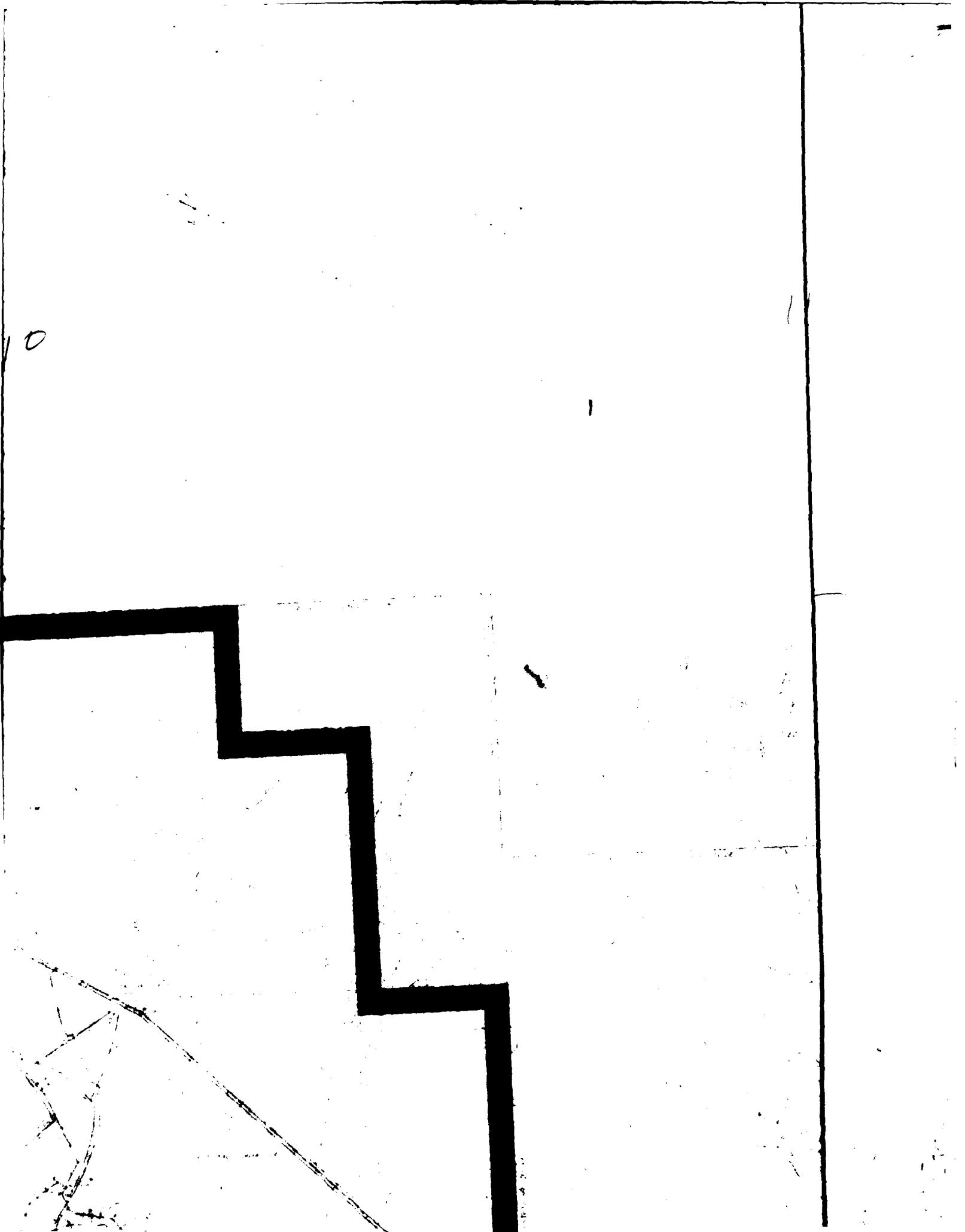
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3

MEYER LAUNCH SITE

10





PREPARED UNDER THE DIRECTION OF THE DISTRICT ENGINEER, U.S. ARMY ENGINEER DISTRICT, ALBUQUERQUE FOR THE POST ENGINEER, WHITE SANDS MISSILE RANGE, BY LIMBAUGH ENGINEERING AND AERIAL SURVEYS, INC., ALBUQUERQUE, NEW MEXICO IN 1963 BY PHOTOGRAMMETRIC METHODS. PLANIMETRIC DATA UPDATED AND REVISED BY KOOGLY AND POULS ENGINEERING, INC., ALBUQUERQUE, NEW MEXICO IN 1966 BY PHOTOGRAMMETRIC METHODS. THIS MAP COMPLIES WITH THE NATIONAL STANDARD MAP ACRYLAL REQUIREMENTS APPROPRIATE TO A 100 FOOT CONTOUR INTERVAL. MAP SHEET 17C141

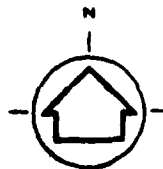
- BUILDING PERMANENT
- BUILDING SEMI-PERMANENT
- BUILDING TEMPORARY
- STRUCTURE
- TOWER
- PAVED ROAD AND PARKING
- GRADED ROAD
- TRAIL ROAD
- FENCE
- DIKE OR DAM
- DEPRESSION
- WASH OR APPROX.

17

MARKED SAFETY AREA

1000 500 0 1000 2000

SCALE IN FEET



WHITE SANDS TRANSVERSE MERCATOR PROJECTION |
WHITE SANDS DATUM

1:50,000 (1:50,000)

APPROXIMATE AREA

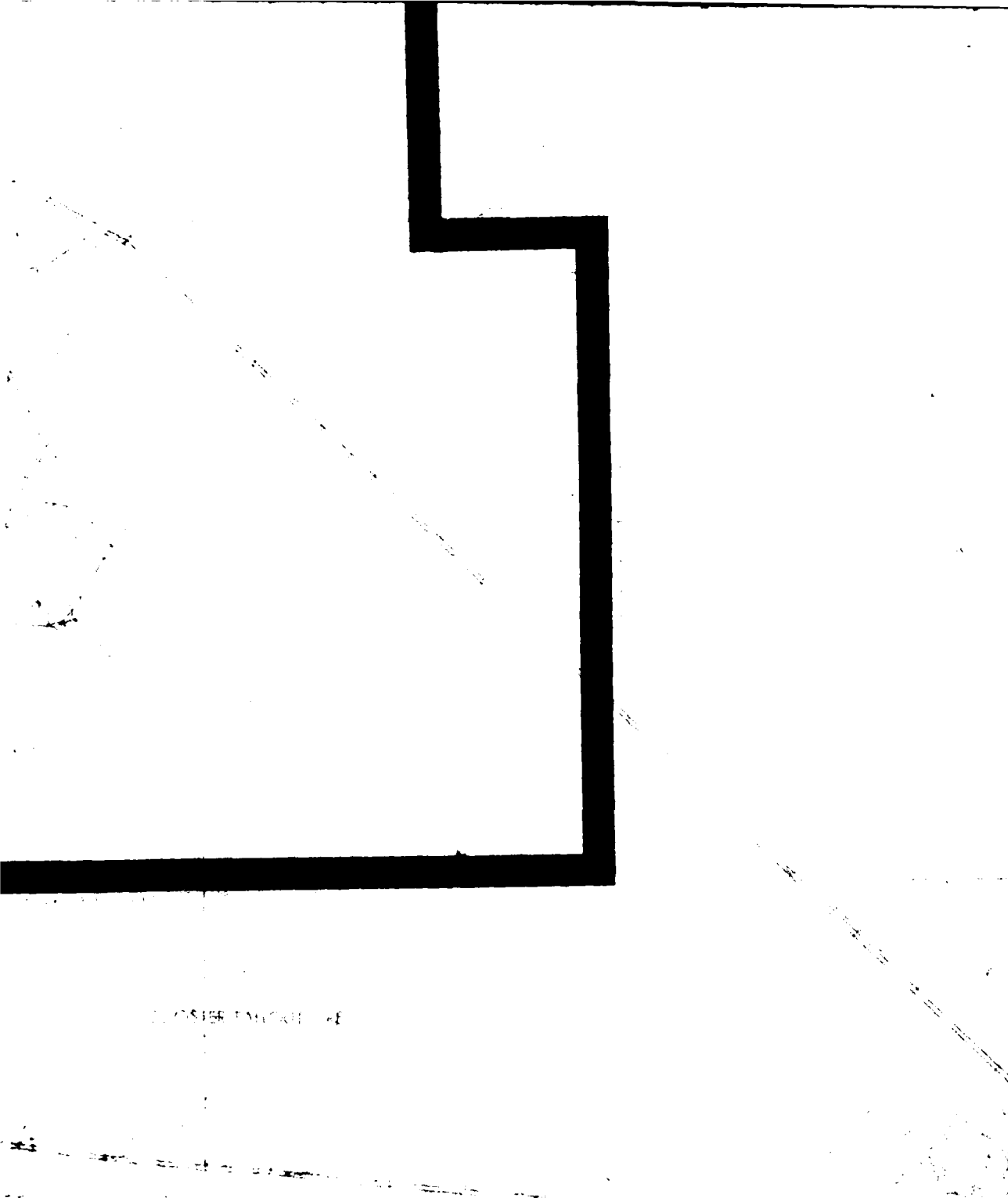
BOOSTER FALLOUT AREA

WHITE SANDS MISSILE RA

MASTER PLAN
BASIC INFORMATION

GREEN RIVER - GENERAL

GR-G7/G8 SPE



UNCLASSIFIED

WHITE SANDS MISSILE RANGE, NEW MEXICO

MASTER PLAN
BASIC INFORMATION MAPS

GREEN RIVER - GENERAL SITE MAP INDEX GR-G7/G8 SPECIAL

| DATE REVISED | SCALE | DRAWING NO | SHEET | PLATE |
|--------------|----------------|--------------|--------|-------|
| OCTOBER 1972 | 1" = 1000 FEET | PE-GM-692-GR | 1 of 6 | 1 |

5 1 18

SECTION 2

CHAPTER 2.0 AN OVERVIEW OF THE CULTURAL AND RELEVANT NATURAL HISTORY OF THE GREEN RIVER LAUNCH COMPLEX

2.1 PHYSICAL ENVIRONMENT

2.1.1 Earth Resources

Topography. The Green River Launch Complex (GRLC) includes 3546 acres (1435 hectares), plus 11,752 acres (4756 hectares) of joint-use area, and is located near the Green River in east central Utah. The Complex lies at the northern end of the Canyonlands section of the Colorado Plateau Physiographic Province.

The site consists of undulating terrain, with low rounded hills and ridges, valleys, and shallow-to-moderate slopes. Elevations range from 4070 ft. (1241 m) in the valley of the Green River and Browns Wash in the northwest corner, to 4626 ft. (1410 m) in the southwest corner.

The most prominent features are two valleys. The first is about 3 miles (4.8 km) long and up to 2000 ft. (610 m) wide, and extends southwest from Browns Wash in the northwest corner of the facility. It is flanked by small erosional fans, and has a 150 ft. (46 m) bluff on the east side. The valley of Little Grand Wash crosses the southern joint-use area and is about 0.5 miles (0.8 km) wide. The cantonment area is in the valley of the Green River. Most of the site has low to moderate local relief, except the bluff along the northern valley and hills south of Little Grand Wash, which are up to 250 ft. (76 m) high.

The Green River is about 0.25 miles (0.4 km) west of the northwest corner of the study site. Browns Wash on the northwest corner and Little Grand Wash are the most prominent drainages. Smaller, unnamed drainages flow into these and the Green River.

Geology. The study area is located in the very northwest portion of the Paradox Fold Belt of the Colorado Plateau Physiographic Province, adjacent to the Roan Plateau and Book Cliffs subprovinces. The Colorado Plateau is a relatively stable structural feature, independent of the Basin and Range and Overthrust geologic provinces on the west, which are not relatively stable structural features. The Colorado Plateau also is independent of the San Juan geologic province on the east, which is of moderate stability. It has been suggested that the Colorado Plateau is a detached portion of the stable North American Continental Interior Craton (Battelle Memorial Institute 1981.)

Formations exposed at and near the surface of the study area consist of Jurassic and Cretaceous terrestrial and shallow marine shales and sandstones, exposed by the down-cutting of the Green River and tributaries. These formations are characterized by lithified depositional basinal and delta sediments derived from erosion of the Sevier Organic Belt to the west and Mogollon Uplift to the south. During the Laramide Uplift (Late Cretaceous), the shallow seas retreated, forming the present Rocky Mountains, Uinta Plateau, and San Rafael Mountains. The Eocene Green River formation of the

Roan Plateau is north of the study area. This formation is a product of deposition in a large inland lake created by the aftermath of Laramide uplifting (Hintze 1975).

Geologic maps and aerial photos of the GRLC area indicate a possible "geologically recent" fault, with clearly visible displacement in Section 36 of R 16 E, T 21 S, and Section 31 of R 17 E, T 21 S. Topographic maps of the area indicate a location called Crystal Geysir, which seems to lie directly on the fault in the vicinity of the Green River (off-site). This large normal fault on the southern boundary of the study area is called the Little Grand Wash Fault, with as much as a 1000 ft. (305 m) of displacement at the study area. The fault cuts transversely or diagonally across the southwest limb of the Court House Syncline, which is associated with the Paradox Fold Belt episodes. This would make the Little Grand Wash Fault geologically younger than the Paradox Fold Belt episode (Williams 1964; Martha Smith, personal communication). The fault may be associated with Late Cenozoic or Quaternary gravity compensation and stress relief in the Roan Plateau, Book Cliffs area. This fault cuts transversely or diagonally across the northwest trending Paradox Fold Belt (Pennsylvanian and post-Pennsylvanian in age) and the northeast trending Colorado Lineament (Laramide and earlier in age), and probably is not associated with either of these tectonic events, which implies a geologically recent fault (Raines and Simpson 1980; Doug Maier, personal communication).

Possible examples of rotational slumps or flows are noted in Sections 23 and 26 of T 21 S, R 16 E; Sections 33 and 34 of T 21 S, R 16 E; and Section 31 of T 21 S, R 17 E. These may be related to recent movement along the Little Grand Wash Fault and probably occur in the Mancos Shale or Morrison formations. However, these also may be related to differential weathering along slightly dipping strata in the region.

The sand bar and constriction in the straight reach of the Green River at Section 34 of T 21 S, R 16 E (on the inferred fault) indicates a disturbance in water flow velocity at that point. This is indicative of a reach that has a disturbed channel and hasn't achieved graded equilibrium, further suggesting a disturbance possibly related to recent fault movement.

Crystal Geysir appears to be located on the fault and probably is controlled in part by fluid circulation deep within the fault itself. Because of the possible recent movement along this fault, Crystal Geysir spring probably has been active in the recent past, especially after significant tectonic activity in the region (Baer and Rigby 1978).

Therefore, it is possible that recent tectonic activity along the fault, if it has occurred, may have produced significant noticeable activity in emanations from Crystal Geysir in the recent geologic past. This may have had symbolic significance to early man in the region.

The economic geology of the GRLC area generally is limited to minor uranium mineralization in the Morrison Formation and possible deep carbon dioxide deposits along the axis of the Green River Anticline. Chert (agate) and tufa (travertine) deposits may have been exploited by both prehistoric and historic man on a small scale. Some petroleum and natural gas discoveries recently were made near the study area, although none have been made at the study area (Battelle Memorial Institute 1981).

Soils. Detailed soils information is not available for the GRLC. A general soils map of Utah and soils description in Wilson et al. (1975) indicates that the soils consist of a complex of typic torriorthents (shallow), lithic calciorthids, and lithic natrargids, with smaller areas of lithic ustollic calciorthids, badlands, and rockland. Soils are mildly to very strongly alkaline, calcareous, and slightly saline. Runoff is rapid and sediment production is high. The soils are predominantly shallow, with underlying shale or sandstone within 20 in. (51 cm) of the surface, except in the valleys. No arable soils exist on the site.

2.1.2 Water Resources

No perennial surface water exists on site. Browns Wash, Little Grand Wash, Solitude Wash, and numerous smaller unnamed drainages are dry except after heavy rains. No springs occur on site.

The Green River is near the northwest corner of the site. The historical flow from 1914 to 1957 varied from 1,300,000 to 8,400,000 acre ft. (1.6 to $10.4 \times 10^9 \text{ m}^3$), with a mean of about 3,000,000 acre ft. ($3.7 \times 10^9 \text{ m}^3$) (Irons et al. 1965). Peak flow occurs in late May, with a secondary peak in early July. The water quality at the town of Green River exceeds the maximum concentration for dissolved solids allowed for domestic use, about 70 percent of the time, but is suitable for irrigation.

Crystal Geyser and related springs occur about 2 miles (3.2 km) west of the site near the banks of the Green River, and about 4 miles (6.4 km) south of the town of Green River. Crystal Geyser produces about 320 acre ft. ($39.5 \times 10^4 \text{ m}^3$) of saline and mineral-laden water per year (Irons et al. 1965). The water is charged with carbon dioxide and erupts irregularly several times each day (Baer and Rigby 1978).

2.1.3 Modern Climate

The climate is arid and continental, with hot dry summers and moderately cold dry winters. Precipitation averages 5 in. (13 cm) per year, and occurs sparsely throughout the year with somewhat higher amounts in summer and fall. Snowfall averages 4.3 in. (10.9 cm) per year. Summer and fall precipitation occurs mostly as localized thunderstorms which may cause flash floods. The evaporation rate is 60 in. (152 cm) per year (Ludeman et al. 1982).

The annual average temperature is 52.5°F (34.7°C), ranging from an average low of 27.7°F (9.9°C) in January to an average high of 79.8°F (62.0°C) in July. The January mean maximum and minimum temperatures are 38°F (20°C) and 8°F (10°C), respectively, and the July mean maximum and minimum are 96°F (78°C) and 62°F (44°C), respectively. The frost-free period at Green River averages 158 days (Brown 1960).

Humidity averages about 50 percent, ranging from 65 percent in winter to between 1 to 10 percent in summer. Prevailing summer winds are from the southwest at 5.8 mph (9.3 kph); fall and winter winds are slightly stronger and from the north or northwest (Ludeman et al. 1982).

2.1.4 Plant Resources

The site is entirely in the salt desert shrub zone of the intermountain shrub region (Branson et al. 1967). The vegetation is dominated by several species of low growing, salt-tolerant shrubs. Vegetative cover ranges from 2 to 5 percent in the harsher sites to 10 to 20 percent in other areas, and productivity is correspondingly low (USDA - Soil Conservation Service 1975).

Within the area, patterns of species dominance and community development are derived primarily from differences in soil characteristics (West and Ibrahim 1968). Areas of very shallow soils over shale are dominated by mat saltbush, and have the lowest cover and productivity. Shallow loamy soils are dominated by shadscale and Nuttall saltbush, and deeper loamy soils by shadscale, winterfat, black sagebrush, Indian rice grass, and galleta. Other common plants include bud sagebrush, fourwing saltbush, greasewood, snakeweed, and western wheatgrass. Herbaceous annuals also are important, particularly in favorable years (USDA - Soil Conservation Service 1975).

Lists of food plants used by the aboriginal populations of the intermountain region are available from ethnobotanical studies (Steward 1970, Chamberlin 1909, 1911, Yanovsky 1936, Stoffle and Dobyns 1982), and from archeological studies (Coulam and Barnett 1980, Hogan 1980). Although a number of species in the salt desert have edible seeds, their scattered occurrence, short season, low productivity, and lack of other resources made these low-use areas. Edible seeds could be collected from the various species of saltbush, sagebrush, grasses, and some other plants. More varied resources may have been present locally near the Green River.

2.1.5 Animal Resources

Wildlife populations are low in the area due to sparse vegetation cover and low plant productivity. Wildlife populations are highest in areas of taller and denser shrubs, or near rough broken terrain. Riparian woodland scattered along the Green River may be the best habitat in the area for many animals, particularly small birds. Flat, sparsely vegetated areas may have few regular inhabitants other than burrowing rodents and horned larks.

The most abundant mammals are blacktailed jackrabbit, antelope ground squirrel, and other small rodents. Larger mammals include coyote, badger, and bobcat. Mule deer occur occasionally. A small introduced population of Rocky Mountain bighorn sheep occur along the Green River in Desolation Canyon (Ludeman et al. 1982). Desert bighorn are found in the rugged canyons along the Green and Colorado Rivers in the Glenn Canyon National Recreation area.

Relatively few bird species occur regularly in the salt desert scrub. The most common species is the horned lark. The only game bird occurring regularly is the mourning dove. Other large birds include common raven, common crow, and several species of raptors. Waterfowl are present along the nearby Green River (Behle and Perry 1975).

Amphibian and reptile populations are low in this part of Utah. Several species of snakes and lizards may occur in low numbers (Hayward et al. 1958).

2.1.6 Paleoenvironment

Paleontology. Various Jurassic and Cretaceous Formations found within the study area have been ranked by the State of Utah as paleontologically sensitive formations. Rankings place these Jurassic and Cretaceous Formations in a range of moderate to highly important from a paleontologically sensitive view (Madsen 1980). The current ranking is as follows:

1. For invertebrate fossils, the Ferron/Frontier Sandstone ranks 1, the Morrison Formation ranks 5, the Cedar Mountain/Burro Canyon Formations rank 16, the Dakota Sandstone ranks 20, and the Mancos/Tununk Shales rank 32 in a field of 35 formations.
2. For fossil plants, the Cedar Mountain/Burro Canyon Formations rank 5, the Morrison Formation ranks 7, the Dakota Sandstone ranks 10, and the Front Formation ranks 11 in a field of 15 formations.
3. For trace fossils, the Ferron Sandstone ranks 9 and the Lowe Morrison Formation ranks 12 in a field of 15 formations.
4. For vertebrate fossils, the Morrison Formation ranks 2, the Cedar Mountain shale ranks 17, the Mancos Shale ranks 23, and the Dakota Sandstone ranks 34 in a field of 50 sensitive formations.

Prehistoric Environmental Changes. The natural environment of the intermountain area has changed greatly in the past 10,000 to 15,000 years, with the major changes occurring near the Pleistocene-Holocene boundary, and additional less dramatic fluctuations since then. The schedule of significant changes is presented in Table 2-1.

The climate of the late Pleistocene has been the subject of much study and speculation, with different authors suggesting various combinations of reduced temperatures and increased precipitation to account for known environmental changes. Recent reviews by Van Devander and Spaulding (1979) and Mifflin and Wheat (1979) suggest a climate not radically dissimilar from the present, with moderately cooler temperatures and increased precipitation. Mifflin and Wheat (1979) suggest an average precipitation increase of 68 percent in Nevada. This amount of increase would leave the Green River area arid, and probably dominated by big sagebrush steppe. The nearest site studied, Cowboy Cave, is about 1400 ft. (427 m) higher in elevation and was characterized by a mixture of montane forest and sagebrush in the late Pleistocene, and pinyon-juniper woodlands and sagebrush today (Lindsay 1980, Spaulding and Peterson 1980).

Changing rainfall amounts and seasons, and/or changing temperatures, caused rapid vegetation change in the early Holocene. Vegetation zones by 8500 B.C. were essentially as they are today (Curry and James 1982, Lindsay 1980). The Pleistocene megafauna became extinct during this period, including muskox, horse, onager, mammoth, bison, camel, mountain goat, and others (Grayson 1982). Climatic fluctuations have occurred several times during the Holocene, as shown in Table 2-1, and have caused accompanying shifts in vegetation and wildlife composition (Curry and James 1982, Lindsay 1980).

Table 2-1. A SUMMARY OF THE ENVIRONMENTAL HISTORY OF THE AREA OF GREEN RIVER LAUNCH COMPLEX

| <u>Date (a)</u> | <u>Curry and James, 1982 Northeastern Great Basin Review and Summary of Available Literature</u> | <u>Date</u> | <u>Lindsay, 1980; Spaulding and Peterson, 1980 Cowboy Cave Pollen, Plant Fossils</u> |
|-------------------------|--|-----------------------|--|
| 2000 BP -Present | Essentially modern | 4500 BP -Present | Modern conditions, with some fluctuations, apparent cooler period at 3300 BP and drier after 2500 BP |
| 3500 BP -2000 BP | Cooler, slight lowering of conifer forest and other vegetation zones | | |
| 5000 BP -3500 BP | Near modern? Data somewhat ambiguous | 5000 BP -4500 BP | Cooler, neoglacial, increase in pinyon and juniper |
| 7500 BP -5000 BP | Warmer and drier than present (reduced moisture effectiveness) with two very dry periods, 7000-6500 BP and 6000-5500 BP | 8500 BP -5000 BP | Warm, dry, altithermal increase in grasses, xeric vegetation and non-arboreal species |
| 12,500 BP -7500 BP | Warming and drying, decrease in glaciers and lacustral systems, great rise in elevation of vegetation zones, with reversal of overall trend 11,000 to 10,000 BP, extinction of Pleistocene megafauna | 13,000 BP -8500 BP | Gradual warming and drying from Pleistocene glacial/pluvial. Montane vegetation persisting until 8500 BP |
| 15,000 BP -12,500 BP | Final resurgence of glaciers and lakes. Tree lines 500 m below present. Valley floors of Great Basin not occupied by lake were mostly dominated by sagebrush and/or, to a lesser extent, juniper. | | |
| 17,000 BP -15,000 BP | Warming and drying, some retreat of glaciers and lakes | | |
| 23,000 BP -17,000 BP | Full advance of glaciers and lacustral systems | | |
| (a) Before Present (BP) | | | |

Historic Environmental Changes. The natural environment of the facility also has undergone changes since Euro-American settlement. The most dramatic have been associated with construction and operation of the test site, causing elimination of natural vegetation and wildlife habitat, and overcovering of soils in the cantonment area, launch areas, roads, and related facilities. Similar impacts resulted from construction of the Union Carbide uranium mill (off-site), which operated from 1958 to 1961 near the town of Green River. In addition, the area of the mill and tailings pile were contaminated with radioactivity. A surrounding area was contaminated by wind blown tailings, and contaminants flowed to the Green River during floods in 1959 and 1968.

Other changes have been associated with grazing. Desert ranges such as this have been used as wintering areas for sheep and have endured heavy grazing impacts during the past 100 years. Due to the proximity of the Green River as a water source, much of the site probably was subjected to heavy grazing. West and Ibrahim (1968) postulated little change due to past heavy grazing in the sparse vegetation or heavy erosion of a similar area near Cisco 55 miles (88.5 km) east. However, Turner (1971) and Lusby (1970) found that grazing caused some changes in species composition and an increase in erosion and sediment yield. Differences in vegetation due to grazing were slight compared to those due to soil differences. Other authors (Stewart et al. 1940, USDA - Soil Conservation Service 1975) indicate that shadscale, mat saltbush, and weedy species such as cheatgrass and Russian thistle increase under heavy grazing in the salt desert, and palatable species, such as winterfat and black sagebrush, decline. Probable changes on-site due to grazing therefore would be reduced abundance of palatable grass or shrub species, and increased abundance of less palatable species and introduced weedy annuals.

Some animal species have been reduced or eliminated from the area. Those important on or near the site may have included pronghorn antelope, bison, and bighorn sheep. Wolf and grizzly bear are other large mammal species which have been eliminated from the region.

2.2 THE CULTURAL ENVIRONMENT

2.2.1 Prehistory

Four stages encompass the prehistory of the GRLC study area. These include Lithic or Paleo-Indian, Archaic, Formative, and Post-Formative Stages. In this study, stage is defined as a level of cultural development.

Lithic or Paleo-Indian Stage. The earliest definable stage to appear in the Great Basin was the Lithic or Paleo-Indian Stage. Willey and Phillips (1958) offered the following description of the Lithic or synonymous Paleo-Indian Stage:

This stage was conceived of as embracing two major categories of stone technology: (1) Unspecialized and largely unformulated core and flake industries, with percussion the dominant and perhaps

only technique employed, and (2) industries exhibiting more advanced "blade" techniques of stone working, with specialized fluted and unfluted lanceolate points the most characteristic artifact types.

The archeology of this stage attempts to answer questions concerning the antiquity of human settlement in the New World and the nature of the adaptations made by the Old World immigrants into a pristine Post-Glacial environment of the New World.

The Paleo-Indian stage is comprised of the Clovis, Folsom, and Plano complexes, and possibly the Pre-Clovis, as well. These complexes have both diagnostic stylistic criteria and chronological implications, since they occur in succession and are well dated. The term complex refers to the variety of tools and other items that comprise the entity under consideration. The term period refers to the time frame occupied by the complex. Consequently, Clovis complex can be used to differentiate among other archeological entities, and Clovis period can be used to place it in time. The terms Llano and Clovis often are used interchangeably, particularly since the diagnostic spear point of the Llano complex is the fluted Clovis point.

Pre-Clovis Period. A number of sites and localities have been excavated and dated prior to the Clovis period. These sites and localities are being subsumed under the general heading of the Pre-Clovis period. The term Pre-Clovis as a unique period was first used by Humphrey and Stanford (1979) in a publication of the Anthropological Society of Washington. Despite the comparatively large number of Pre-Clovis sites located and excavated over the years, none have won universal acceptance for their antiquity. The controversy centers on either the nature of the archeological evidence, the geological contexts, or the dating method used. However, some of these sites are probably genuine.

One site in Utah has been attributed to the Pre-Clovis period. Clark (1975 a&b) has reported on a Pre-Clovis site. It consisted of two small caves and a surface lithic scatter located on a high Bonneville terrace south of Salt Lake City. The terrace, once thought to be 40,000 years old, now is estimated to be 18,000 years old. There is no substantial evidence to prove the surface finds are equal to the date of the supporting geological structure (Clark 1975 a&b).

Clovis Complex (Llano Complex). The Clovis complex is the earliest human culture accepted by all archeologists working in North America. Mammoth kill sites attributed to the Clovis period are known from Arizona, Colorado, Idaho, New Mexico, Oklahoma, and Wyoming. In Utah, isolated finds of Clovis fluted points have been reported from Acord Lake (Tripp 1966), Oak Creek Canyon (Lindsay 1976), and Duchesne (Crouse 1954). Sites attributed to the Clovis complex usually are dated to approximately 11,000 Before Present (BP) (9200 BC).

Folsom Complex. The Folsom complex followed Clovis. Folsom hunters specialized in killing the now extinct longhorn Bison, Bison antiquus. As many as a dozen of these huge creatures were killed at one time during a

typical hunt. Folsom materials have been reported from Silverhorn (Gunnerson 1956), Cederview (Lindsey 1976), Moab (Hunt and Tanner 1960), Green River (Tripp 1967), Sweet Alice Springs, Utah (Sharrock and Keane 1962) and from the Dugway Proving Ground (Schmidt, Karl LT., Catalogue #386226, Smithsonian Collections).

Plano Complex. In general the complex may be subdivided into a number of subcomplexes, each with its own diagnostic characteristics. Plano people as a whole specialized in the hunting of large animals, particularly the now extinct bison, *Bison occidentalis*. The fact that they were able to kill large numbers of these animals, as many as 200 in a single kill, indicates that Plano population density had reached a fairly high level. Specialized butchering areas, i.e. front quarters, hind quarters, etc., found at these mass kill sites are indicative of a high degree of specialization and social complexity.

Plano materials have been recovered in the La Sal Mountains of Utah (Hunt 1953). However, according to Schroedl (1977:1), ". . . there is no well-controlled archeological evidence on the Colorado Plateau prior to about 8300 BP (6350 BC), i.e., there are no sealed cultural deposits in association with extinct fauna or with chronologically distinctive artifacts." On the other hand, the sheer quantity of surface finds argues for Paleo-Indian occupation or use of the Colorado Plateau and since archeological interest in the area is fairly recent, Schroedl's appraisal soon may be outdated.

Archaic Stage. The Archaic stage of the Colorado Plateau also is referred to as the Desert Culture or the Desert Archaic Culture. Schroedl (1976: 11) has defined the Archaic Stage of the Colorado Plateau as:

A stage of migratory hunting and gathering cultures following a seasonal pattern of efficient exploitation of a limited number of selected plant and animal species within a number of different ecozones.

The Desert Culture, as an entity, is found throughout the American southwest, Great Basin, northern Mexico, and Colorado Plateau areas (Jennings and Norbeck 1964). In this region, surface water was rare to nonexistent, and vegetation was sparse, resulting in low human carrying capacity and specialized adaptations to arid living.

The Great Basin or desert cultural patterns are best known from numerous stratified dry cave sites (Danger Cave and Hogup Cave in Utah, Ventana Cave in Arizona, Lovelock Shelters and Leonard Shelter in Nevada) while the Colorado Plateau is known from such Utah sites as Cowboy Cave, Sudden Shelter, Joes Valley Alcove, Thorn Cave, and Deluge Shelter. The latter sites provide valuable information on the nature of the upland adaptations of the Desert Culture.

These shelters have preserved an extensive, yet perishable, artifact inventory featuring a wide variety of implements made from wood, bark, and fiber. Items such as baskets, netting, matting, and sandals were present in these shelters. The prime characteristic of the Desert Culture was the

seasonal movement of its people to exploit ephemeral food resources. Archeologically, Steward's (1970) model of seasonal exploitation has been tested in the Reese Valley of Nevada by Thomas (1973), and in the Piceance Basin of northwestern Colorado by Grady (1980). In the Reese Valley, Thomas clearly demonstrated a pattern of riverine zone exploitation, coupled with the use of the distant but complimentary pinyon-juniper vegetation zone. Grady's work in the Piceance Basin also demonstrated a pattern of seasonal resource use. In this case, however, the resources were distributed by marked altitudinal differences, and the major integrating factor between the uplands and lowlands was the annual movement of the Basin's mule deer herd. Both patterns were typical of the Desert Culture.

Analyzing materials from Sudden Shelter, Cowboy Cave, and Joes Valley Alcove, Schroedl (1976) has identified four distinct Archaic phases for the Colorado Plateau, the Black Knoll, Castle Valley, Green River, and Dirty Devil phases. These are defined as follows:

Black Knoll Phase. The Black Knoll phase, earliest of the four phases, dates 8300 to 6200 BP (6300 to 4200 BC). This phase is subdivided into Early Black Knoll and Late Black Knoll. Black Knoll Phase materials are present at Sudden Shelter, Cowboy Cave, and Joes Valley Alcove. A dramatic population increase occurred in 7200 BP (5200 BC); Schroedl (1976) also notes a marked difference between the contents of high and low elevation sites. High elevation sites emphasize the presence of artiodactyls and low elevation sites emphasize vegetation, indicating either a high degree of regional specialization among the population, or a system of annual seasonal rounds.

Castle Valley Phase. This phase dates 6200 to 4500 BP (4200 to 2500 BC), and is divided into an Early and Late phase. Between 6200 and 5000 BP (4200 and 3000 BC), there was either a clear decrease in population or intensity of occupation. Population increased after 5000 BP (3000 BC), but did not reach earlier levels. This increase continued to ca. 4500 BP (2500 BC), then declined. Schroedl (1976:64) also notes a decrease in annual precipitation in this phase.

Green River Phase. This phase dates 4500 to 3300 BP (2500 to 1300 BC). According to Schroedl (1976: 66-68), Gypsum and San Rafael projectile points dominate in the high plateau section. The presence of Duncan, Hanna, and McKean points in Level 12 (stratigraphic level) at Deluge Shelter attest to a Plains influence in the northeastern portion of the Colorado Plateau. However, the full nature and extent of Plains influence in the Green River phase currently is not known.

Dirty Devil Phase. This phase dates 2300 to 1500 BP (1300 BC to AD 500) and is considered to be the most tenuous of the four phases because of a "break" in the radiocarbon dates between 3000 and 2000 BP (1000 BC and AD 0.). The introduction of the bow and arrow (Rose Spring and East Gate points) arbitrarily marks the end of this phase.

The Formative Stage. Willey and Phillips (1958) defined the Formative stage as being marked by: ". . . the presence of agriculture or any other subsistence economy of comparable effectiveness and by the successful integration of such an economy into well established sedentary village life."

The cultural entity normally equated with the Formative stage in Utah is called the Fremont Culture. In general, the Fremont Culture is characterized by the cultivation of maize, a sedentary or semi-sedentary lifestyle, the presence of pithouses and masonry dwellings, a distinctive rock art style, and the presence of a variety of ceramic graywares. Despite the homogeneity implied by this definition and by the term "Fremont Culture," it has long been recognized that Fremont is a theme with many variations. In 1970, John Marwitt published his seminal work on Median Village in which he developed a detailed schema on Fremont regional variations. Although criticized, it remains the commonly accepted schema (cf. Madsen 1980).

Marwitt discussed five regional variants, but only the San Rafael variant has any significance in the GRLC study area (Figure 2-1). Marwitt's (1970) San Rafael variant is quoted as follows:

San Rafael Fremont

Dating: 700 to 1200 AD

Named for: The San Rafael Swell, a prominent geologic feature located roughly in the center of the area.

Excavated sites: Turner-Look (Wormington, 1955); the Fremont River sites (Morss 1931); Nine Mile Canyon (Gillin 1938); other sites, including Emery, have been tested (see Gunnerson 1957, 1969).

Diagnostic Attributes:

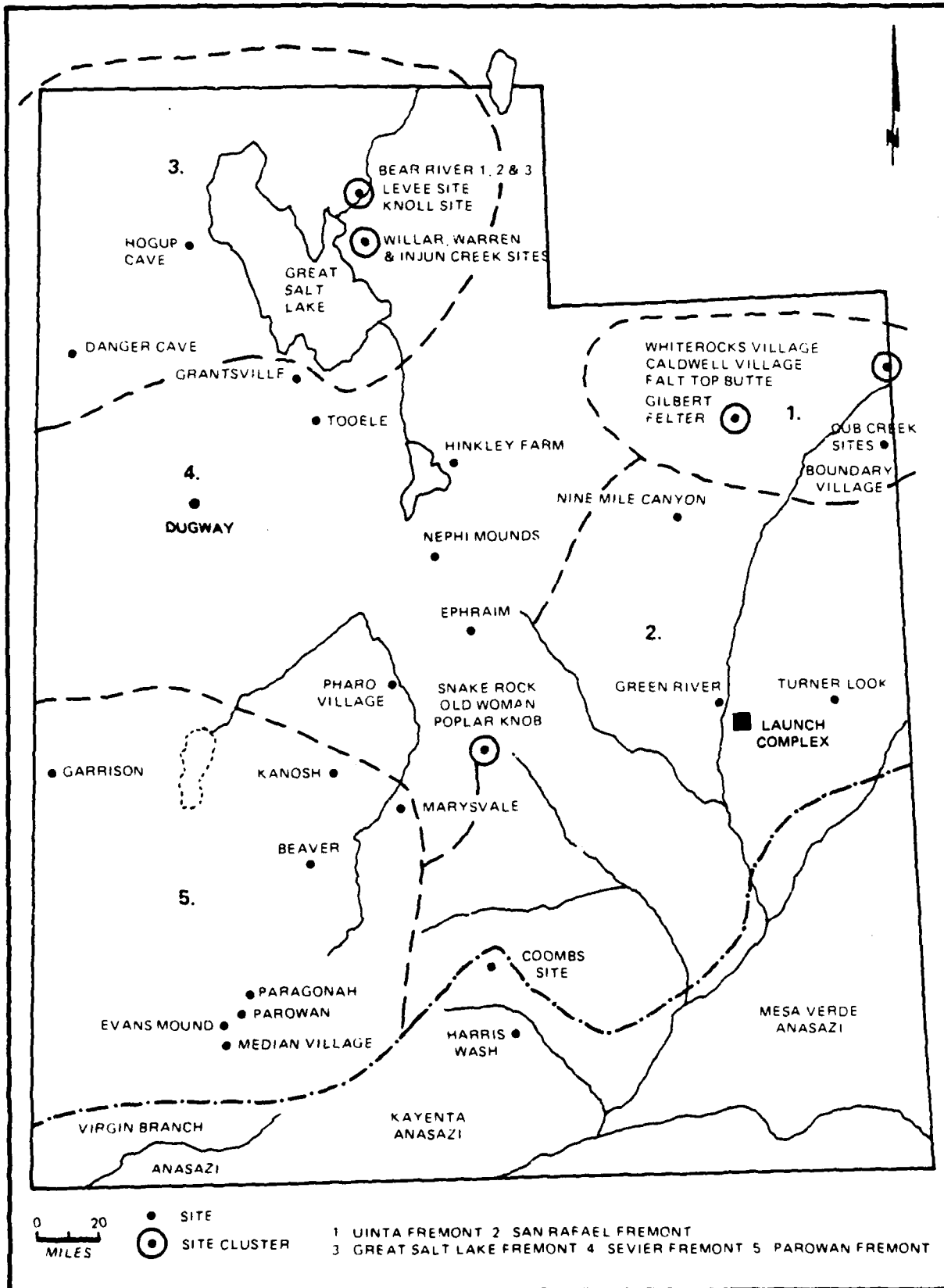
Domestic Architecture. Wetlaid and drylaid masonry, slab-lined pit structures.

Ceramics. Emery Gray pottery is the dominant type. Surface manipulation, including pinched, punched, incised, appliqued, and corrugated varieties of the basic grayware are common; painted pottery is present but may not have been locally made; Anasazi (Mesa Verde and Kayenta) trade pottery is relatively more common than in any other variant.

Projectile points exhibit a wide range of variation, and no firm diagnostic types can be distinguished. Serrated scrapers are common but their diagnostic value is uncertain; side and end scrapers are rare in contrast to other variants.

Presently, no other diagnostics can be distinguished.

The Post-Formative Stage. The Post-Formative Stage which followed the Fremont in Utah is characterized by the appearance and spread of Numic speaking peoples throughout the Great Basin and Colorado Plateau. Numic



(MARWITT 1970 137)

Figure 2-1. FREMONT REGIONAL VARIATION

refers to a branch of the Uto-Aztecan linguistic family which, ethnographically, is composed of the various Shoshone groups such as the Western Shoshone, Ute, and Southern Paiute. These Numic speaking peoples occupied the area from ca. 1200 AD until their displacement by Anglos during the middle of the nineteenth century. Their existence is marked archeologically by the presence of Desert side-notched points, Shoshone pottery and, where preservation was particularly good, the presence of a distinctive basketry style (Adovasio 1980).

The Numic speakers' homeland was originally in the southwest portion of the Great Basin. Starting ca. 1000 AD, they spread northward and eastward into Utah and onto the Colorado Plateau (Lamb 1958, Miller 1966, Fowler 1972, and Wright 1978). According to Madsen and Berry (1975), they were contemporaries with the preceding Fremont peoples and through resource competition with the Fremont, may have contributed to the Fremont demise. According to Stuart (1981), early Numic occupation was restricted to the lake edges and was followed later by a shift to the adjacent upland areas.

Based on the ethnographic record, particularly that of Steward (1970), the Numic speakers of the area followed an annual round of economic activities in which they shifted from the exploitation of a given resource to another resource on a seasonal basis. During the course of the annual round, group size varied from nuclear families (a self-supporting economic unit) to fairly large groups. There also was a concomitant shift in tool inventories and political structures, as well. The technology, social organization, and ideology of the pertinent Numic speaking groups in the study area are contained in Section 2.2.2.

2.2.2 Utah Ute Ethnography

The Ute Indians' aboriginal territory included the eastern half of Utah and central and western Colorado (Stewart 1966:207). The Ute aboriginal tribal area included the GRLC (Figure 2-2). Material culture, settlement and subsistence patterns, lifeways, and non-Indian influence have been examined from historical documents as these pertain to the archeology of the study area and associated Management Plan for the installation. This overview discusses the archeological potential for the time period between prehistoric and Euro-American settlement and influence, and satisfies requirements of the Native American Religious Freedom Act.

The early Ute culture fits Jesse Jennings' (1968:156-157) description of the Desert Culture, which he defined as nomadic people living in small bands exploiting every available food source in a seasonal round. They lived on the verge of starvation, wore little or no clothing, wove rabbit fur blankets, occupied caves or constructed brush shelters, and occasionally hunted large game animals and small game, with the jack rabbit the most plentiful food source (Stewart 1966:44). However, the Ute hunted the small herds of buffalo in the vicinity of Green River and the Great Basin before they acquired horses in the late eighteenth century. Figure 2-3 is a pictograph southeast of Green River showing mounted horses and buffalo.

Euro-American Contact. The historic period began in 1598 with the Spanish intrusion into New Mexico. The northward thrust of this empire reached but did not enter the Ute area. Drastic changes in the Ute lifeway

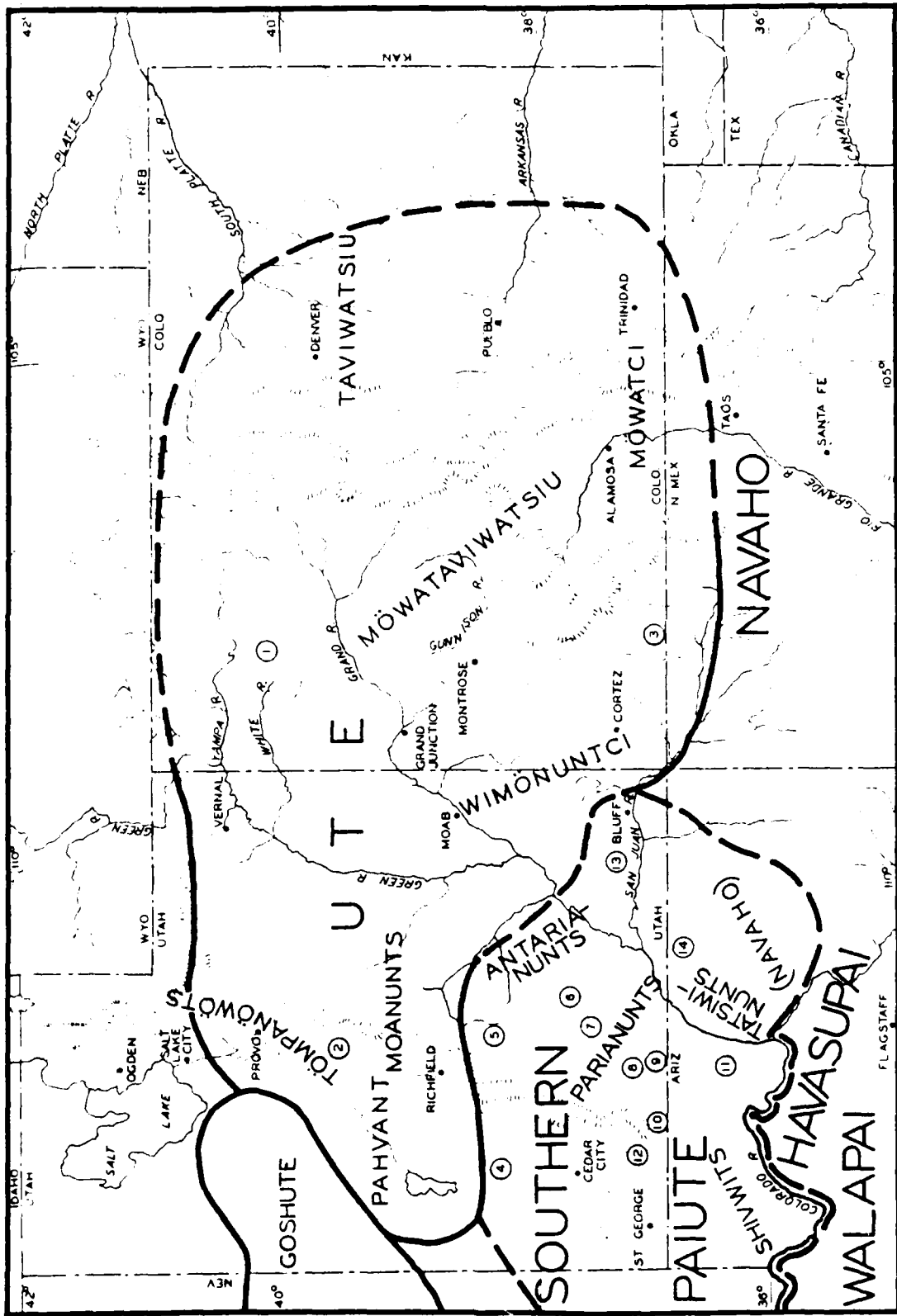


Figure 2-2. BAND DISTRIBUTIONS OF UTE INDIANS

(STEWART 1942:233)



(CASTLETON 1978 169)

Figure 2-3. MOUNTED HORSES WITH BUFFALO PICTOGRAPH
SOUTHEAST OF GREEN RIVER

began as a result of this influence, with the introduction of the horse and metal utensils. Widespread use of the horse by the Utah Utes was characteristic of the eighteenth and nineteenth centuries. The horse not only increased their range for hunting but also increased their efficiency for defense. Even with the acquisition of the horse, the basic economic pattern of seasonal exploitation of multiple resources did not change.

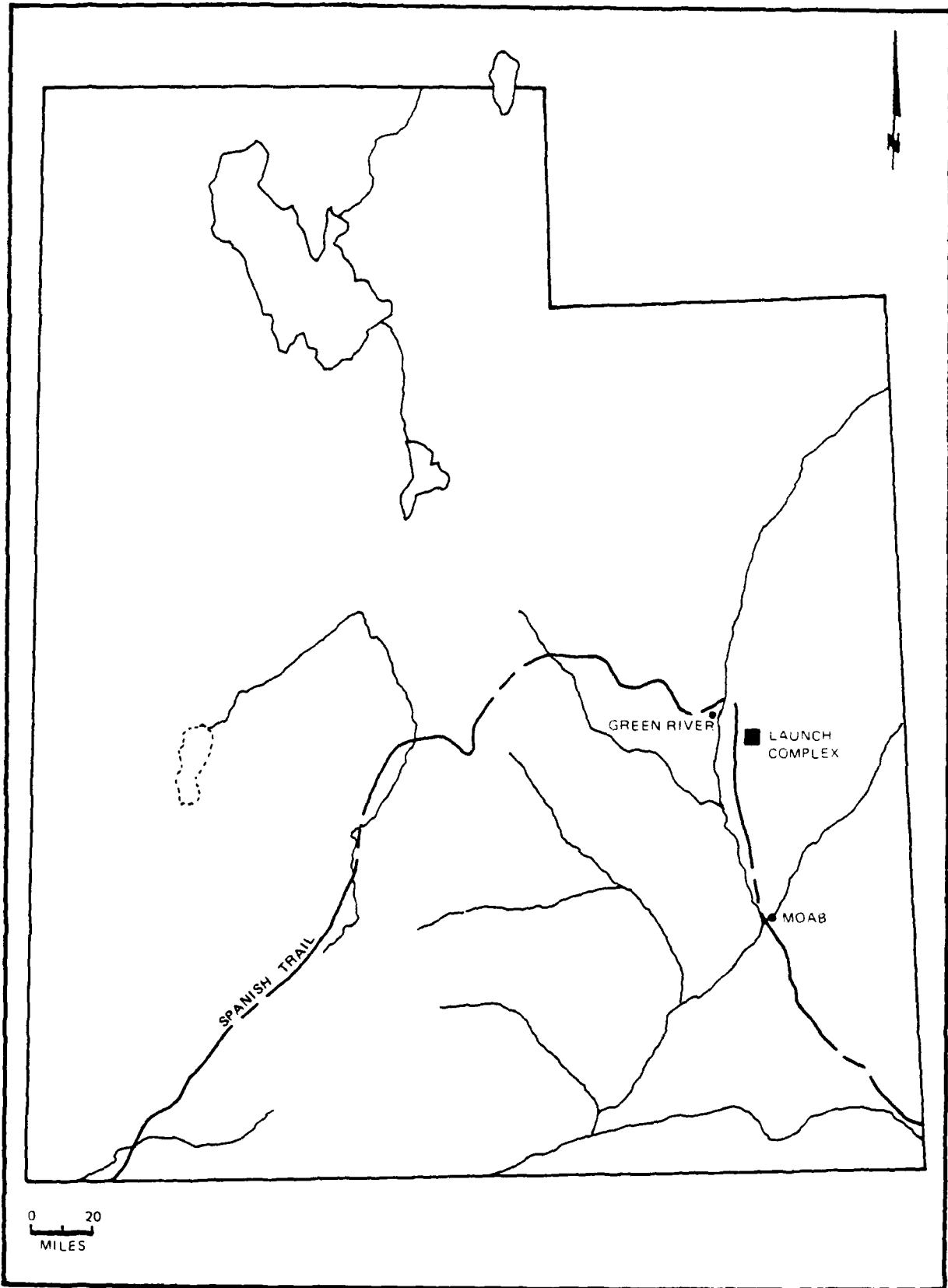
Several accounts in the Spanish Archives in New Mexico, especially those of Friars Escalante and Dominguez, contain descriptions of the Ute prior to white settlement. In 1776, Escalante and Dominguez were chosen to find a route to California from New Mexico. The Utah Ute had no horses at the time Escalante met them. Their culture was hardly distinguishable from the Gosiute and other Shoshoni, called "Digger Indians" by many of the early travelers (Steward 1966:54).

The earliest account of fur trading occurred in the Great Basin in 1813. Opening the Old Spanish Trail caused increased white pressure when whites began encroaching on Ute territory in the early 1830s. The route crossed the territory of the Kapota, Weminuc, Tumpanuwac, and Panvant Ute bands, including the area where the Launch Complex is today. A large number of Anglos crossing the trail were trappers who continued their trade in Ute territory (Figure 2-4). The trappers and traders who entered the Uinta Basin after 1800 had little or no influence on the social and economic structure of the Ute, except they brought firearms into the territory. With the gradual displacement of bows and arrows for guns and iron tools, the Ute were able to hunt more effectively and increase the general standard of living. More importantly, the Utes were able to defend themselves from those who wanted to raid them for horses or hunt in their territory (Lang 1953:56). Once the fur trade became important, Antoine Robidoux established Ft. Uinta in 1837 near the present town of Whiterocks, Utah, in the northern Uinta Basin.

In 1836, Wakara (known as Chief Walker) a powerful Ute leader, rose to power by stealing horses and imposing a tribute on the caravans traveling the Old Spanish Trail. He also led raids against the Pahvant, Gosiute, and Paiute for women and children to sell as slaves to the Spanish. Horses, tribute, slavery, and fur trading provided temporary economic prosperity to the Ute during this period.

When Mormon settlement began in 1847, difficulties became inevitable. The Indians began to lose their hunting and gathering areas and their horse pastures as the Mormons usurped the best territories for farming and grazing. The Mormons moved south from Salt Lake City to the Sanpete Valley in 1848, expanding their farm lands. In 1849, Fort Utah was established in Provo. With the reduction of their hunting territory and food source, the Ute retaliated by killing cattle and horses. The Mormon military attacked an Indian campsite near the Fort, pursuing and killing many Indians. Woman and children captives were taken to Salt Lake City and incarcerated by the Anglos (O'Neil 1973:28).

Mormon encroachment on native lands, elimination of the slave trade, and prohibition of taking tribute from immigrants on the Old Spanish Trail led the Indians to resist, resulting in the Walker War of 1853, led by Walker, the Ute war leader. The war continued for nine months, until Walker was forced to sue for peace. In this settlement the questions of slavery and land purchase remained unanswered. This defeat and control exercised by



(CRAMPTON 1979:374)

Figure 2-4. THE OLD SPANISH TRAIL'S LOCATION AT THE LAUNCH COMPLEX

the Mormon leaders made the following years exceedingly difficult for the Ute. The Utah Ute numbers declined. They were forced into use of the inferior land around Mormon farms. At the same time the wild game herds were depleted due to the competition for the same grazing land as domesticated cattle.

The urgency to remove the Indians from the Utah Valley increased after the Walker War. Having determined the Uinta Basin was unsuitable for Mormon use, President Lincoln, by Executive Order in 1861, set aside the Uinta Reservation. Much of the aboriginal land of the Utah Ute became the Uinta Reservation. However, the Utes were not moved to the reservation as a result of this Order. The Spanish Fork Treaty was signed in 1865 by the Walker Utes, several other bands of Utes, the Superintendent of Indian Affairs O.H. Irish, and ex-Indian agent Brigham Young. (Indian agents were appointed by the federal government to serve as the Executive Director of the reservation and to execute federal policy toward the Indians.) The terms of the treaty included removal of the Utes to the Uinta Reservation, and furnishing much needed supplies and food. The treaty also offered payment for the land taken from the Utes. The promise of money, supplies, and equipment was never fulfilled, nor was the treaty ratified by the Senate. Much of this conflict reflected federal attitude toward the Mormon Church after the Civil War. The Utes interpreted the failure of Congress and the President to approve the treaty as an act of treachery and bad faith, creating an atmosphere for further violence (Lang 1953:13).

Federal attempts to enforce the unratified treaty by removal of the Utes led to resistance and the long Blackhawk War. The Indians united under the leadership of Blackhawk to search for food and resist removal. Sporadic violence continued until 1867, when Blackhawk met with Superintendent of Indian Affairs Head and agreed to maintain peace. The Indians subsequently were removed to the Uinta Reservation. Indian agents offered little consistency in reservation management during the 1860s, and with food supplies undelivered and starvation prevalent, many Ute who came to the reservation soon returned to Central Utah. Conditions on the reservation did not improve until 1871 when J.J. Critchlow was appointed as agent. He did much to improve the Ute standard of living. Within a few years Critchlow found himself with more charges.

The year 1879 proved to be a crucial point in Ute history. Nathan C. Meeker, the Indian agent at the White River Agency, Colorado, and some of his staff were killed by the Colorado Ute. As a result, the White River Utes were forced to the Uinta Reservation as punishment and the Uncompahgre Utes were removed to the Utah Ouray reservation. Once on the reservation, the Ute experienced constant pressure from illegal grazing and mining activities. The Confederated Ute Bands of Colorado and Utah was formed in 1896 to hire attorneys to advise them of their treaty rights.

In 1902, Congress moved to dispossess the Utes. Each Indian was allocated some land. Coal and timber lands were reserved for the tribe, and the rest of the land was open for white homesteading in 1905 (O'Neil 1971:139). By proclamation, President Theodore Roosevelt set aside 1,010,000 acres of the reservation for a forest reserve, 2100 acres (850 hectares) as a townsite, 1,004,285 acres (406,434 hectares) for homesteading, 2140 acres (866 hectares) for mine claims, and 60,160 acres (24,347 hectares) for reclamation projects, with only 282,460 acres

(114,312 hectares) left as tribal land (O'Neil 1971:140) (Figures 2-5 and 2-6). After the land allocations, the Confederated Utes won a long legal battle over land claims in Colorado and Utah (Stewart 1966:59-60). In 1950, the Ute were awarded \$32 million for payment of the lands they agreed to give up in the unratified treaty of 1865. The U.S. Indian Claims Commission further ruled the government was liable for lands under the Executive Order of 1861.

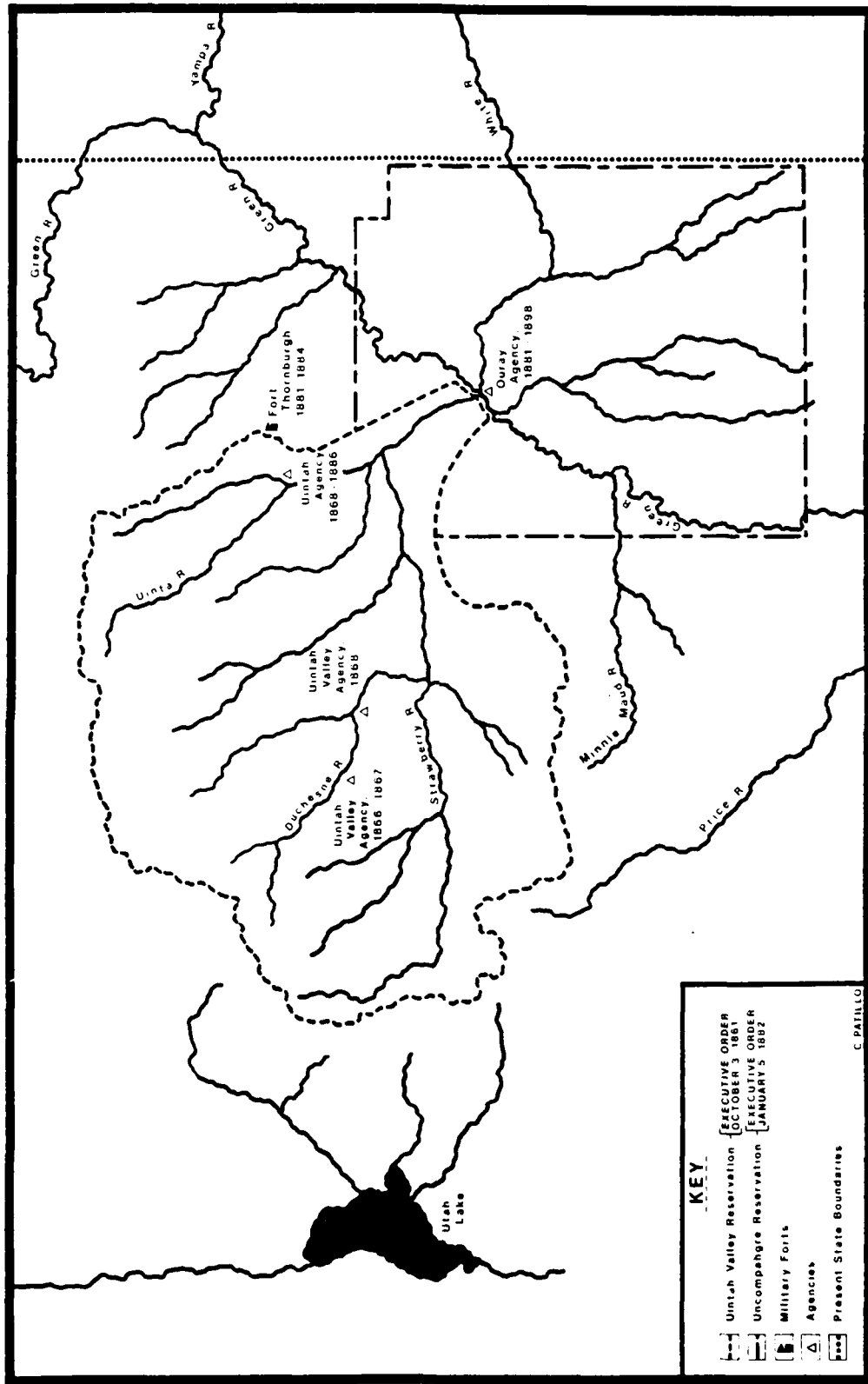
All records concur that the Ute roamed and hunted on or near the Launch Complex in the years prior to 1870.

Aboriginal-Historical Culture. Omar C. Stewart and Julian Steward visited all the Great Basin groups. Stewart produced "Culture Element Distributions: XVIII, Ute-Southern Paiute" under the direction of A.L. Kroeber (Stewart 1942). Julian Steward (1970) extensively studied the Great Basin socio-political organizations and adaptive strategies. Perhaps the most exhaustive ethnography was completed by Anne M. Cooke Smith (1974) who did her field work on the Uinta-Ouray reservation in 1936 and 1937. Her work is the basis for most of the following information on Ute lifestyle and material culture.

The Utes belong linguistically to the Shoshonean or Numic branch of the Uto-Aztecan family and are related to the Paiutes and Shoshoni of the Great Basin. However, Stewart (1966:42) states that Ute folklore has no migration myths; their tales of creation of the world strongly suggest they always have lived in their present location. Archeological investigations, primarily at Danger and Hogup Cave in the Great Basin and Cowboy Cave on the Colorado Plateau, revealed continuous occupation from 10,000 years. Stewart (1966:42) suggests these first occupants could have spoken a proto-Uto-Aztecan language and could have been the ancestors of the modern Ute. The cultural manifestations at these sites appear similar to the descriptions of the early historical accounts of hunting and gathering Ute and Gosiute who still live in the area. However, according to Smith (1974:14), linguistic evidence supports the hypothesis that movement of Numic speaking peoples into the Great Basin is comparatively recent.

Material Culture. From early accounts, brush shelters or wickiups, were used by all Utes. These varied in size due to the permanency of the shelter. A winter house could sleep 10 to 12 people (Figure 2-7). Hide tepees, used after acquisition of the horse, were made from elk more frequently than buffalo. A summer shade was constructed and most daily activities occurred under it (Smith 1974:35-42). All northern Utes used a sweat lodge. Standing wickiups, tepee rings, and sweat lodge structures have been identified in Utah and Colorado and are attributed to the Ute.

The Utah Ute used bow and arrow, clubs, and throwing sticks to hunt virtually every animal available. Rabbits were the most plentiful game animal and were a dependable food source. Rabbit nets were used in communal rabbit drives (Smith 1974:57). These were family-owned and manufactured from wild flax, 3 to 4 ft. (0.9 to 1.2 m) high. Quantities of nets of fiber cordage, have been found at Hogup and other caves in Utah (Aikens 1970b:189). Bear were killed occasionally. Buffalo were hunted in Utah prior to extinction in 1830. Castleton photographed a petroglyph in Thompson Wash depicting mounted figures on horses shooting buffalo, undoubtedly Ute



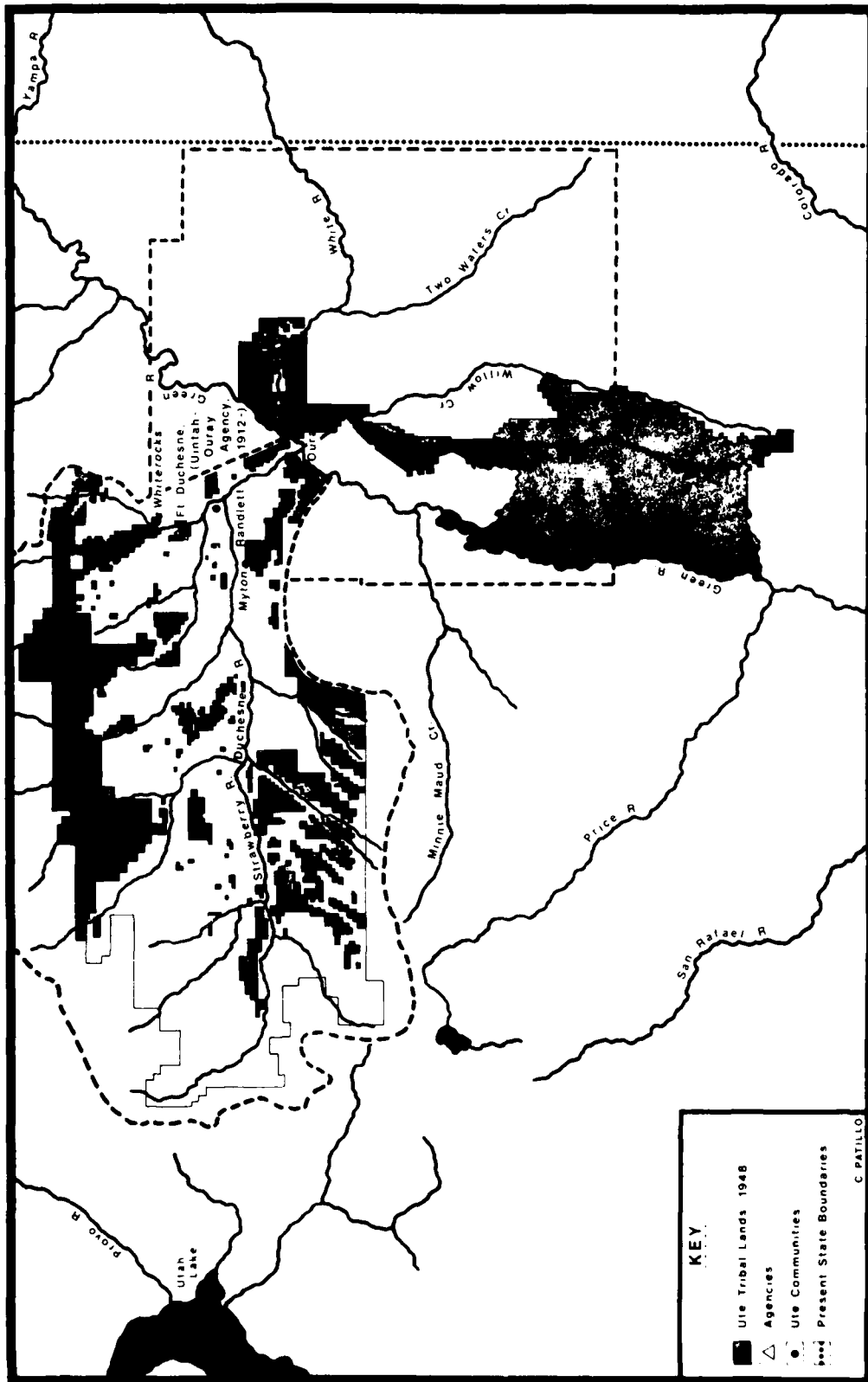
KEY

- Utah Valley Reservation [EXECUTIVE ORDER OCTOBER 3 1861]
- Uncompahgre Reservation [EXECUTIVE ORDER JANUARY 5 1892]
- Military Forts [Square symbol]
- Agencies [Triangle symbol]
- Present State Boundaries [Dotted line]

C. PATILLO

(CONETAH 1982.53)

Figure 2-5. UTAH UTE RESERVATIONS, 1861 - 1898



(CONETAH 1982 142)

Figure 2-6. CURRENT BOUNDARY OF
UINTAH AND OURAY RESERVATION



(SMITH 1974:PLATE 21)

Figure 2-7. BRUSH SHELTER

(Figure 2-3). Buffalo were hunted in the vicinity of Green River before the Ute acquired the horse (Stewart 1966:49). Antelope were hunted communally with a leader selected for his hunting ability. The animals generally were surrounded and driven over a cliff.

Eagles, prized for their feathers, were captured by the pit method. Holes were dug and covered with willows, with a piece of meat on top. The hunter reached through a hole to grab the eagle's feet. Pits of this type have been identified by archeologists in Colorado and on the northern plains. Fish, an important source of food for the Utah Ute, were shot with unfeathered arrows, caught with woven dips, weirs, and woven basket traps.

The Utah Ute drove grasshoppers and Mormon crickets (a grasshopper like insect) into grass-lined pits which were then ignited. The parched insects were ground on metates and the paste stored. Grasshopper and cricket legs and wings have been recovered from coprolites at Danger Cave, suggesting that these insects have been used as a food source in Utah for centuries (Jennings 1978:85).

Roots were dug with a pointed digging stick and baked in a stone-lined earthen oven. Berries, seeds, and nuts of all varieties were collected on a seasonal basis. Pine nuts were a major food source. They were ground with a mano and metate and stored in hide bags. Greens and inner bark of pine were also important staples in the Ute diet. Three different types of caches for food were used: 1) holes in cliff overhangs, pits lined with bark, and sacks made out of rawhide or woven sage brush lined with grass and stored in pits; 2) platforms of sticks constructed in pine trees with thick foliage for protection from the elements; and 3) temporary storage platforms constructed outside of shelters to protect food from animals.

The Utah Utes wore rabbit skin robes; other available fur also was used. In 1776 Escalante described Utes wrapped in fur blankets made of rabbit and horse. Woven rabbit fur blankets and milkweed fiber nets have been excavated in caves in Utah and Nevada (Stewart 1966:44). Women wore skirts and shirts woven from sagebrush bark. Leggings and sandals were made of twined sagebrush bark and yucca fiber. After acquisition of the horse, skin clothing was made from antelope more frequently than buffalo, and was undecorated. Men wore buckskin breech clouts. Buckskins tanned by Ute women were exceptionally well done and were frequently used as trade items with other tribes and the Spanish of New Mexico. Eagle claw and bear claw necklaces were worn by men.

Both men and women used face paint. The earliest users of uranium ore in Utah were the Indians who used it for paint (Notarianni, 1982:9). Children were tattooed with cactus thorns.

Early documents reported that all Utes made brownware pottery (Smith 1974:84). Temper was of vegetal material; the pot was manufactured by coiling (Smith 1974:85). Potters made conical bottom pots for cooking, water jugs, mugs, and children's toys. Utes also collected pottery from Pueblo ruins or obtained pottery by trade.

All northern Ute bands made and used a variety of paint decorated baskets. However, the lack of game animals restricted the use of hide containers. Conical burden baskets, twined seed gathering baskets, coiled basket water jugs covered with pitch on the inside, and berry baskets were manufactured. Squawbrush was the preferred material; it was most pliable when gathered in the spring.

Wooden utensils, including cups, ladles, bowls, and platters were made. Mountain sheep horns were used for cups and ladles. Rawhide parfleches were used for food and clothing storage containers. Wood constructed cradle boards were covered with rawhide and buffalo hide and decorated differently for each sex.

Musical instruments included the notched rasp or marache used in ceremonial dances. Flutes were used only in courtships by young men and were constructed from hollowed out sticks. The double-headed drum, adopted from the Wind River Shoshoni, was incorporated into the Ute culture (Smith 1974:106).

Weaponary of the Utes consisted of the mountain sheep horn bow, later replaced by a single-curved wooden bow made of juniper, chokecherry or service berry. Double curved sinew backed bows also were made. Arrow straighteners were made of stone, bone, or horn. Arrow points made by the hunters were from 3/4 to 3 in. (2 to 7.5 cm) in length. Smith (1974:111) states that old arrow points discovered by the Ute were picked up, resharpened, and reutilized, making it difficult to assign appropriate cultural affiliation to Ute archeological sites. Buffalo hide shields and war clubs were used by the northern Ute.

Socio-Political Organization. The family group was the most important socio-political unit in the Uinta Basin. Up to 10 households would forage together. There were no recognized territories or boundaries defined for the Ute groups. However, loosely organized bands tended to stay in an area with which they were familiar and where they could use the resources most effectively. There was no organized band leadership; leadership only occurred when an older man was chosen for qualities of best judgement in deciding when and where to move, for horse stealing and slave raids, and leadership in war. The need for leadership only became important during white contact when there was increased pressure from whites to deal with a spokesman.

Marriage patterns were described as a tenuous, temporary bond; divorce was easy. The choice of marriage partners was limited; a man could not marry any female blood relative (Lang 1953:9). All cousins, both cross and parallel, were equated. Marriage to either was tabooed. Polygyny was common.

Because survival was a serious matter, their religion emphasized health, long life, and economic skills. The Shaman (a supernatural, culturally defined religious leader) had power for curing illness, controlling weather, or leading successful communal animal drives and was an important person in the society.

There were isolation ceremonies at birth and at female first menses. Boys were not allowed to eat their first kill, to prevent misfortune in future hunts. Berdache, men who chose not to participate in male activities and wore female attire, were not welcomed by the family. However, they were not ostracized and were allowed to do female activities. Burial was in rock crevices; possessions of the dead were burned and their horses often killed. Relatives cut off their hair during mourning.

Two dance ceremonies are held during the year. The Sun Dance, introduced in 1890, is held in July and is important socially and religiously to the Ute people. Curing powers obtained during the ceremony are acquired

by dreaming of animals or birds who taught the dreamer to use individualistic paraphernalia or rituals. Peyote buttons were used in the ceremony for their curing powers. "The Sun Dance, with its communication with the Creator, helped to give back to the Ute people a source of renewed self esteem" (Conetah 1982:5). The Bear Dance, held in the spring, lasts from four to 10 days. The focus, according to Conetah (1982:3), has changed from hope of good hunting to concern for the well being of the people.

2.2.3 History

The region's natural isolation and harsh environment caused Green River to be one of the last parts of Utah to be settled. The history of Green River exhibits many of the elements popularly associated with America's frontier history, cowboys, outlaws, pioneer farmers, rural railroad companies, and eventually, prospectors and miners. While these people appeared during the late nineteenth century, Green River's history can be traced for nearly 100 years before the Mormons first entered Utah in 1847.

The government of New Spain encouraged individuals to undertake exploration into Colorado and finally as far as southeastern Utah during the eighteenth century. Trade with Utes increased Spanish knowledge of their empire, both through native stories of the lands and reports from Spanish traders venturing into Ute homelands with goods. By the 1760s, the modern Grand Junction, Colorado, area had been visited by traders from Sante Fe (Goetzmann 1966:38-40, 68-77). One of the most famous Spanish North American explorations took place during the next decade when Dominguez and Escalante undertook their trip through present-day Colorado and Utah in 1776. While the party did not visit Green River, they did survey much of the surrounding region and their reports did little to encourage further Spanish or Mexican settlement of the Colorado Plateau (Goetzmann 1966:68-77, Bolton 1950).

Although Spanish officials found only discouragement in the Dominguez-Escalante reports, traders continued to visit the Colorado Plateau into the 1840s and 1850s. As late as 1851, Mexicans penetrated the region searching for trade with the Utes, often trading human beings. The Mormon Church finally suppressed slave trade during the 1850s, effectively ending Hispanic-New Mexican presence in the area until the early twentieth century, when Mexicans were brought to the Colorado Plateau as agricultural laborers (Poll et al. 1978:35-49).

Despite formal U.S. recognition of Spanish claims to the area in the Adams-Onis Treaty of 1819, Anglo-Americans began to make their presence felt on the Colorado Plateau during the 1820s. The Anglos came in search of beaver pelts, gained either through trapping or trading with the local Indians. Strong markets and relaxation of trade restrictions after the Mexican Revolution of 1821 precipitated the rapid spread of the fur frontier into the Rocky Mountains and eastern edges of the Great Basin. However, the rugged terrain and lack of beaver in the Grand Junction-Green River area led to only limited use of the region by mountain men. Among these were William Ashley, who descended the Green River from Wyoming into northern Utah in 1825 after James O. Pattie had followed the canyon rims along the Green River three years earlier. By the 1840s, the period of rapid decline in the fur trade, east-central Utah was known to many but no one recommended it as an area for settlement (Goetzman 1966:76, 135, Frost 1960, Hafen 1954).

The mountain men were replaced in the 1840s by federal explorers in the West. Between 1843 and 1845, John C. Fremont of the U.S. Army Corps of Topographical Engineers, made two explorations of the Rocky Mountain West searching for alternative travel routes for Oregon emigrants. Ten years after Fremont's initial visit, Lt. John W. Gunnison led a party through the region as part of congressionally-sponsored surveys for a transcontinental railroad (Figure 2-8). During the interim, the United States gained title to the region in the Treaty of Guadalupe-Hidalgo, the peace settlement ending the Mexican War in 1848. The Gunnison survey identified the present site of the town of Green River as a good river crossing. The route Gunnison followed roughly parallels the present line of the Denver and Rio Grande Western Railroad through eastern Utah (Goetzmann 1959:65-109, 262-304).

Army activities associated with the Mormon War of 1857 and establishment of a base at Camp Floyd, Utah, led to further exploration of the Colorado Plateau. In 1859, Army officials, discouraged by inadequate supply lines along the Platte River/Overland Trail, sent Captain J.N. MaComb to explore the Green River and Colorado Plateau for possible wagon routes from New Mexico into central Utah (Schubert 1980:37-50).

Although he failed, MaComb's surveys marked the end of early federally-sponsored exploration in the West. After the Civil War, the effort was renewed to catalog the vast resources of the West. Among those who visited the Green River area was John Wesley Powell with his monumental survey of the Colorado River system. Contemporary with Powell were F.V. Hayden and his survey of the territories for the then newly created United States Geological Survey, and Clarence King and his exploration of the Fortieth Parallel from California to the Great Plains.

Several explorations were conducted for the Mormon Church from 1850 to the 1870s. Mormon settlement of the Great Basin, beginning in 1847, and the Church's concept of a proper society, demanded that agricultural lands be found for emigrating converts. When the Mormons explored eastern Utah, they found the Green River area held little promise for their needs because of its arid conditions, isolation from Salt Lake City, and hostile Indians. Because of these factors, Mormon leaders paid little attention to the area until the late nineteenth century, when many non-Mormons began to use the lands for cattle and sheep raising (Stegner 1942:25-31, Poll et al. 1978:371-373).

The Colorado Plateau, seen by many Euro-Americans as fit only for the Ute, began to attract attention from stockmen by the late nineteenth century. The vast expanses of open range led pioneer ranchers into the Green River area by the 1870s. By 1890 and continuing into the early twentieth century, falling cattle prices, depleted forage, and the introduction of Basque sheep herders led to friction and violence between cattlemen and sheepmen. State authorities eventually ended the violence through the courts (Poll et al. 1978:372-384, Drago 1970).

Forage depletion, the introduction of purebred stock, and severe winters all combined during the late 1880s to force cattlemen to raise hay and some grains for feed. Success of early hay crops led others to settle limited acreages along Green River and attempt to raise crops using irrigation. The pioneer farmers depended on themselves and their neighbors for construction of the primitive water systems. These same people also attempted, on a very limited basis, to raise orchard crops after 1882. This was an extension of

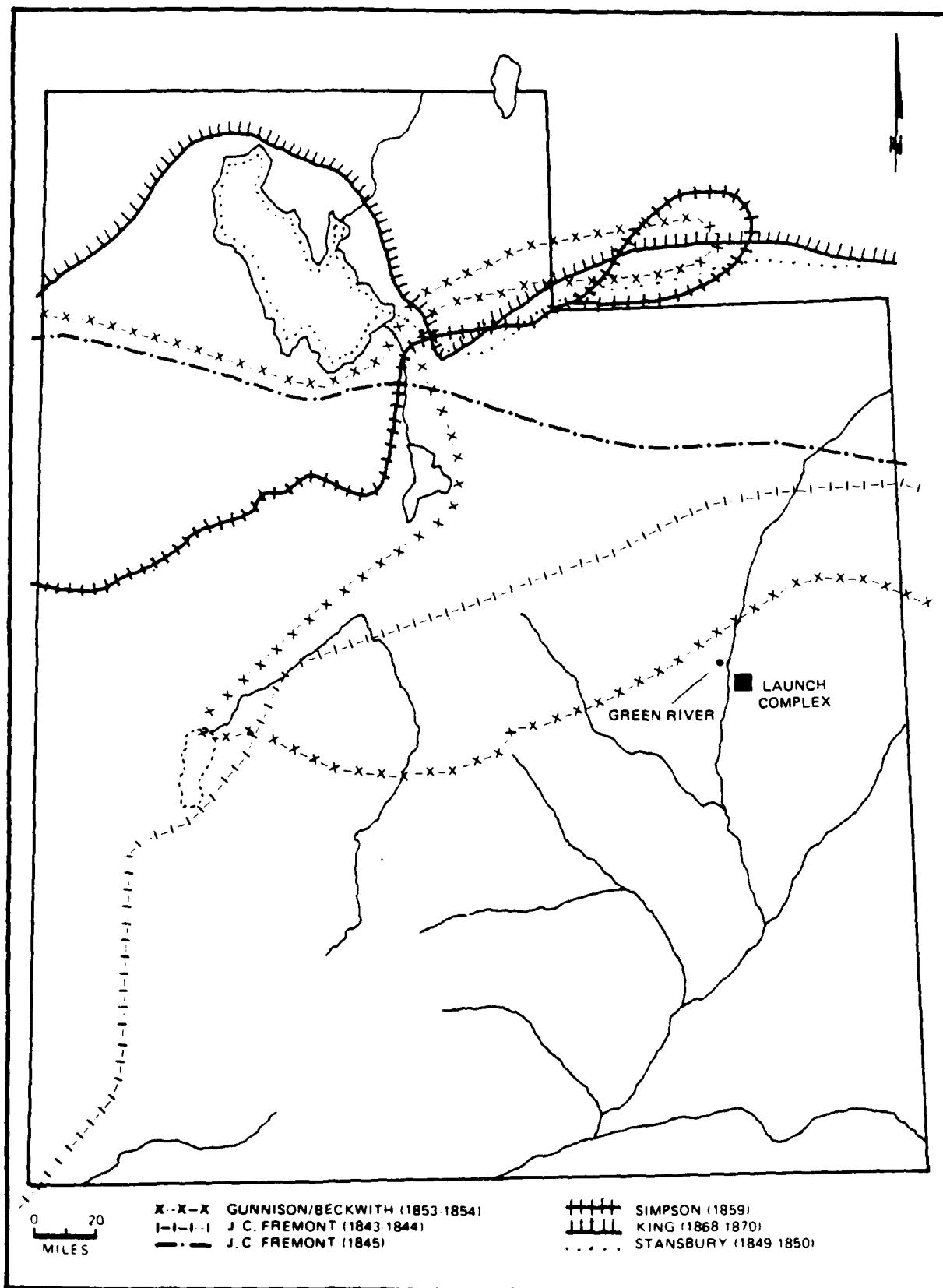


Figure 2-8. MAJOR EXPLORATION OF UTAH

the Grand Junction fruit industry, also in its formative years during the early 1880s. In addition to the lack of tillable soil and a limited water supply, the nearby presence of the Ute Reservation discouraged intensive farm settlement around Green River until the early twentieth century (Poll et al. 1978:373-380, Minority Enterprise Service Associations 1982:4:35-37).

Transportation, the single element that often determined farm settlement patterns in the late nineteenth century, proved not to be a problem for Green River after 1883 and the arrival of the Denver and Rio Grande (D&RG) railroad from Colorado and Salt Lake City. The terrain and the Ute precluded development of major trails through the region; the Old Spanish Trail never carried the same volume of traffic as the other routes. The northern branch was all but abandoned by the 1850s. Stockmen developed some trails for moving herds from one range to another, but these were of limited use since they went from one unsettled area to another.

The D&RG, the late nineteenth and early twentieth century lifeline to Green River, was primarily responsible for the founding and survival of the town. The D&RG was envisioned as a road south from Denver, Colorado, into New Mexico and, if possible, on to Mexico City, Mexico. However, plans changed when the Santa Fe Railway captured Raton Pass, the route south out of Colorado. William J. Palmer, D&RG builder, then turned his attention to the lucrative mining traffic of Colorado's mountains. Once lines were built to the mining camps and the Utes were removed from western Colorado, Palmer and his associates began to look at the possibility of extending their line to Ogden and connecting with the Central Pacific Railroad from California. By 1882, the D&RG Western (later Rio Grande Western), a Utah corporation, began construction of a railroad from Salt Lake City southeast toward the Grand Valley (Chappell 1977:61-70, Athearn 1962:120-123) (Figure 2-9).

News of D&RG plans and knowledge that the most practical rail route to the Grand Valley had to cross the Green River at or near the present city of Green River caused land speculators to form a town at the crossing. In March 1883, railroad construction crews met at a point 13 miles west of Green River and the mainline was completed (Chappell 1977:70-74). Two years later, portions of the track were re-aligned and a new Green River bridge was built (Chappell 1977:78, 92-95).

Rail service opened the area for development and the railroad company actively promoted settlement at Green River. With rail connections, Green River attracted merchants and businessmen looking for a new area to open their shops. Local stockmen chose Green River as the shipping point for their animals. As with cattletowns elsewhere in the West, the money brought into Green River by stockmen was the town's largest local source of income. Finally, the rail company, always searching for new ways to increase revenues, began to promote Green River as a desert oasis and a perfect vacation spot. However, the D&RG's efforts could not overcome the lack of amenities, and tourism remained only a minor industry in the area (Chappell 1977:63-64, Athearn 1962:126-27, 194).

The railroad also attracted outlaws and bandits to Green River. The laissez-faire attitude of local law enforcement officials, and the surrounding area's numerous isolated hideouts and escape routes, encouraged their presence. Among the more famous outlaws to frequent the town were the McCarthy Gang and the Wild Bunch, including Butch Cassidy. Green River served as the Wild Bunch's base of operations for raiding banks and railway

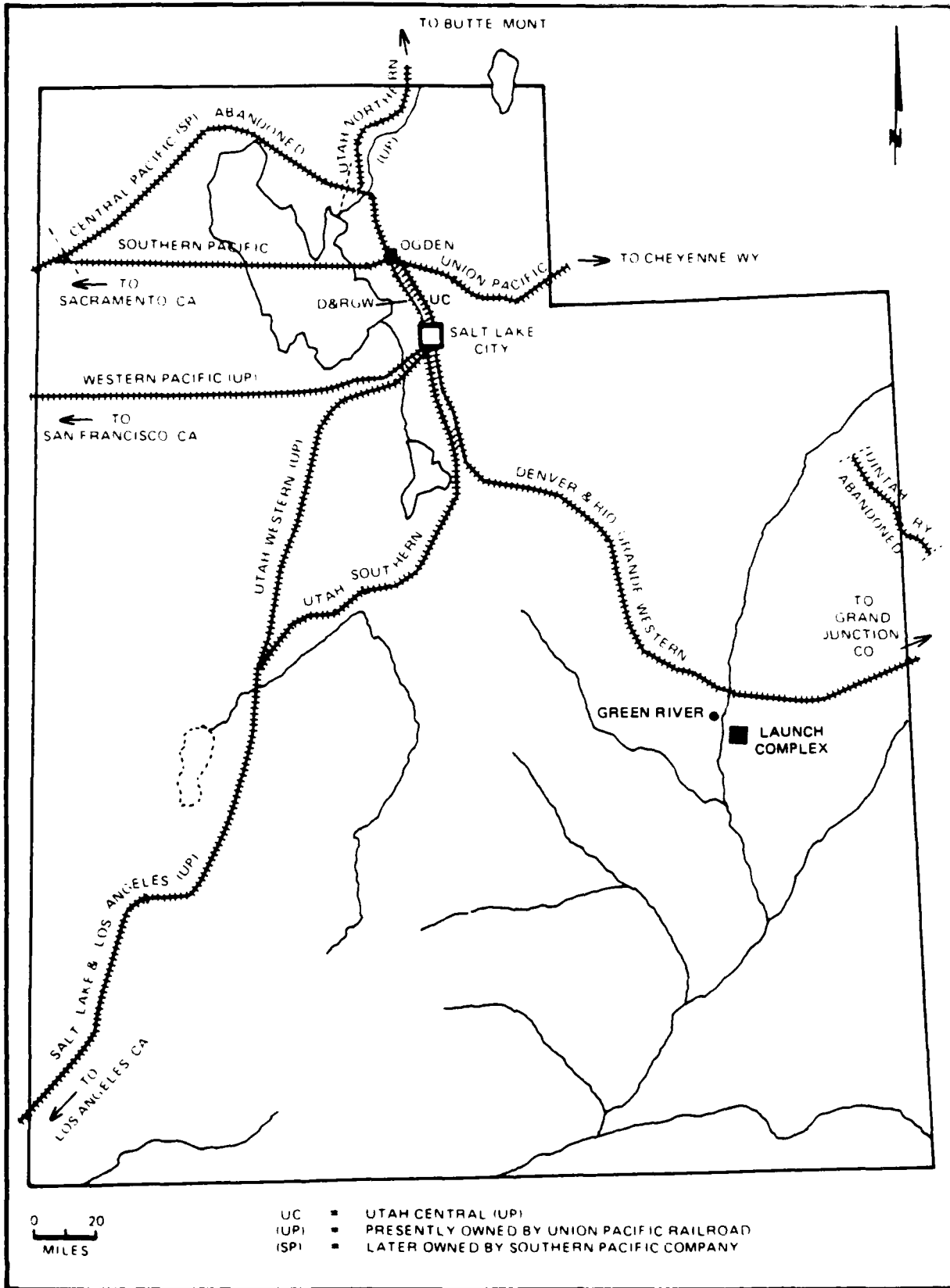


Figure 2-9. MAJOR UTAH RAILROADS

express cars. The gang's first attempted train robbery although unsuccessful, was on the D&RG near Grand Junction, Colorado. The gang remained active into the twentieth century (Chappell 1977:70, 89, Kelly 1959).

Presence of the D&RG led to development of coal mining in Emery County because the "black diamonds" could be marketed profitably in Salt Lake City and elsewhere along the route (Figure 2-10). Railroad management assured coal production by founding the Utah Fuel Company to mine the region's coal beds. The company imported Greeks and other immigrants to work in the mines. Coal made relatively inexpensive fuel available to much of Utah, including Green River. Coal mining remained important into the 1950s when market conditions, especially the adoption of diesel locomotives by western railroads, led to drastic cutbacks in coal demand and production (Minority Enterprise Service Associates, 1982:Vol. 5:7-10; Athearn 1962:193-195).

The search for alternative energy sources began in Grand County during the 1880s and 1890s. Petroleum was the first replacement for coal to be commercially viable in the industrialized United States. Oil, then used primarily for lubricants, gained in importance and demand as industry grew.

By the 1890s, oil prospectors began drilling wells throughout the West. Utah's first oil well drilled was put down on or near the GRLC in 1891. The "dry hole" was financed by Utah traction magnate and later State Governor Simon Bamberger (Lupton 1912, Hansen and Scoville 1955:11). Another well was drilled 44 years later, probably for oil, at what today is known as Crystal Geyser. This well failed, also (Figure 2-11). Finally, in 1948 wells in the Ashley Field of northeastern Utah proved productive and during the period since 1950, much of eastern Utah, including Grand County, has been found to hold commercially viable reserves of oil and natural gas (Hansen and Scoville 1955:39-50).

The other alternative energy source that influenced Green River history was uranium. The radioactive mineral was first noticed in the 1880s and 1890s by gold and silver prospectors on the Colorado Plateau, but received very little attention before the twentieth century. By 1898, the Welsh-Lofftus Company was founded to mine and process the known uranium deposits in Grand and Emery counties. Welsh-Lofftus and other American producers stayed in business until the 1920s, when discoveries of easily processed pitch-blend (a variety of uranium ore) in the Belgian Congo forced market prices down and drove the American companies out of business (Minority Enterprise Service Associates 1982:Vol. 5:9-10).

The nuclear revolution caused by development of the atomic bomb, and Cold War fears for national security, led to a new and more extensive phase of uranium prospecting and development on the Colorado Plateau from the early 1950s to the 1960s. The center of this activity was the Atomic Energy Commission's office in Grand Junction.

Evidence of uranium claiming activity still can be seen on the Launch Complex. At the height of the boom during the early 1950s, as many as 1600 claims a day were being filed in Grand County. During this same period, from the end of World War II into the 1950s, Union Carbide operated a uranium-vanadium processing plant on what is today the cantonment and storage areas of the Launch Complex. The Atomic Energy Commission ended prospecting in 1958 by halting uranium purchases from new suppliers and subsidies for claim development (Husband 1982, Alexander 1966:132, 134).

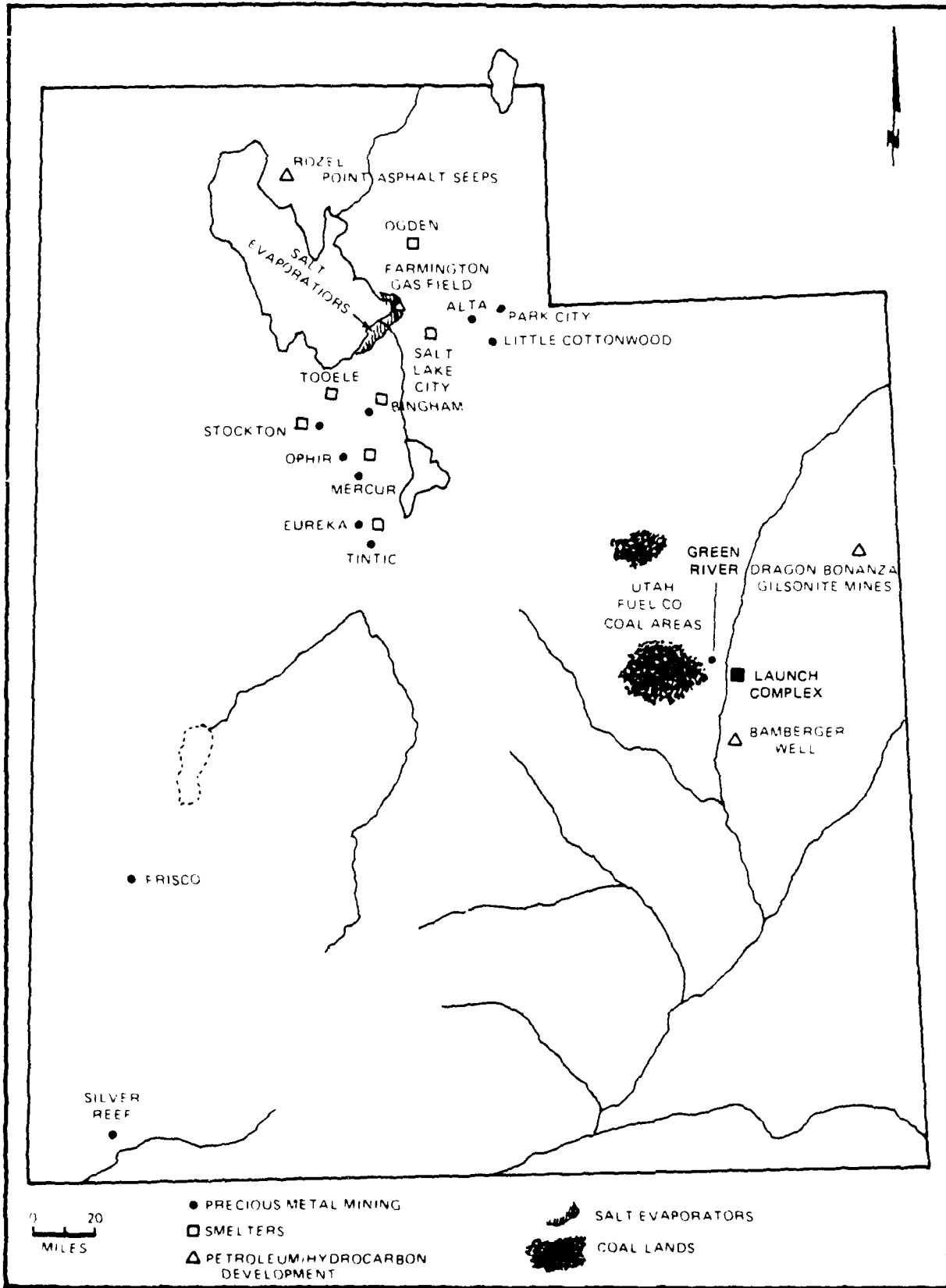
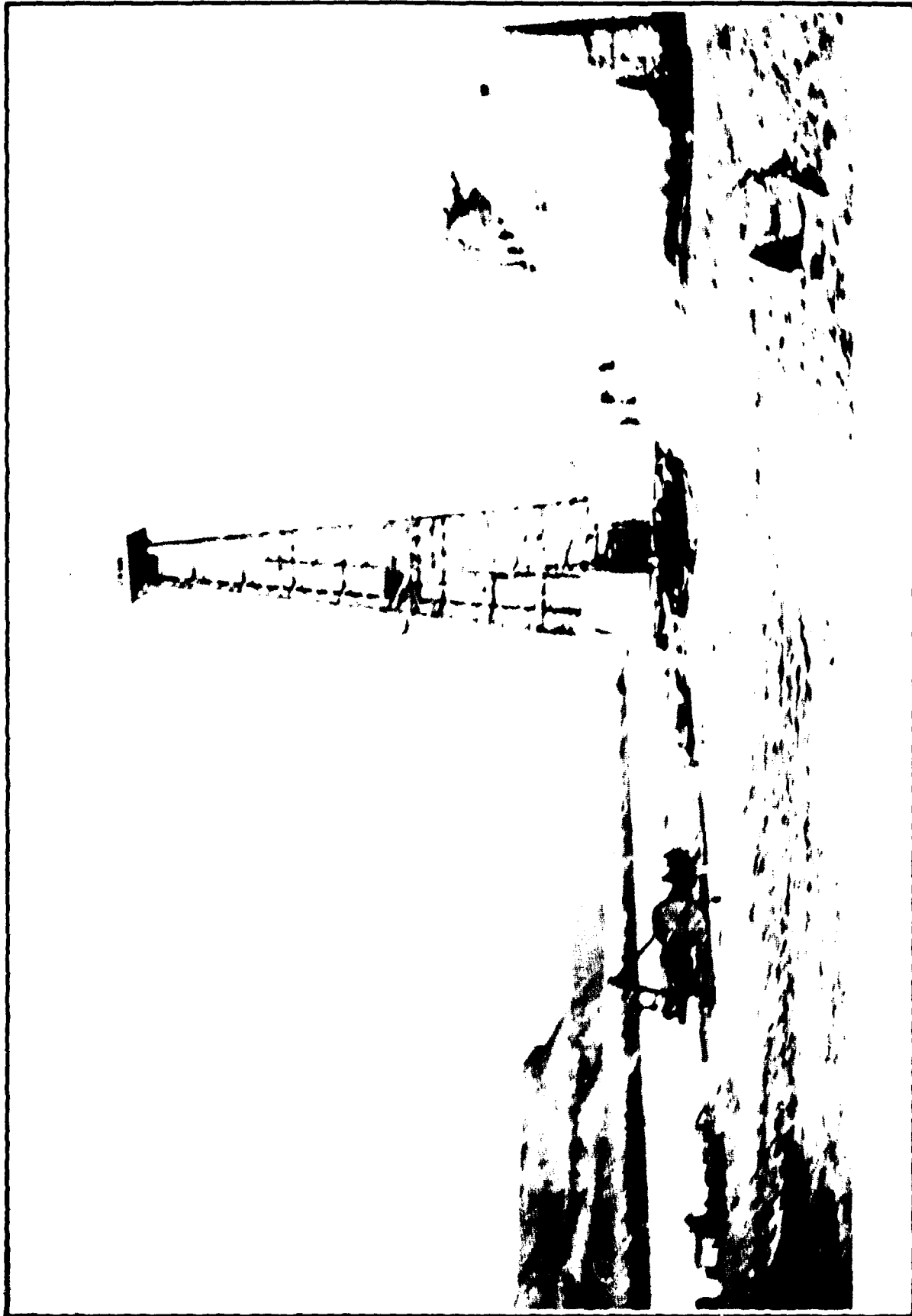


Figure 2-10. 19TH CENTURY UTAH MINERAL DEVELOPMENT
2-31



(PHOTO BY DICK BEDIER)
GREEN RIVER RESIDENT

Figure 2-11. DRILLING OF "OIL" WELL AT
CRYSTAL GEYSER, 1935

The most significant factor in Green River's early twentieth century development was the opening of parts of the Uintah/Ouray Ute Reservation in 1902 to Anglo-American settlement, thereby creating the town of Elgin on the east side of the Green River. This town was established by land speculators who worked closely with irrigation promoters, searching the Colorado Plateau for possible reservoir sites and town locations. Their passage has been marked by dozens of agricultural ghost towns throughout the area. Elgin's history was representative of this promotional phenomena (Figure 2-12).

Elgin's founders felt the area had potential for land speculation because the Ute "menace" was under control, the site had rail service, lands were available for farming, and irrigation water was available from the Green River. Elgin boosters compared the local soils to those found near the orchards of Grand Junction, and by 1917, Elgin had developed into an orchard farming community of about 250 people (Minority Enterprise Service Associates 1982:Vol. 4:36-36, Carr 1972:151-152).

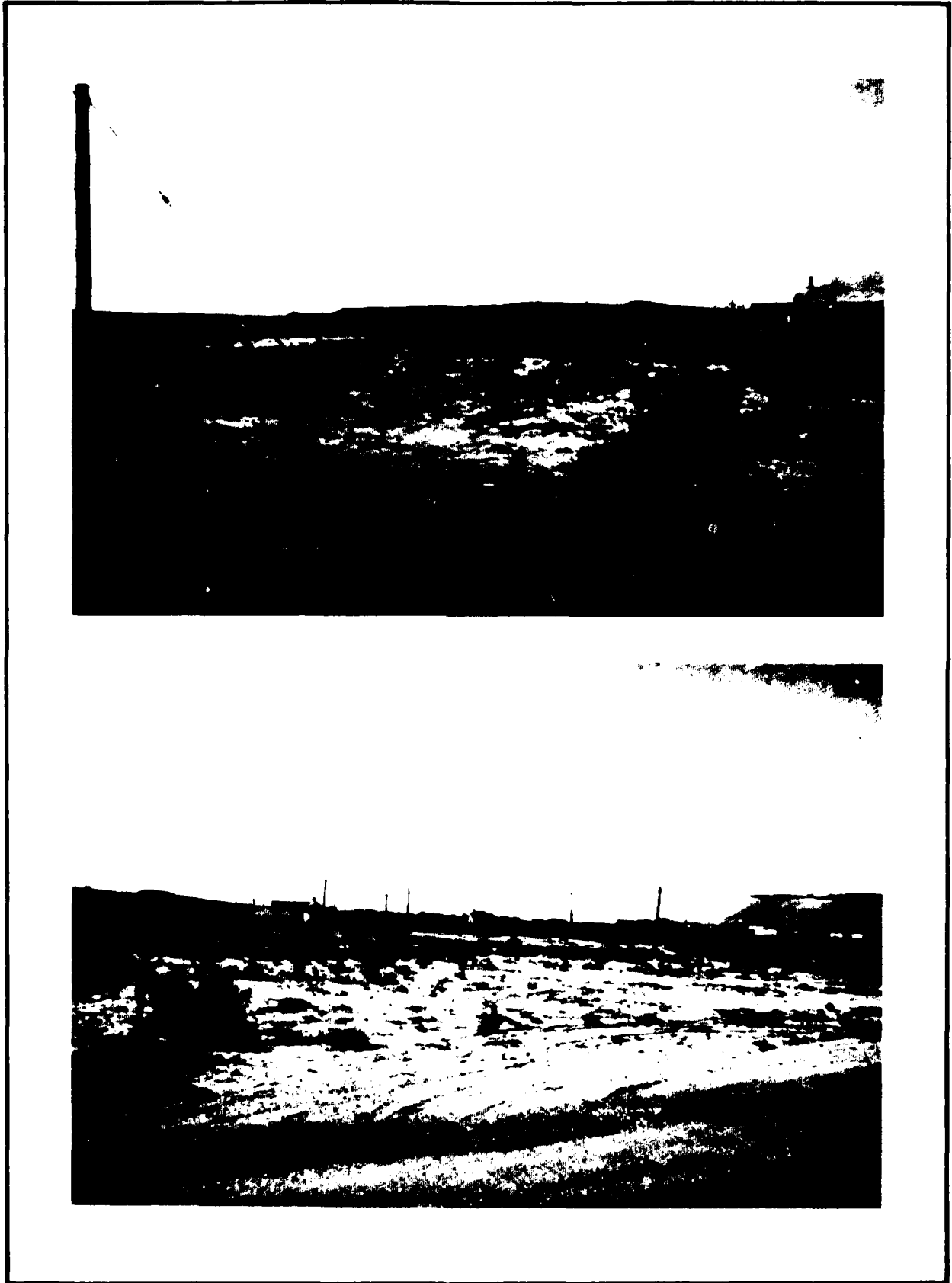
The year 1917 marked the beginning of Elgin's sharp decline. Hard freezes and late spring frosts killed many of the peach trees, and the World War I demand for coal drove prices up for water users because the water pumping plant was coal-fired. The agricultural recession of the 1920s and Great Depression of the 1930s led to the near abandonment of Elgin and the end of farming near the town (Carr 1972:152). The Elgin experience was common to many Colorado Plateau towns.

The community of Green River and the surrounding area continued to serve as a regional trade center for nearby ranchers and farmers. The spread of auto ownership and highway construction did little for Green River until the 1920s, when tourists began to use cars rather than trains for vacation travel. Green River benefitted by offering, in addition to scenery, a chance to see "the Wild West." Also, river rafting grew in popularity, bringing more visitors to the region (Mehls 1982:100-106, 266-270).

The major break from nineteenth century lifeways around Green River was the ever-increasing role of the federal government. The first evidence of this was in the 1920s when the federal government approved the Colorado River Compact, an agreement involving all states in the Colorado River drainage. Leaders of these states, including Utah, recognized the importance of the river system's water to the entire Southwest, fearing that unregulated usage would permanently impair regional growth and prosperity. Officials eventually arrived at an equitable water division in 1929, and their agreement was approved by the federal courts and Congress (Poll et al. 1978:476-478).

The U.S. Department of the Interior was the primary federal agency that altered Green River life during the twentieth century. Establishment of national parks and monuments led to increased tourist traffic through the town. More importantly, the Department controlled nearly all of the land surrounding the town, and its administration of the public domain has had significant impacts on the local ranching economy.

During the late nineteenth and early twentieth centuries, the government made no attempt to control land use. However, in 1934 the U.S. Grazing Service was established within the Department of the Interior and policies were developed to manage and improve the range. Since the range had suffered from over-grazing, the most effective action was to limit the number of animals grazing on a given tract. Similar thinking was adopted by the



PHOTOS BY J. GRADY

Figure 2-12. MODERN ELGIN, UT.

Bureau of Land Management (BLM) when it was created in 1947 by a merger of the General Land Office and Grazing Service. BLM presence today continues to be a major factor in the Green River area (Poll et al. 1978:662-666).

Another federal agency to have a significant impact on the area was the U.S. Army. As the Cold War intensified during the late 1950s and strategists placed heavier reliance on guided missile weapons systems, the Army and Air Force began programs to develop more effective rockets. These efforts received greater emphasis after the Soviet Union successfully orbited unmanned satellites and manned spaceships. John F. Kennedy's election as U.S. President led to increased defense budgets and American entrance into the space race.

Despite funding increases, the Air Force could not afford the expense of numerous test firings of full-sized intercontinental ballistic missiles, and began looking for alternatives. One of the solutions proved to be the use of scaled-down rockets to examine missile re-entry patterns. Project Athena was established to carry out these tests, with the White Sands Missile Range (WSMR) in New Mexico designated as the impact area. In 1961, military planners looked for launch sites and determined that Green River was ideally suited because of available land and the small number of people that would be inconvenienced by the launchings. Land was purchased and transferred from the BLM and Utah State Land Board under special permits, and the base opened in 1963.

As Project Athena ended in 1973, after 141 firings, the base decreased operations. New launch pads were built during the early 1970s for 60 Pershing II tests, which since have been concluded. At that time, all Utah rocket launching functions were consolidated at Green River. Although the supplies and technicians were imported from other areas, which did not add significantly to the local employment base, the test programs benefitted Utah, as rocket parts were built by Utah companies and base supplies were handled through Hill Air Force Base, Utah. Presently, the launch complex is inactive with only caretakers and security personnel stationed there (Alexander 1966, Sexton 1983). A summary of the cultural chronology of the area is contained in Table 2-2.

2.3 ARCHEOLOGICAL RESEARCH DIRECTIONS

2.3.1 Research Concerns

Past work on the Colorado Plateau, including the Green River study area, can be categorized into one of three general approaches. These categorized approaches are arbitrary; work defined under one approach may fit equally well in another.

The first category, individual research, is work that was initiated and completed without being part of a larger or regional program. Work in this category includes Gunnerson (1969), Leach (1966, 1967, and 1970) Wormington (1955), Wormington and Lister (1956), and Buckles (1971). All of these contributions are considered substantial and are essential to an understanding of Colorado Plateau prehistory.

Table 2-2. A SUMMARY OF THE CULTURAL CHRONOLOGY OF THE AREA OF GREEN RIVER LAUNCH COMPLEX

| Cultural Unit | | Date | General Settlement Patterns | General Subsistence Systems | Kinds of Archeological Remains Representative of Period |
|----------------------|--------------------|--------------------|--|---|---|
| Tradition | Period or Phase | | | | |
| American | Post-World War I | AD 1920 to Present | Urbanized areas widely separated, scattered ranches, much public land, limited and sporadic growth. | Ranching, service trades, transportation. Temporary mining, industry, and commerce. | Anglo-American manufactured goods including auto, farm, aircraft parts, seamless and seamed cans, clear glass, machine-made bottles, plastic goods. Milled lumber, concrete, brick. |
| | Post-Railroad Boom | AD 1883 to 1920 | Beginnings of urbanization, scattered ranches, cabins. | Ranching, farming, transportation, commerce and the service trades. | Anglo-American manufactured goods including molded-relief ceramics, colored glass, wire nails, canning jars with rubber seals, iron and steel farm implements, leather goods/harness. Milled lumber, brick, concrete. Railroad parts and tools. |
| | Frontier | AD 1870 to 1883 | Settlement in widely scattered ranches. | Ranching (open range) | Anglo-American manufactured goods, soldered tin cans, ceramics and colored glass, iron and steel implements with mostly wooden parts, leather goods/harness, rough-hewn lumber and stone building materials. |
| Mexican | Fur trade | AD 1760 to 1870 | No permanent settlement, limited-use campsites and shelters. | Trading and trapping | Early English and American manufactured goods, trade articles such as iron implements, Spanish and Anglo leather goods/harness. |
| Post-Formative Stage | Numic-Ute | ? to present | Basic patterns described by Steward (1970). Based on the seasonal collection of wild plants and periodic hunting. A system in which small groups moved from one resource to another as resource availability dictated. | Hunting and gathering | Lithic scatters and ground stone tools. Use of rock shelters and caves. Rock art where suitable surfaces are available. Campsites in Pinyon regions. Game drives and storage pits. Brown wares. Wickiup structures in mountains. |

Table 2-2. A SUMMARY OF THE CULTURAL CHRONOLOGY OF THE AREA OF GREEN RIVER LAUNCH COMPLEX (Continued)

| Cultural Unit | | Date | General Settlement Patterns | General Subsistence Systems | Kinds of Archeological Remains Representative of Period |
|-----------------|------------------------|--|---|---|--|
| Tradition | Period or Phase | | | | |
| Formative Stage | Fremont/ San Rafael | AD 700? to AD 1200? (not well dated) | Small open village sites (ca 12+rooms) on high ridges, knolls, or buttes well above arable lands. | Horticulture, seasonal hunting and gathering. | Small open village sites, caves and rock shelters used for habitation/storage. Rock art panels and flint brush shelters. |
| Archaic Stage | Dirty Devil | AD 500 to 1300 BC | A seasonal round between the uplands and the lowlands. Upland emphasis on hunting, lowland emphasis on gathering. | Despite periodization, the subsistence system is stable. Upland hunting, lowland gathering. | Caves, rock shelters, open sites, lithic scatters, quarries, rock art panels (?). |
| | Green River | 1300 BC to 2500 BC | | | |
| | Castle Valley | 2500 BC to 4200 BC | | | |
| | Black knoll | 4200 BC to 6300 BC | | | |
| Lithic | Paleo-Indian | 10,000 BC to 6300 BC | Not well known in Utah. | Not well known, probably big game hunting and lake edge exploitation. | Only materials found to date are isolated surface finds. |

The second category, cultural resource management studies, includes work of various individuals and firms who have conducted land surveys to meet various federal regulations prior to disturbance for energy development.

The third category is work initiated and completed as part of the University of Utah's on-going inventory process. Although the program was initiated in 1948, research interest has only recently shifted from the Great Basin to the Colorado Plateau.

A series of sites were excavated during the 1970s (Jennings 1980, Jennings et al. 1980), and analysis has shown that the northern Colorado Plateau is an entity in and of itself, not merely a reflection of the Great Basin.

Regional Research Questions. Despite its uniqueness as a region, the Colorado Plateau has certain problems similar to those of the Great Basin, such as the Paleo-Indian occupation of the area. Since the only evidence for this occupation in Utah is surface derived, nothing is known about the settlement patterns, economic activities, or the basic chronology of these people. The earliest cultural assemblages from Cowboy Cave, Sudden Shelter, and Joes Valley Alcove all show well developed archaic assemblages that have no equivalent in the Paleo-Indian stage (Schroedl 1976:54-55). Consequently, the origin of the Archaic stage is unknown and the nature of its ultimate demise remains equally questionable.

The origins of the succeeding Fremont culture also are obscure. It is not known if the horticultural Fremont people had their beginnings in the northern plains (cf. Marwitt 1973) or in the migration of Pueblo II people from the Virgin branch of the Anasazi, ca. 950 AD (Gunnerson 1960, 1969, and Ambler 1969). Aikens (1970 a&b) and Marwitt (1973) believe the Fremont was an outgrowth of the archaic assemblages. Madsen and Berry (1975) believe a "hiatus" occurred between the Archaic stage and the Formative (Fremont) stage, based on evidence from the Hogup Cave. It is not known if this hiatus occurred for all of Utah or just the Great Salt Lake region. The demise of the Fremont has yet to be resolved, as it is not known whether they gave up horticulture and became "Numic" or whether Numic speakers replaced the Fremont.

2.3.2 Installation-Specific Archeological Research Directions

An area as small as the GRLC cannot answer all of these questions. However, the presence of Archaic sites nearby supports the potential for archaic materials being found on the complex. Of even greater potential is the presence of an unreported prehistoric quarry. Trace element analysis (through neutron activation and mass spectrometry) of materials in this quarry and of materials from the Plateau could provide much data and many insights into the prehistoric trade patterns of the region.

2.3.3 Regional Historic Archeological Research Directions

Much is known about the general history of the Green River area, although most of this knowledge is very general and little has been associated with specific sites. Great potential exists for further study on

post-World War I history, especially on area ranching, and on the ever increasing role of the federal government in the West during the twentieth century. Particularly lacking is a synthetic study of the impacts of the conservation-environmental movement as interpreted through implementation of federal laws and regulations in the Rocky Mountain West.

2.3.4 Installation-Specific Historic Archeology Research Directions

The site-specific concerns are phrased as questions which, when answered, will add useful information to presently available data. Because of the relatively small size of the launch complex, these questions also could apply to adjacent lands.

1. Can trail markers, campsites, trade sites, or other evidences of early Spanish/Mexican or Anglo-American traders or explorers be found on the complex?
2. Can the exact crossings of the Old Spanish Trail over the Green River be found? Was there only one crossing or a series of crossings?
3. Can the 1891 and mid-1930s well drilling be clarified as to purpose and location?
4. Can evidences of the outlaw uses of the eastern Utah badlands be found on the complex, such as once-occupied caves, shelters, or graffiti?
5. What can resources such as graffiti or campsites reveal about the daily life of cowboys or sheepherders in the area? Can ethnic diversities be established through these sources?
6. What remains on the complex, if anything, of the Elgin townsite and associated agricultural lands and irrigation systems?
7. Can a fuller history of the Union Carbide Plant and other activities associated with the development of nuclear power in the area be obtained through oral history, and archival and historic archeological work?

For any research design to be successful, certain basic criteria must be met: 1) the research problem(s) must be clearly defined, 2) testable hypothesis must be clearly stated and related to the problem(s) posed, 3) the nature, amount, and extent of data needed to test the hypothesis must be determined, 4) the research problem(s) should be prioritized, and 5) specific resource selection for survey, evaluation or data recovery should be based on the specific research problem.

Consequently, questions need to be specifically stated and because the research questions are specific, it is possible to identify the types of data needed to answer the questions, and to identify the types of sites likely to produce that data (Janetski and Holmer 1982).

Seven main problem domains have been identified. These include:

- A. Chronology
- B. Settlement and Subsistence
- C. Cultural Relationships
- D. Demography
- E. Environment
- F. Technology and Material Culture
- G. Data Recovery Techniques

Based on a regional literature review, the questions in Table 2-3 could be raised. To have meaning, the questions require a data base, and the questions might reasonably be answered based on the data that may exist on-post or within the region. Additional finds of a different nature than those currently known to exist would pose a different range of questions.

Table 2-3. RESEARCH DESIGN: PROBLEM DOMAINS AND DATA REQUIREMENTS FOR THE GREEN RIVER LAUNCH COMPLEX

| Problem Domain | Research Topics | Research Question | Data Requirements |
|----------------|-------------------|--|---|
| Chronology | Projectile Points | What is the date range of Paleo-Indian points in the study area? | Points should be in context with materials of datable nature, i.e., kill sites with datable hearths, open site with evidence of fire, sheltered sites with subsurface deposits. |
| | | What is the date range of points usually assigned to the Archaic period in the Study area? | As above. |
| | | What is the date range of Rose Spring and related points in the study area? | As above. |
| | | What is the date range of Desert side-notched points (Numic) in the study area? | As above. |
| Ceramics | | What other types of projectile points and what is their date range that occur in the study area? | As above. |
| | | What is the earliest date for ceramics in the study area. | As above, excluding kill sites. |
| | | What is the date range for decorated ceramics in the study area? | As above, excluding kill sites. |
| | | What is the date range for the "supposed Numic" brown wares? | As above, excluding kill sites |

Table 2-3. RESEARCH DESIGN: PROBLEM DOMAINS AND DATA REQUIREMENTS FOR THE GREEN RIVER LAUNCH COMPLEX (Continued)

| Problem Domain | Research Topics | Research Question | Data Requirements | |
|----------------------------|---|--|--|---|
| Settlement and Subsistence | Paleo-Indian Occupation | What tool types and food resources, both plant and animal, occur with the fluted point tradition on the Colorado Plateau? | Preservation is critical, therefore dry sheltered sites with subsurface deposits occurring in areas where numerous point styles and other diagnostics occur. | |
| | Fremont Occupation | What tool types and food resources, both plant and animal, occur with the lanceolate, points of the Plano Complex? What plant and animal resources are associated with Fremont materials in the study area? | As above. Caves, rock shelters or open sites with good preservation. | |
| Cultural Relationships | Archaic Occupation | What tool types are associated with diagnostic Fremont artifacts? | Diagnostic Fremont artifacts or datable materials in association with tools associated with various types of food preparation. | |
| | Mumic Occupation | How valid is Schroedl's (1976) Archaic scheme for the Green River area? | Caves or rock shelters with good preservation and long stratigraphic sequences. | |
| | Archaic/Fremont Transition | Same as for Fremont. | Same as for Fremont. | |
| | Fremont/Mumic Transition | Do diagnostic Fremont artifacts follow Archaic diagnostic artifacts in an unbroken succession? | Do diagnostic Fremont artifacts follow Archaic diagnostic artifacts in an unbroken succession? | Deeply stratified sites such as rock shelters or caves. |
| | | Do diagnostic Fremont and Archaic artifacts occur in direct association with each other? | Do diagnostic Fremont artifacts follow diagnostic Archaic artifacts in a broken (hiatus) succession? | As above. As above. |
| | Same as for Fremont/Archaic transition. | | Same as for Fremont/Archaic transition. | |

Table 2-3. RESEARCH DESIGN: PROBLEM DOMAINS AND DATA REQUIREMENTS FOR THE GREEN RIVER LAUNCH COMPLEX (Continued)

| Problem Domain | Research Topics | Research Question | Data Requirements |
|----------------|---------------------------------|---|--|
| Demography | Anasazi Influence | What sorts of Anasazi influences are found in the study area? | Presence or absence of materials attributable to Anasazi culture. |
| | Archaic Population Fluctuations | <p>During periods when high population are hypothesized to exist (e.g., ca. 1500, 3500, 6500 B.P.)</p> <p>a. Does site frequency increase? b. Does site frequency decrease? c. Does site frequency remain constant?</p> <p>or:</p> <p>Does intensity of site occupation:</p> <p>a. Increase? b. Decrease? c. Remain constant?</p> | <p>Datable cultural materials from stratified sites.</p> |
| Environments | Archaic Population Fluctuations | <p>During periods where low population is hypothesized to exist (e.g., ca. 2500 B.P. and 5500 B.P.)</p> <p>As above.</p> | As above. |
| | Colorado Plateau Environments | <p>What is the nature of the evidence for environmental fluctuation on the plateau?</p> <p>What is the date range of these fluctuations?</p> <p>How does this correlate with the Great Basin environmental fluctuations.</p> | <p>Excavation of non-archeological sites to: a) acquire environmental data, and b) to acquire datable material.</p> <p>As above.</p> <p>Other sequences - literature</p> |
| | Lithic Materials | <p>What raw materials were used in making stone tools?</p> <p>What were the sources of the raw materials?</p> | <p>Lithic/debetage analysis.</p> <p>Regional survey to locate quarry sites and/or lithic sources.</p> |

Table 2-3. RESEARCH DESIGN: PROBLEM DOMAINS AND DATA REQUIREMENTS FOR THE GREEN RIVER LAUNCH COMPLEX (Continued)

| Problem Domain | Research Topics | Research Question | Data Requirements |
|--------------------------|-----------------------------|--|--|
| Data Recovery Techniques | Survey Results (Surface) | Can surface features be located through use of aerial remote sensing techniques? | Aerial survey/test at variety of scales and emulsions plus ground truth. |
| | Survey Results (Subsurface) | Can archeological features (subsurface) be located through the use of aerial remote sensing techniques? | As above. |
| | Environmental | Can current land fauna on environment (washes, terraces, etc.) be located through the use of aerial remote sensing techniques? | As above. |

SECTION 3

CHAPTER 3.0 AN ASSESSMENT OF ARCHEOLOGICAL RESOURCE PRESERVATION AND SURVEY ADEQUACY

3.1 ENVIRONMENTAL CONSTRAINTS TO SITE PRESERVATION

The Green River Launch Complex (GRLC) lies in the northern portion of the canyonlands section of the Colorado Plateau. This area is rimmed by highlands and has been deeply carved by the Colorado River and its tributaries, such as the Green River. In general, the area is characterized by mesas and plateaus, separated by broad valleys.

Three factors exist which may preclude long-term preservation of archeological sites on the Green River facility. These are 1) the unconsolidated soils, which consist of sand, silt, and clay intermixed with gravels, overlying a bedrock subsurface, 2) the lack of surface cover or vegetation to hold the loose soils, and 3) the occurrence of rare downpours which are often torrential. These downpours can move vast quantities of soil, rock, and other debris, and in a matter of minutes completely eliminate a site that has managed to survive over the millenia.

3.2 HISTORIC AND RECENT LAND USE PATTERNS

Historically, most of the GRLC was used for periodic livestock grazing, with a very low animal-to-land ratio. During the late nineteenth century, the area was used by outlaws as a place to escape pursuit by peace officers. Also, much of the land was prospected for uranium during the late 1940s and early 1950s. No permanent structures were built on the lands until after 1945.

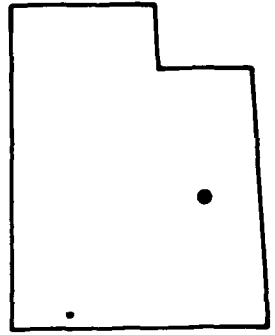
The GRLC headquarters/cantonment area has been the most heavily used portion of the complex. Beginning with the settlement of adjacent Elgin in 1905, the lands have had nearly continual use. Some of the cantonment area likely was cultivated by Elginites from 1905 until the early 1920s and possibly as late as the 1930s. After 1945, Union Carbide built a uranium processing plant near the town of Green River which remained opened until the late 1950s. Army missile launching has been the most recent land use; however, these activities impacted only portions of the base (Figure 3-1, Table 3-1).

The most recent land disturbance near the base has been construction of the Interstate Highway, I-70, which created a linear disturbance zone approximately 100 yards (91 m) wide along the northeast perimeter of the facility.

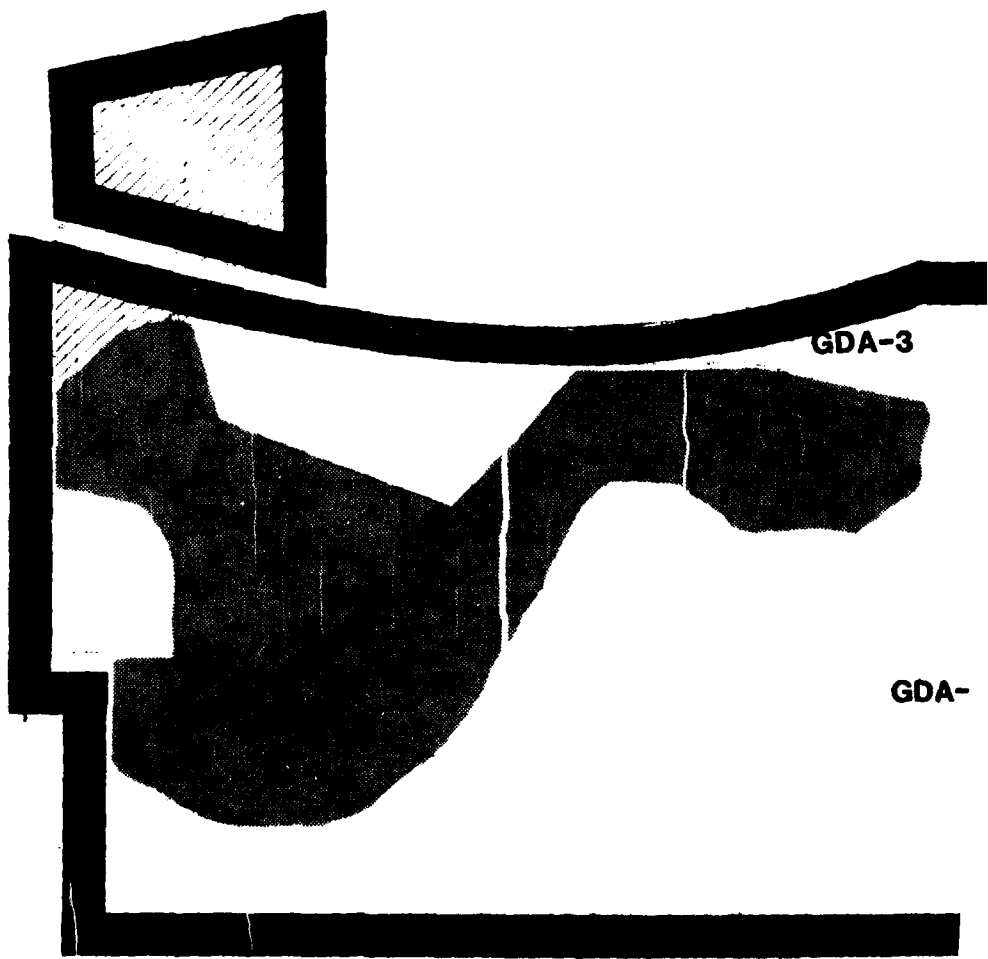
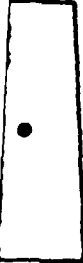
3.3 PREVIOUS CULTURAL INVESTIGATIONS; COVERAGE AND INTENSITY

There are no surveys on record for this installation (Tables 3-2, 3-3).

**Figure 3-1 HISTORIC AND MODERN
GROUND DISTURBANCE
AT THE
GREEN RIVER LAUNCH COMPLEX**



UTAH MAP LOCATING
GREEN RIVER VICINITY



GDA-3

GDA-

GDA-3




GDA-3

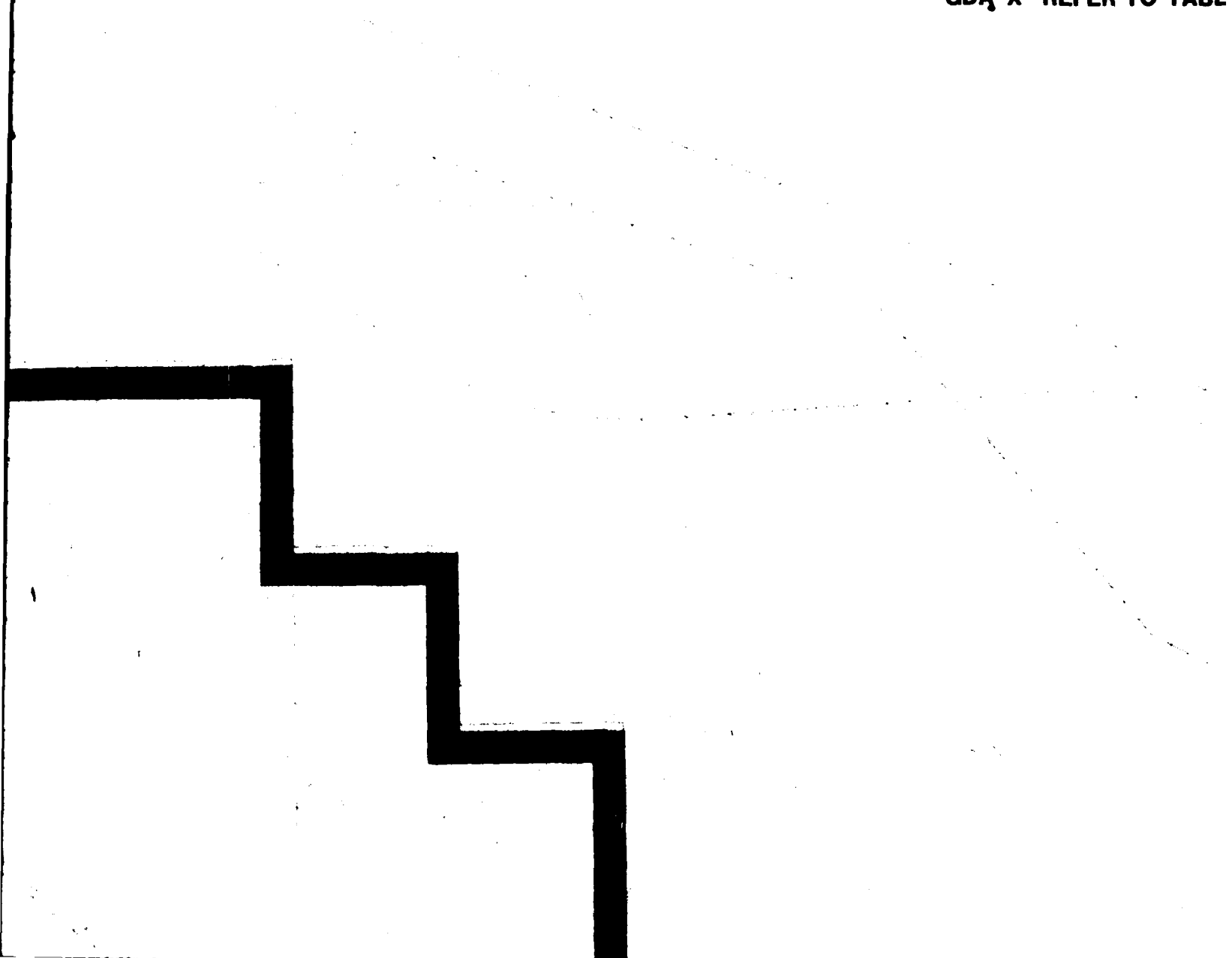
GDA-1

GDA-3

GDA-2

**Figure 3-1. HISTORIC AND PROPOSED GROUNDWATER QUALITY
GREEN RIVER LAUNCH COMPLEX**

-  > 90% AND 3 FT TO 6 FT
-  > 90% AND 6 IN TO 3 FT
-  BORDER OF STUDY AREA
- GDA-X- REFER TO TABLE



1

5

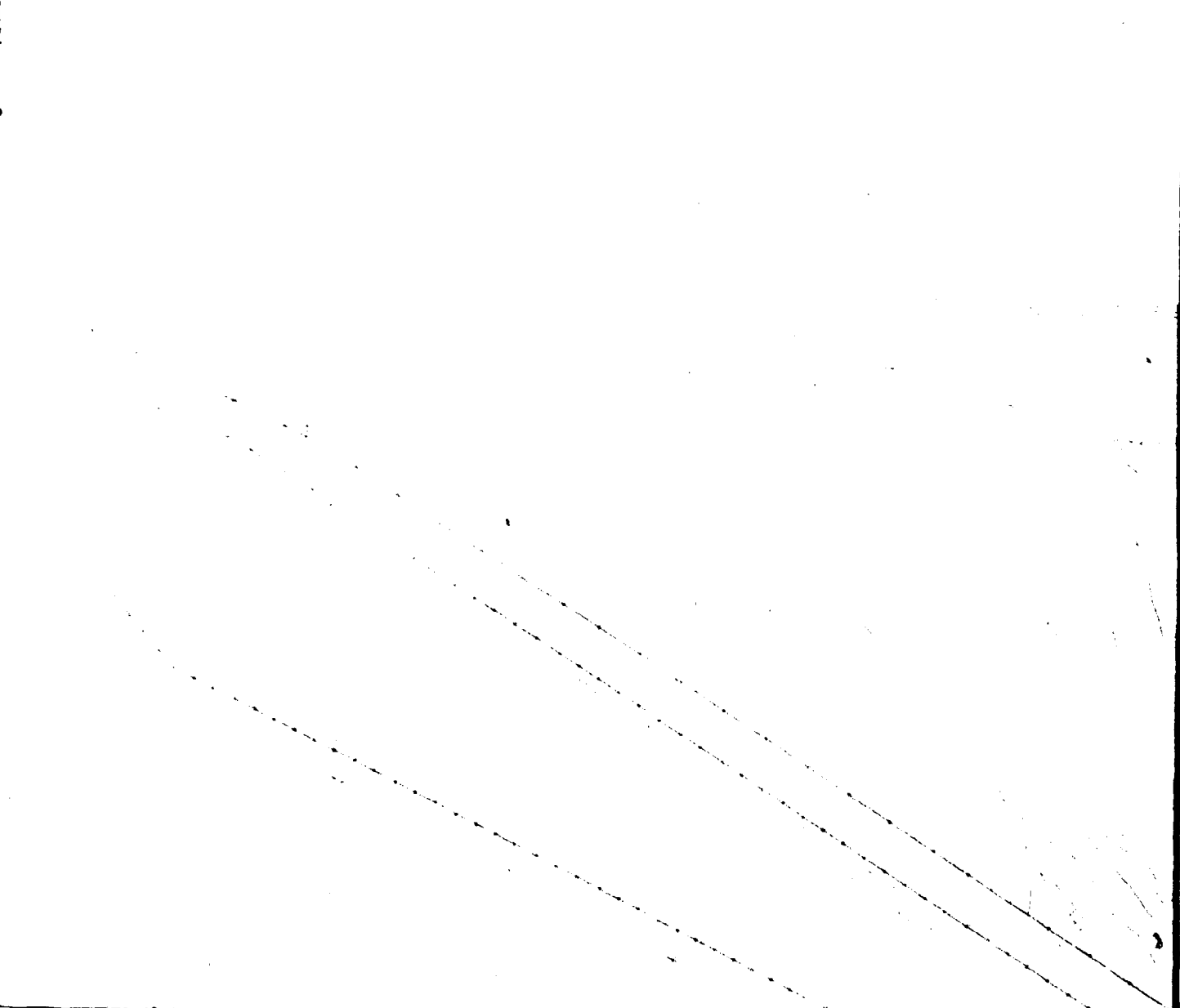
**PROPOSED GROUND DISTURBANCE -
LAUNCH COMPLEX, WSMR**

10% AND 3 FT TO 6 FT (0.9m TO 1.8m) DEEP

10% AND 6 IN TO 3 FT (15cm TO 0.9m) DEEP

ORDER OF STUDY AREA

-X- REFER TO TABLE 3-1



4



9

1



GDA-3

GDA-3

GDA-2

GDA-1

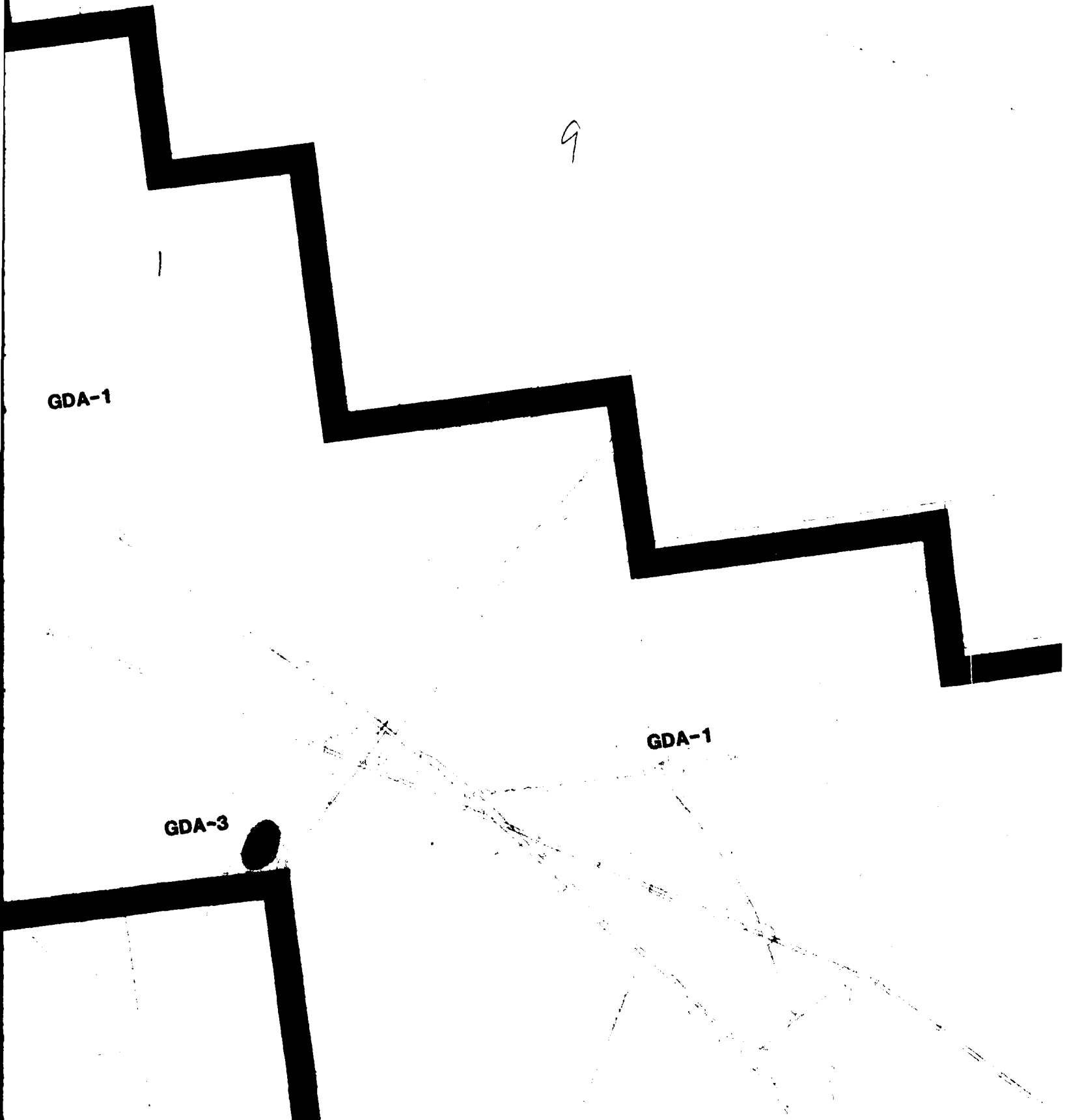
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GDA-1

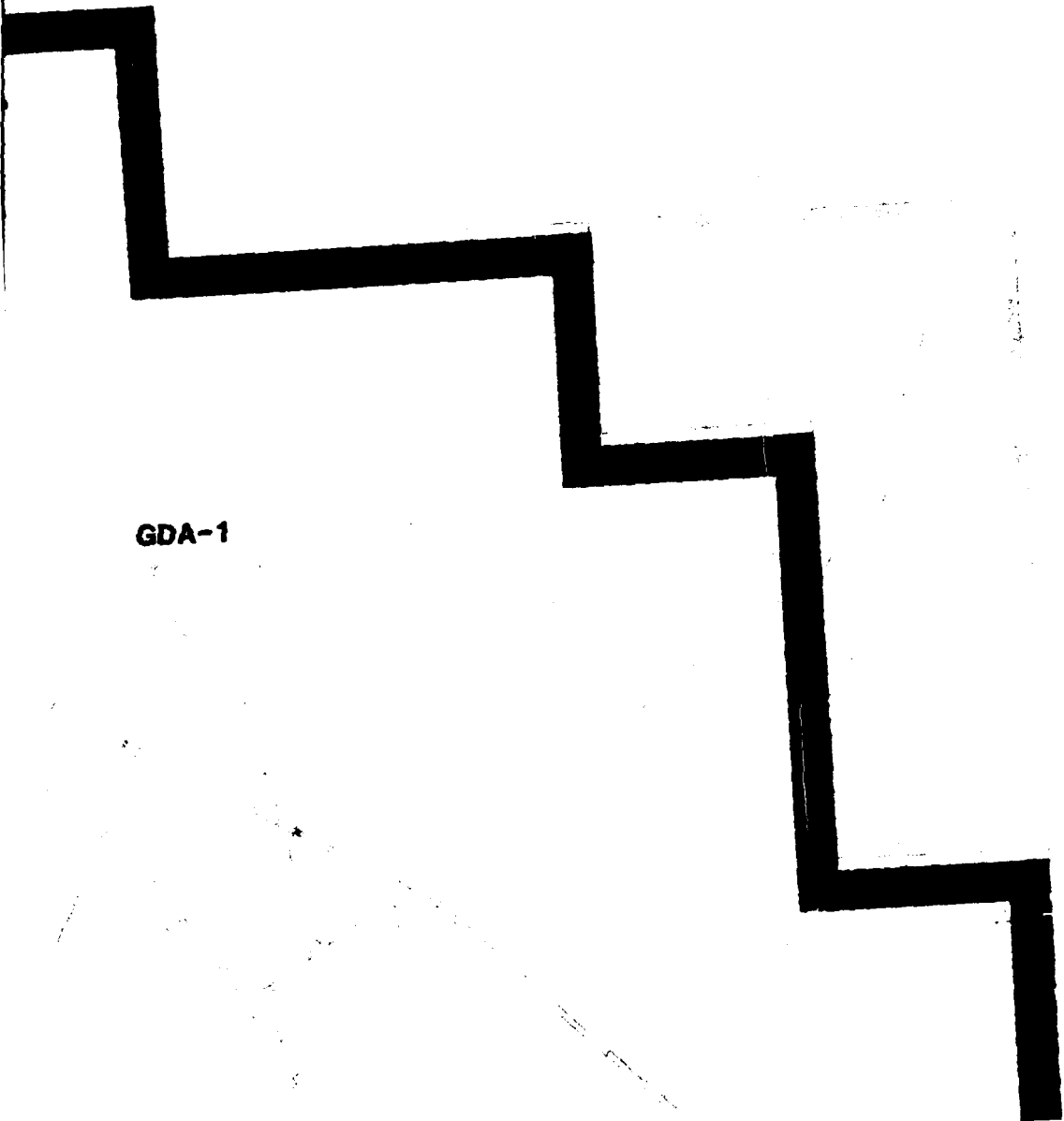
GDA-1

GDA-3

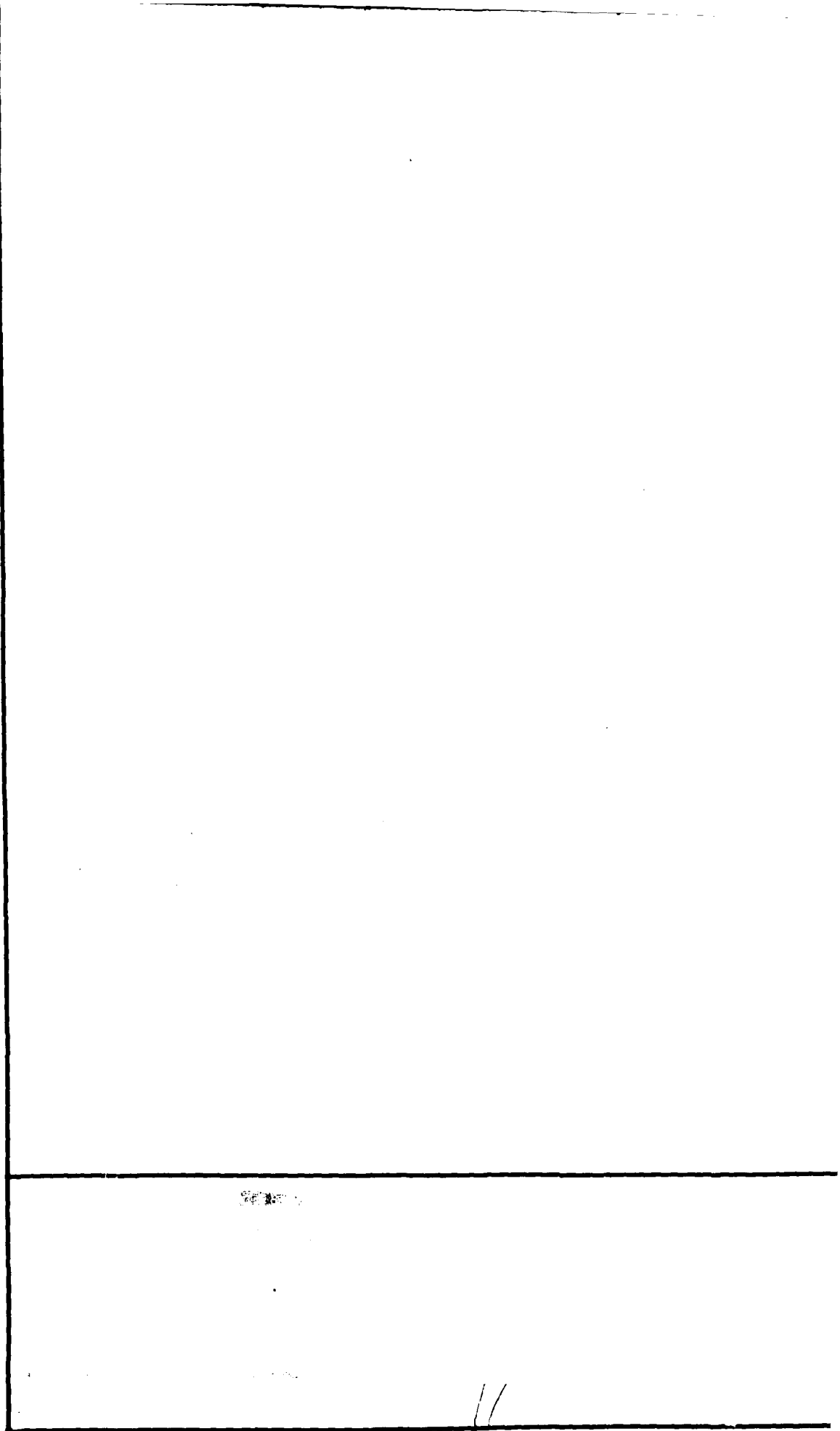


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GDA-1



11

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AD-A142 382

AN ARCHEOLOGICAL OVERVIEW AND MANAGEMENT PLAN FOR THE
GREEN RIVER LAUNCH COMPLEX (U) STEARNS-ROGER SERVICES
INC DENVER CO J GRADY ET AL. 29 MAR 84 CX-0001-2-0048

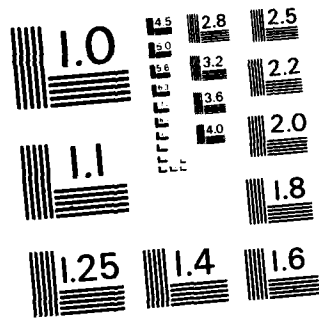
3/2

UNCLASSIFIED

F/G 5/8

NL





MICROCOPY RESOLUTION TEST CHART
NATIONAL BUREAU OF STANDARDS-1963-A



GEYSER LAUNCH SITE

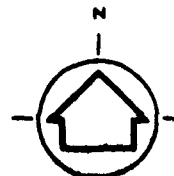
PERKINS SAFETY AREA

LABRES SAFETY AREA

1000 500 0 1000 2000



SCALE IN FEET



WHITE SANDS TRANSVERSE MERCATOR PROJECTION
WHITE SANDS DATUM

1

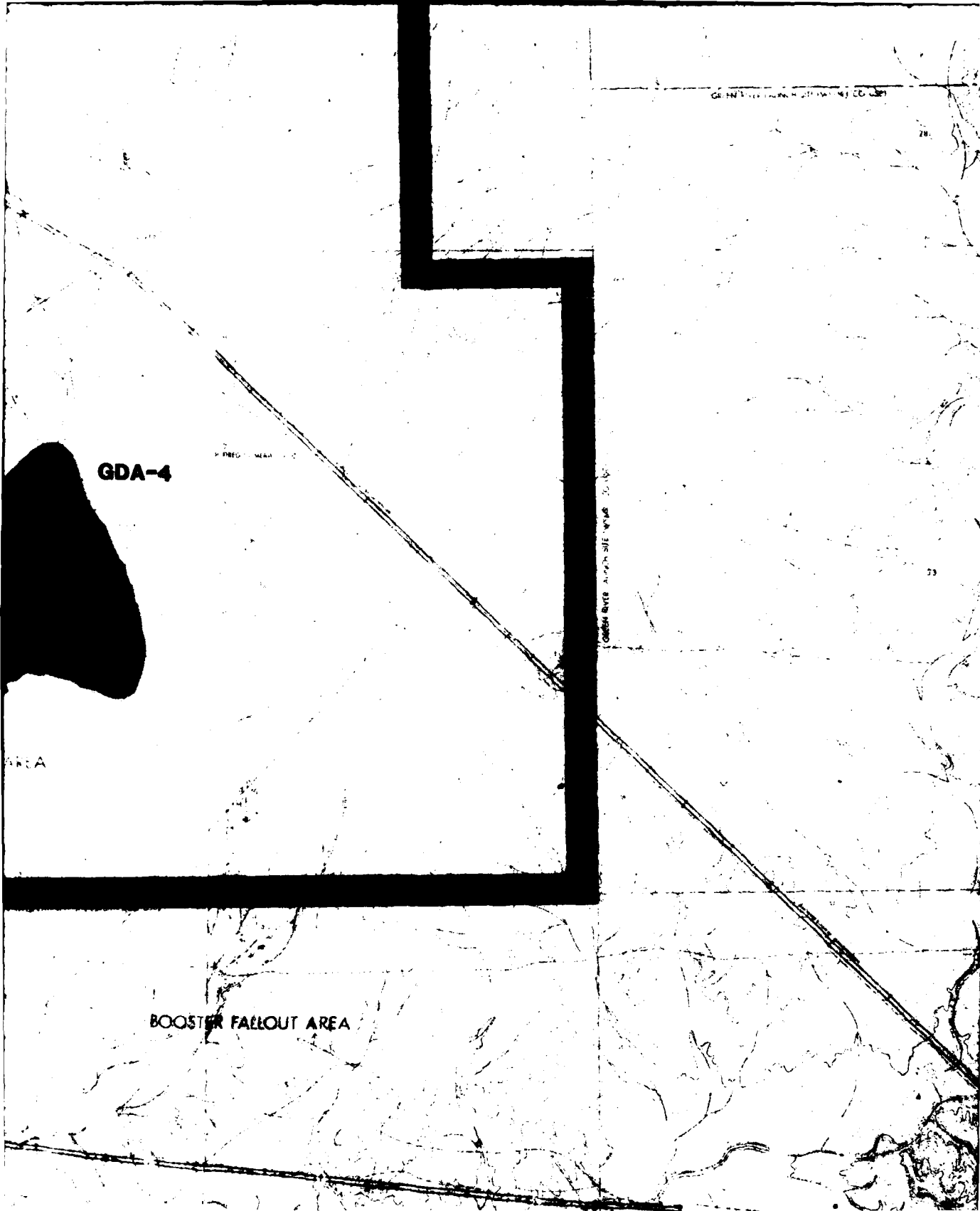
13



GDA-4

ATHENA LAUNCH AREA

BOOSTER F



GDA-4

BOOSTER FALLOUT AREA

GREEN RIVER

GREEN RIVER

AREA

28

33

Table 3-1. A SUMMARY OF HISTORIC AND MODERN GROUND DISTURBANCE THAT MIGHT LIMIT THE PRESENT ARCHEOLOGICAL RESOURCE BASE ON THE GREEN RIVER LANUCH COMPLEX

| GDA No. (a) | Type of Disturbance | Date Conducted (Yr) | Reference | Area Disturbed (acres) | Estimated Depth Below Surface (ft) | Ratio of Disturbed to Total Area | Location of Disturbed Area | | | | USGS Quad Sheet (c) | Coincidental Sites | |
|-------------|--|---------------------------|---|------------------------|------------------------------------|----------------------------------|----------------------------|---------|-----------------|---------------|---|--------------------|-------------|
| | | | | | | | UTM (b) | | Legal Reference | | | | |
| | | | | | | | Northing | Easting | Township | Range Section | | | |
| GDA-1 | Grazing | 1880 to 1960 | Historical Documentation | 3,681 | Less than 6 in. | 1:1 | 4309600 | 574000 | 21S | 17E | 19,29 30,31 | GR1554 | DARCOM GR-1 |
| | | | | | | | 4315250 | 581400 | 21S | 16E | 13,14, 15,22, 23,24, 25,26, 35,36 | DARCOM GR-2 | |
| GDA-2 | Re-Contouring by Bulldozer | 1963 and Subsequent Dates | Historical Documentation, Base Maps, Site Visit | 45 | 6 in. to 3 ft. | 1:1 | 4314020 | 575080 | 21S | 16E | 23 | GR1554 | |
| | | | | | | | 4312200 | 575120 | 21S | 16E | 26 | | |
| GDA-3 | Re-Contouring by Bulldozer, Foundations, and Explosives, Bunkers, Construction | 1963 and Subsequent Dates | Historical Documentation, Base Maps, Site Visit | 445 | 3 ft. to 6 ft. | 7:10 | 4313950 | 574000 | 21S | 16E | 22,23 | GR1554 | |
| | | | | | | | 4314900 | 575250 | 21S | 16E | 35 | | |
| | | | | | | | 4314750 | 577750 | 21S | 16E | 13,24 | | |
| | | | | | | | 4314200 | 576800 | 21S | 16E | 23,24 | | |
| | | | | | | | 4314600 | 577300 | 21S | 16E | 23,24 | | |

Table 3-1. A SUMMARY OF HISTORIC AND MODERN GROUND DISTURBANCE THAT MIGHT LIMIT THE PRESENT ARCHEOLOGICAL RESOURCE BASE ON THE GREEN RIVER LAUNCH COMPLEX (Continued)

| GDA No. (a) | Type of Disturbance | Date Conducted (yr) | Reference | Area Disturbed (acres) | Estimated Depth Below Surface (ft) | Ratio of Disturbed to Total Area | Location of Disturbed Area | | | | | |
|-------------|---------------------------------------|---------------------------|--|------------------------|------------------------------------|----------------------------------|----------------------------|------------------|---------------------|--------------------|---------|--------|
| | | | | | | | UTM (b) | Legal Reference | USGS Quad Sheet (c) | Coincidental Sites | | |
| | | | | | | | Northing | Easting | Township | Range | Section | |
| GDA-4 | Re-Construction of Missile Launchings | 1963 and Subsequent Dates | Historical Documentation Base Maps; Site Visit | 120 | Greater than 6' | 9:10 | 4311250 4311500 | 576850 577000 | 21S | 16E | 35,36 | GR1554 |
| | | | | | | | 4310550 4310900 | 576100 576450 | 21S | 16E | 35 | GR1554 |

NOTE: Most of the land for the complex, except the cantonment area was previously unpatented public domain or state land and as such had experienced little pre-Army disturbance.

- (a) Ground Disturbance Activities (GDA)
- (b) Universal Transverse Mercator (UTM) Zone 12 SWU
- (c) U.S. Geological Survey (USGS) GR1554 = Green River, UT 15 min (1954)

Table 3-2. ARCHEOLOGICAL SURVEYS CONDUCTED ON THE GREEN RIVER LAUNCH COMPLEX

| Survey Administration | Survey Location | | Artifacts | Survey Characteristics | | | Identified Archeological Resources | | | | | | | | |
|----------------------------------|------------------|--------------------------|-------------------------|------------------------|------------------------------|----------------------|------------------------------------|-------------------|-------------------------|------------------|-------------------|------------------------------|----------------------|-------------------|---------------------------------|
| | UTM | Legal Description | | Temporal Coverage | Transect Type, Interval (m.) | Rate (a./person day) | | Sub-surface Tests | | | | | | | |
| SHPO Survey Institution No. Firm | Survey Date (yr) | Survey Record Repository | Bibliographic Reference | USGS Quad Map | Section Range | Township | North-East- ing | Collection Policy | Cura- torial Repository | Survey Type Area | Temporal Coverage | Transect Type, Interval (m.) | Rate (a./person day) | Sub-surface Tests | Isolated Finds & Sites Features |

None to date.

Table 3-3. ARCHEOLOGICALLY RELEVANT RESEARCH INVESTIGATIONS, EXCLUSIVE OF ARCHEOLOGICAL SURVEYS, CONDUCTED ON THE GREEN RIVER LAUNCH COMPLEX

| Study No. | Study Type | Study Date | Institution, Agency Firm | Principal Investigator | Bibliographic Reference | Location | | | USGS Quad Map | Associated Archeological Resources |
|-----------|------------|------------|--------------------------|------------------------|-------------------------|----------|-------|---|---------------|------------------------------------|
| | | | | | | UTM | Legal | Northing Easting Township Range Section | | |

None to date.

3.4 SUMMARY ASSESSMENT OF DATA ADEQUACY, GAPS

The terrain at the Launch Complex is deeply dissected, with many draws and side canyons. Each or any of these could easily contain archeological materials, rock art panels, additional quarry sites, and shelters. Because of the lack of any survey, the entire installation must be considered a "data gap."

SECTION 4

CHAPTER 4.0 KNOWN ARCHEOLOGICAL RESOURCES ON THE GREEN RIVER LAUNCH COMPLEX

4.1 DARCOM GR-1

One prehistoric resource, a lithic quarry, is known to exist on the Launch Complex. This site (DARCOM GR-1) is summarized in Table 4-1 and Appendix B. It is impossible to accurately estimate either the degree of disturbance or the apparent depth of the site. Since the site is in a small drainage channel, part of the site may have eroded away, part may be covered with alluvium, and parts of the site may have been looted (because of evidence of recent human presence).

However, quarry sites can provide information on sources and distribution of raw materials, particularly relating to distribution mechanisms. For this site to produce its full potential of data, it would have to be integrated into a comprehensive regional program of lithic analysis and distribution studies. Few institutions so far have been willing to make the long-term resource (dollars) commitment such a program would require.

4.2 DARCOM GR-2

These mining claim corners, while insignificant by themselves and not 50 years old, are representative of the 1950s uranium boom. The corners are unlikely to yield significant information; however, their location, combined with other similar findings in the region, could help establish prospecting patterns (Tables 4-1, 4-2, 4-3).

Table 4-1. PRESENTLY IDENTIFIED ARCHEOLOGICAL RESOURCES ON THE GREEN RIVER LAUNCH COMPLEX: ADMINISTRATIVE DATA

| Site Number | Site Recorder | Date of Site Record | SHPO Survey Number | SHPO Record Repository | Survey Collection Policy (a) | Current Status of Investigation (b) | NRHP Status (c) | State Local Status (d) | Architectural Association (d) | Bibliographic Reference |
|-------------|---------------|---------------------|--------------------|------------------------|------------------------------|-------------------------------------|-----------------|------------------------|-------------------------------|-------------------------|
| DARCOM GR-1 | Stearns-Roger | 21 April 83 | None | None | CD | RAS | INSF | N/A | N/A | None |
| DARCOM GR-2 | Stearns-Roger | 21 April 83 | None | None | N | RAS | RIP | N/A | N/A | None |

- (a) Collection of diagnostics without mapping (CD), nothing collected (N)
- (b) Recommended for additional study (RAS)
- (c) Insufficient information available by which to judge (INSF), recommended as ineligible by qualified professionals without agency or SHPO concurrence (RIP).
- (d) Not applicable (N/A)

Table 4-2. PRESENTLY IDENTIFIED ARCHEOLOGICAL COMPONENTS ON THE GREEN RIVER LAUNCH COMPLEX: DESCRIPTION AND EVALUATION

| Site Number | Unit Age | | Unit Description | | | | Evaluation | | | | | | |
|-------------|------------|---------------|----------------------|----------|----------------------------|---------------|-------------------|--------------------------|------------------------|--------|---|---|---|
| | Date | Temporal Unit | Depositional Context | Landform | Area (m ²) (d) | Depth (m) (e) | Ascribed Function | Value Percent Intact (f) | RV (g) | CR (h) | | | |
| DARCOM GR-1 | UN- known | Unknown | FL | Quarry | Surface | Outcrop | 1000 | UNK | Lithic Source | 70% | M | 3 | 2 |
| DARCOM GR-2 | Style 1950 | Anglo | Energy Development | Stakes | Surface | Outcrop | N/A | N/A | Mine Claim Corners (3) | 75% | A | 1 | 3 |

(a) Dating method (DM)
 (b) Unknown (UNK)
 (c) Flaked lithics (FL), historic wooden artifact (HW)
 (d) Not applicable (N/A)
 (e) Unknown (UNK), Not applicable (N/A)
 (f) Materials (M), Association (A)
 (g) Research value (RV) ranging from 0 (no value) to 5 (highest value)
 (h) Confidence rating (CR): 1 = not reliable, 2 = moderately reliable, 3 = reliable

Table 4-3. PRESENTLY KNOWN ARTIFACT, ECOFACT, OR DOCUMENTARY COLLECTIONS FOR ARCHEOLOGICAL RESOURCES ON THE GREEN RIVER LAUNCH COMPLEX

| Site Number, Name | Collection Characteristics | | | | | |
|-------------------|----------------------------|-------------------|----------|-------------------|-------------------|-------------------|
| | Collection Location | Artifact | Ecofact | Documentary | Brief Description | Size/No. |
| | Curatorial Repository | Brief Description | Size/No. | Brief Description | Size/No. | Brief Description |

DARCOM GR-1

There are no presently known artifact collections that are directly attributable to these sites.

DARCOM GR-2

Utah State Historical Society
B-57

WPA Pioneer Personal History Interviews, Questions 65-73
136 linear ft. of documents

Table 4-4. POTENTIALLY IDENTIFIABLE BUT NOT PRESENTLY RECORDED ARCHEOLOGICAL RESOURCES ON THE GREEN RIVER LAUNCH COMPLEX

| <u>Site Number, Name</u> | <u>Reference</u> | <u>Description</u> | <u>Research Value CR</u> |
|--------------------------|------------------|--------------------|--------------------------|
|--------------------------|------------------|--------------------|--------------------------|

None are presently known.

SECTION 5

CHAPTER 5.0 AN ASSESSMENT OF THE SIGNIFICANCE OF THE
ARCHEOLOGICAL RESOURCE BASE ON GREEN RIVER
LAUNCH COMPLEX

The descriptive data already presented are synthesized in this section in order to provide the cultural resource planner with an understanding of the significance and values needed to make sound judgements.

In order to clarify the assessment of significance of archeological sites, Schiffer and Gummerman (1977) have isolated five different kinds of significance that pertain to the archeological records. These include 1) legal, 2) ethnic, 3) public, 4) historic, and 5) scientific significance.

- Legal Significance - Legal significance, as a national policy, is based on the passage into law of the Antiquities Act of 1906, the Historic Sites Act of 1935, and the National Historic Preservation Act (NHPA) of 1966, as amended. The latter two established the responsibility for maintaining a National Register of Historic Places (NRHP). Under the law, a site or property eligible for placement on the NRHP must be at least 50 years old and meet certain criteria, including:
The site or property must be 50 years old, and the quality of significance in American history, architecture, archeology, engineering, and culture must be present in districts, sites, buildings, structures, and objects that possess integrity of location, design, setting, materials, workmanship, feeling, and association and:
 - A. Associate with events that have made a significant contribution to the broad patterns of our history; or
 - B. Associate with lives of persons significant in our past; or
 - C. Embody the distinctive characteristics of a type, period, or method of construction, or represent the work of a master, or possess high artistic value, or represent a significant and distinguishable entity whose components may lack individual distinction; or
 - D. Yield or may be likely to yield, information important to prehistory or history.
- Ethnic Significance - Ethnically significant sites are those sites having either religious, mythological, or other special importance for a specific population. Such a determination depends entirely on the views and values of the specific study population.

- Public Significance - Public significance centers on the value of archeological research to the public. Moratto (1975) defines public significance in terms of the educational value of a site, the use of research findings for enrichment or for practical industrial applications, and the use of material cultural remains for exhibits or public enjoyment, and for the enhancement of public appreciation for local history and prehistory.
- Historic Significance - Cultural resources, to be historically significant, must have "the potential for the identification and reconstruction of specific cultures, periods, lifeways, and events, or provide a typical or well-preserved example of a historical tribe, period of time, or category of human activity," or "be associated with a specific event or aspect of history" (Scovill et al. 1972:56).
- Scientific Significance - Scientific significance probably is the most critical in evaluating archeological resources, but is the most difficult to assess. Ultimately, scientific significance deals with a given site's ability to produce useful data capable of solving archeological problems. Inherent problems exist in determining scientific significance, such as research directions changing through time. Consequently, a site that is considered insignificant today may be of critical importance tomorrow. Secondly, archeological methods and techniques are constantly being improved and new ones are being developed.

The types of significance discussed above also contain levels of significance. These are local, state, regional, and national significances.

5.1 THE SIGNIFICANT RESOURCE BASE

As archeologists classify data to facilitate analysis, cultural resource values must be classified in order to facilitate sound management. Table 5-1 represents just such an attempt at classification. In this table the cultural resources, both actual and potential are presented by cultural period and thematic unit. Inspection of the table will quickly reveal that the amounts of known resource is quite small. This is undoubtedly due to the fact that no large scale resource survey of the complex has yet occurred (Figure 5-1).

Highest research values were given to three main temporal units: the Clovis and Folsom portions of the Paleo-Indian Stage; the early Archaic Period; and the Formative Stage of the Fremont period. The Clovis and Folsom Periods are particularly important since they are thought to represent an early adaptation to late-glacial and post-glacial conditions in the New World. This adaptation seems to have emphasized the taking of large and now

Table 5-1. SUMMARY OF SIGNIFICANT ARCHEOLOGICAL RESOURCES ON THE GREEN RIVER LAUNCH COMPLEX

| Temporal Unit | Thematic Unit | Resource Type | Type Occurrence | | Other Likely Occurrences (a) | Sociocultural Association | Landform Association | Physical Integrity | Research Value (b) | RV CR (c) | Socio-Cultural Value (d) | SCV CR (c) |
|--|----------------------------|-------------------------|-------------------------|-----------------------------|------------------------------|---------------------------|---------------------------------|--------------------|--------------------|-----------|--------------------------|------------|
| | | | Known Occurrences (No.) | Potential Occurrences (No.) | | | | | | | | |
| Historic Period | Ranching/Farming | Homesteads/outbuildings | 0 | 0 | + | EuroAmerican | Open plain | Fair | 3 | 2 | 2 | 2 |
| Ethno-historic | Seasonal hunting/gathering | Rock Art/campsites | 0 | 0 | + | Native American | Terraces open plains near water | Fair | 3 | 3 | 3 | 2 |
| Post Formative Period (Numic speakers) | Seasonal hunting/gathering | Rock Art/campsites | 0 | 0 | + | Native American | Terraces open plains near water | Fair | 4 | 3 | 3 | 2 |
| Formative Stage Fremont (sevier) | Horti-cultural | Village/campsites | 0 | 0 | ++ | Native American | Floodplains and alluvial fans | Fair to good | 5 | 3 | 4 | 3 |
| Late Archaic | Seasonal/hunting gathering | Campsite | 0 | 0 | + | Native American | Terraces/springs | Fair | 4 | 3 | 3 | 2 |
| Middle Archaic | Seasonal/hunting gathering | Campsite | 0 | 0 | + | Native American | Terraces/springs | Fair | 4 | 3 | 3 | 2 |
| Early Archaic | Seasonal/hunting gathering | Campsite | 0 | 0 | + | Native American | Terraces/springs | Fair | 5 | 3 | 3 | 2 |
| Unspecified | | Quarry | 1 | 0 | + | Native American | | Good | 4 | 3 | 3 | 2 |

Table 5-1. SUMMARY OF SIGNIFICANT ARCHEOLOGICAL RESOURCES ON THE GREEN RIVER LAUNCH COMPLEX (Continued)

| Temporal Unit | Thematic Unit | Resource Type | Type Occurrence | | | Sociocultural Association | Physical Integrity | Research Value (b) | RV CR (c) | Socio-Cultural Value (d) | SCV CR (c) |
|---------------|------------------|--------------------------|-------------------------|-----------------------------|------------------------------|---------------------------|--------------------|--------------------|-----------|--------------------------|------------|
| | | | Known Occurrences (No.) | Potential Occurrences (No.) | Other Likely Occurrences (a) | | | | | | |
| Piano | Big game hunting | Kill and butchering site | 0 | 0 | + | Native American | Fair to poor | 4 | 3 | 3 | 2 |
| Folsom | Big game hunting | Kill and butchering site | 0 | 0 | + | Native American | Fair to poor | 5 | 3 | 3 | 2 |
| Clovis | Big game hunting | Kill and butchering site | 0 | 0 | + | Native American | Fair to poor | 5 | 3 | 3 | 2 |
| Pre-Clovis | Big game hunting | Kill and butchering site | 0 | 0 | + | Native American | Fair | 4 | 3 | 3 | 2 |

(a) The number of presently known or potential archeological resources of this type is specified here. In addition a judgement has been made as to the likelihood that other members of this resource occur within the facility, based on an analysis of the ethnohistoric or historic land use patterns and/or a review of the landform patterning of prehistoric materials. The probability of these additional occurrences has been noted as negative (-), positive (+), or highly positive (++)

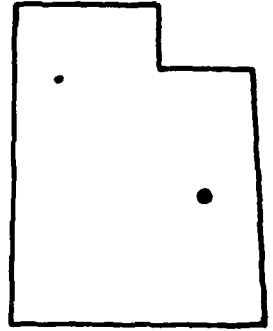
(b) This is a subjective summary assessment of the overall research value (RV) of the resource class. It is an evaluation of the class' quality of preservation, representation of activity diversity or uniqueness, and temporal distinctiveness or reflection of diachronic relationships. It incorporates the need to avoid triviality, but to acquire what may be redundant data so as to discern patterns among those data. Based on these research values, the resource classes under discussion are ranked from 0 (no value) to 5 (highest value), including "NA" if such an evaluation is believed to be impossible given the available information.

(c) The Confidence Rating (CR) is a further evaluation of the perceived reliability of the research (RV) or sociocultural (SCV) values of the resource class. 1 = the judgement is more guess than science, and likely not to be reliable; 2 = the judgement is moderately reliable; 3 = the judgement is most likely reliable.

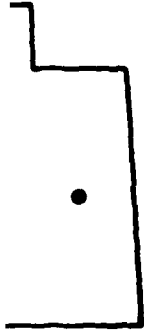
(d) This is a subjective summary assessment of the overall sociocultural value (SCV) of the resource class. It is an evaluation of the social, religious, or political importance of the resource to a contemporary community, from 0 (no value) to 5 (highest value).

**Figure 5-1 MAP OF KNOWN,
POTENTIAL AND SURVEYED
ARCHEOLOGICAL SITES ON THE
GREEN RIVER LAUNCH COMPLEX**

T-215 : 205



UTAH MAP LOCATOR
GREEN RIVER VICINITY



P LOCATOR
ER VICINIT.

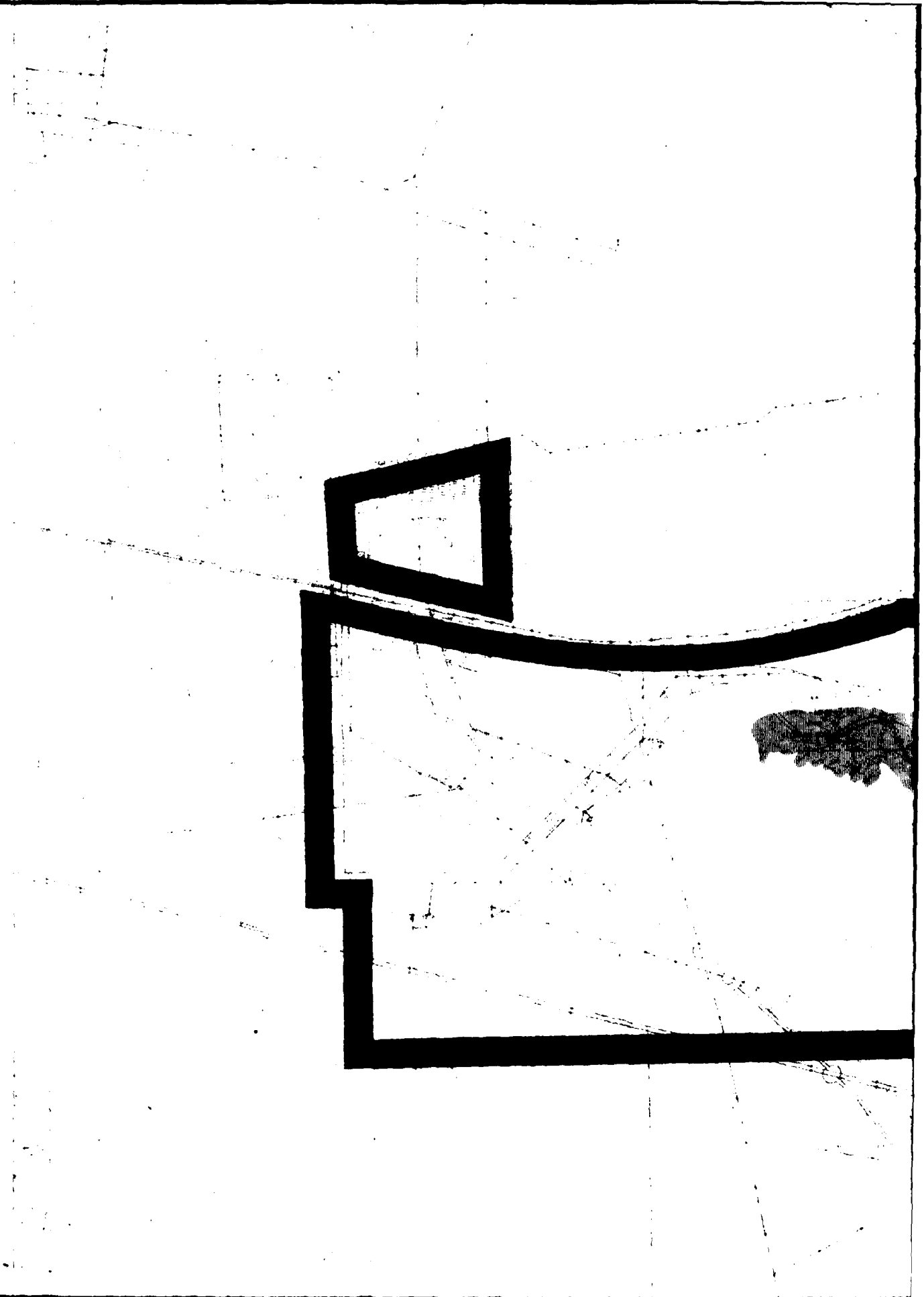




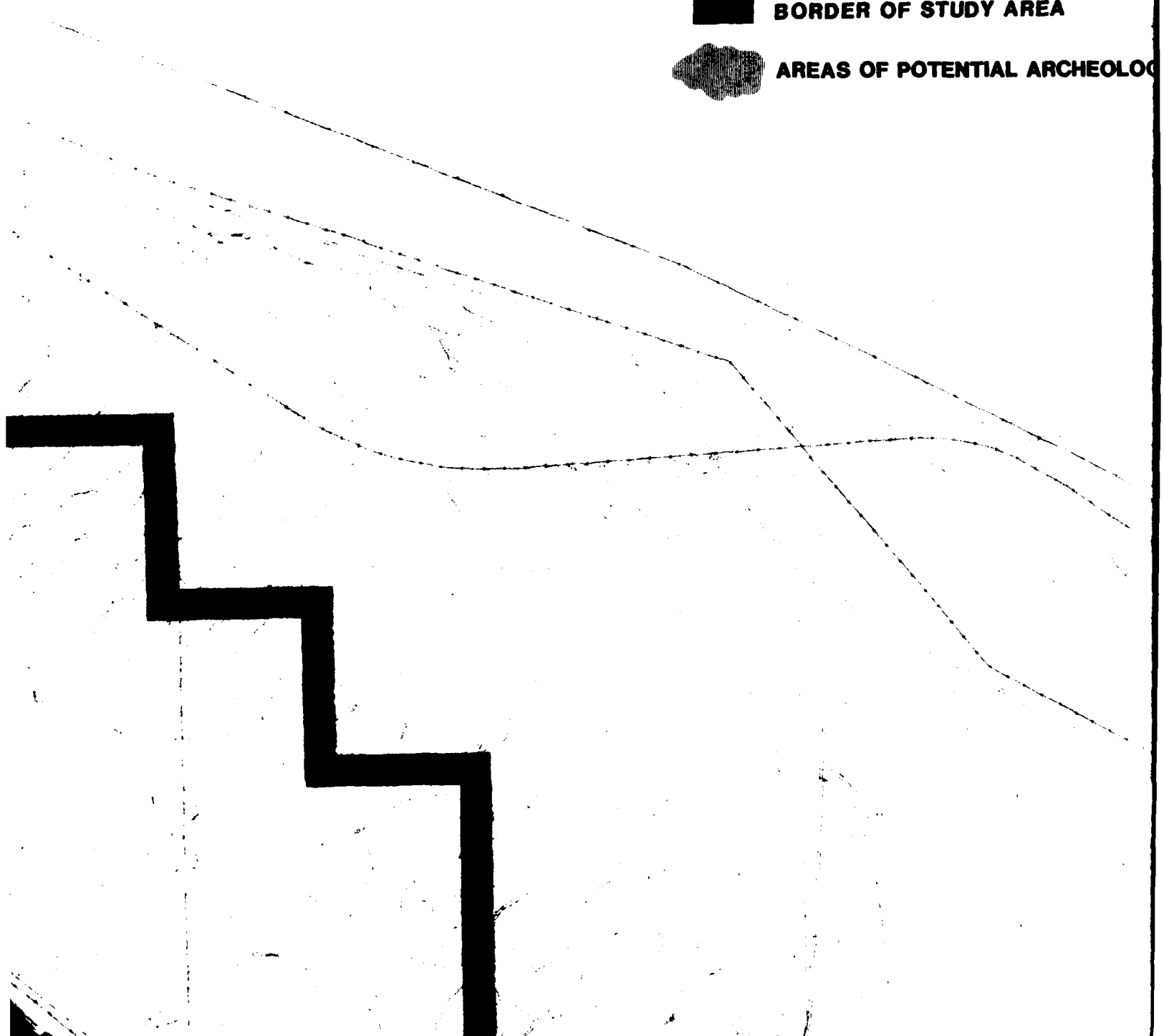
Figure 5-1. KNOWN, POTENTIAL AND SURVEYED ARCHEOLOGICAL SITES GREEN RIVER LAUNCH COMPLEX,

● PREHISTORIC SITE (DARCOM GR-2)

▲ HISTORIC SITE (DARCOM GR-2)

■ BORDER OF STUDY AREA

▨ AREAS OF POTENTIAL ARCHEOLOGICAL INTEREST



SURVEYED ARCHEOLOGICAL SITES -

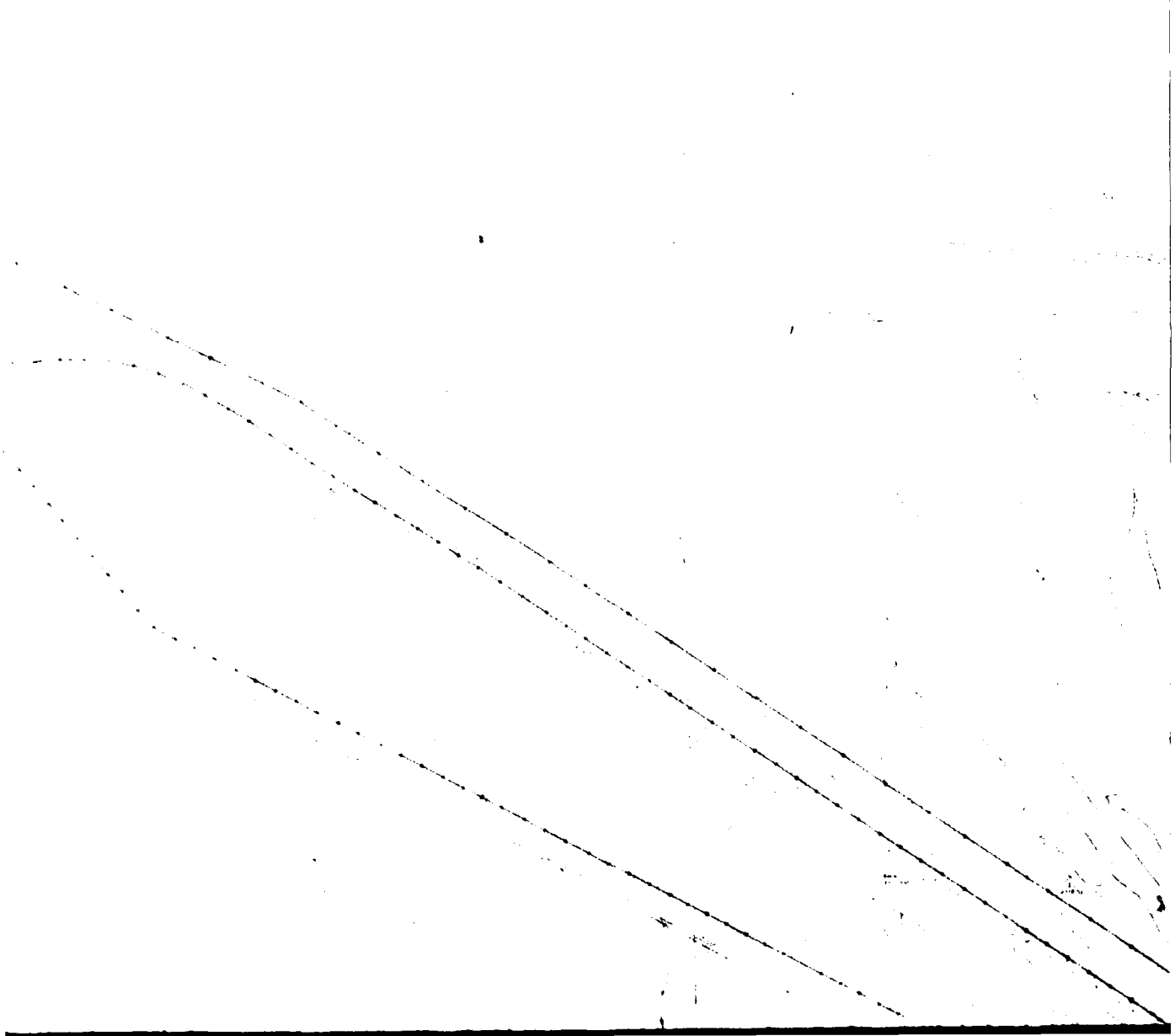
AUNCH COMPLEX, WSMR

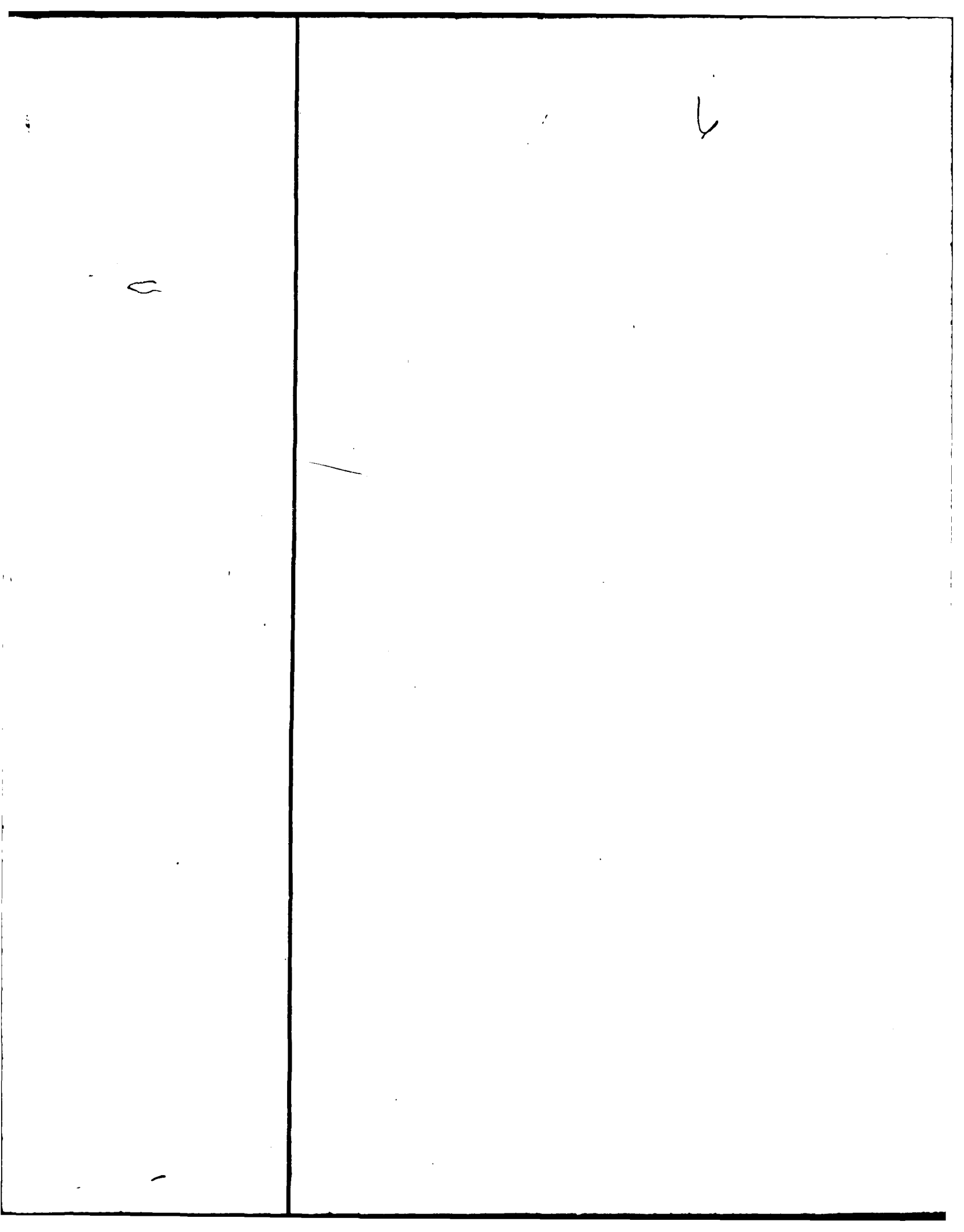
INDICATED HISTORIC SITE (DARCOM GR-1)

INDICATED HISTORIC SITE (DARCOM GR-2)

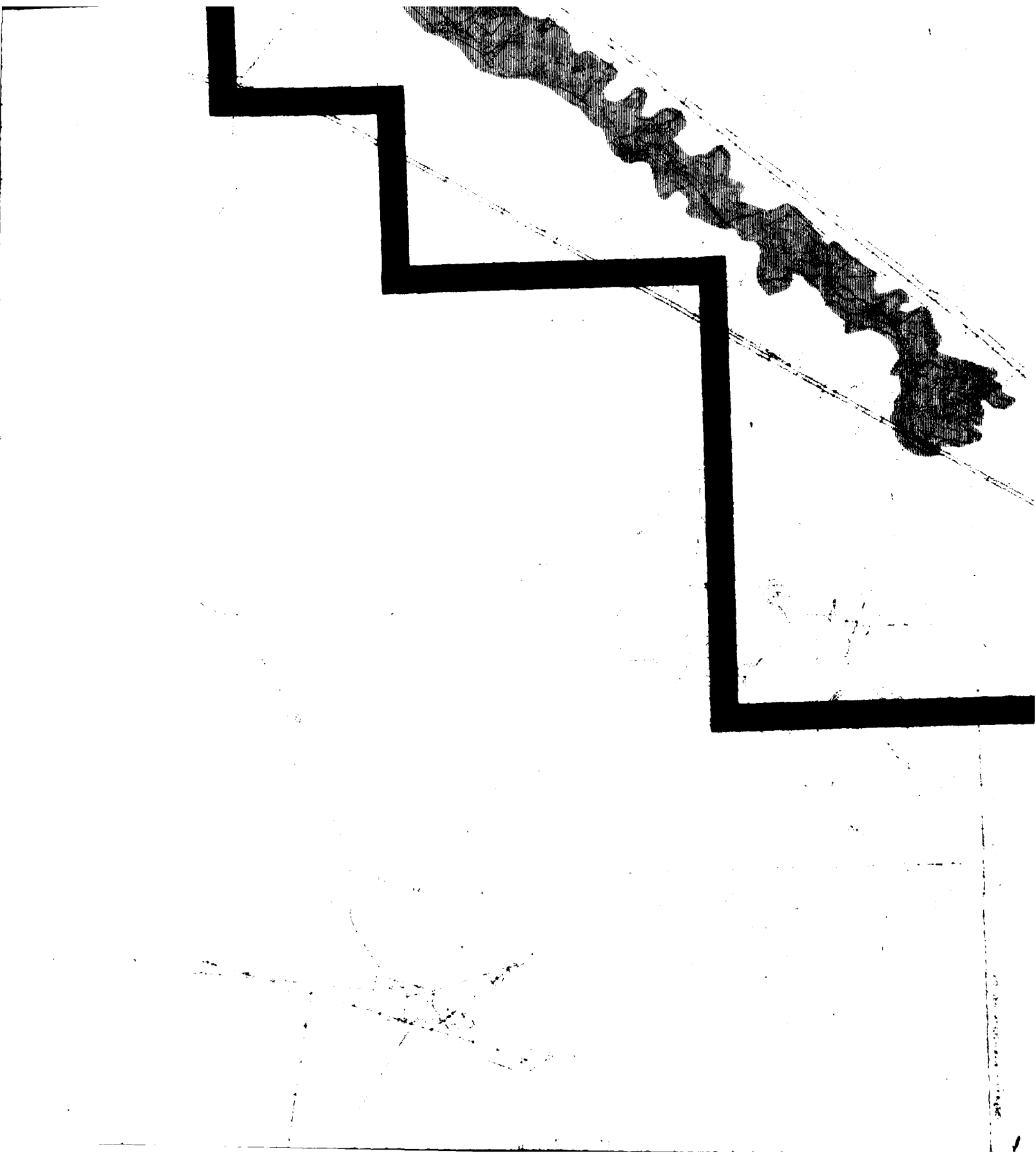
BOUNDARY OF STUDY AREA

BOUNDARY OF POTENTIAL ARCHEOLOGICAL SITES





7

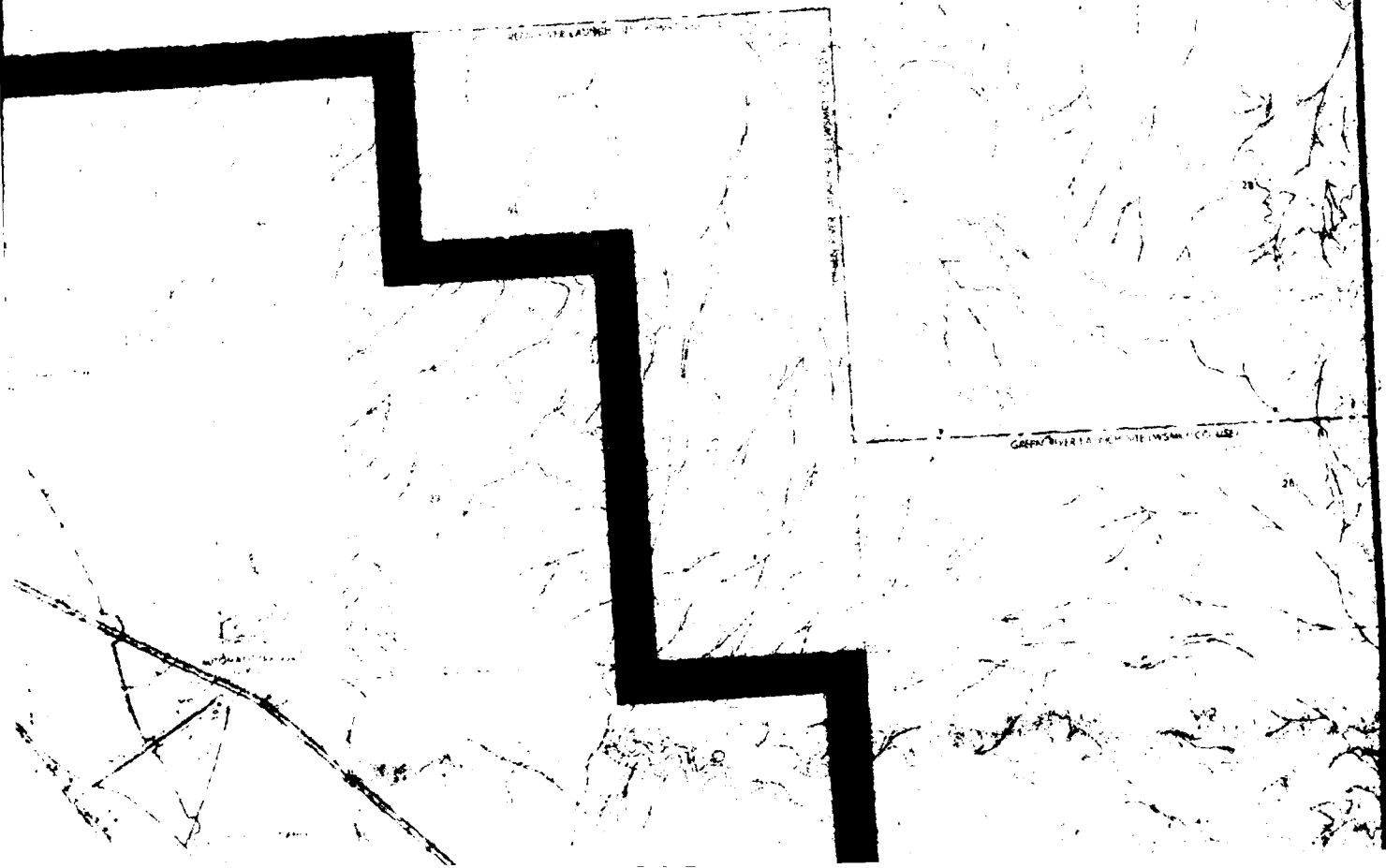


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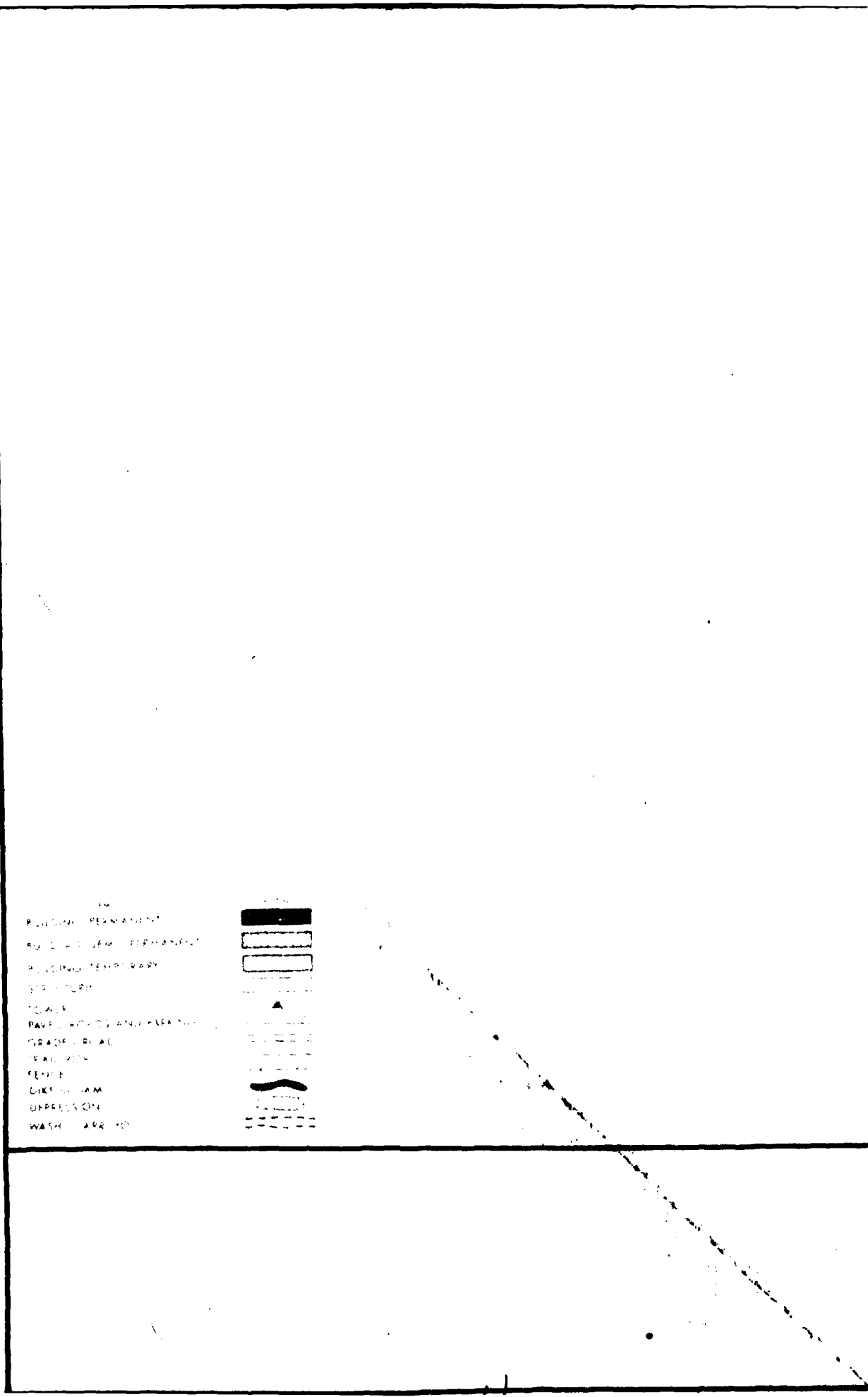


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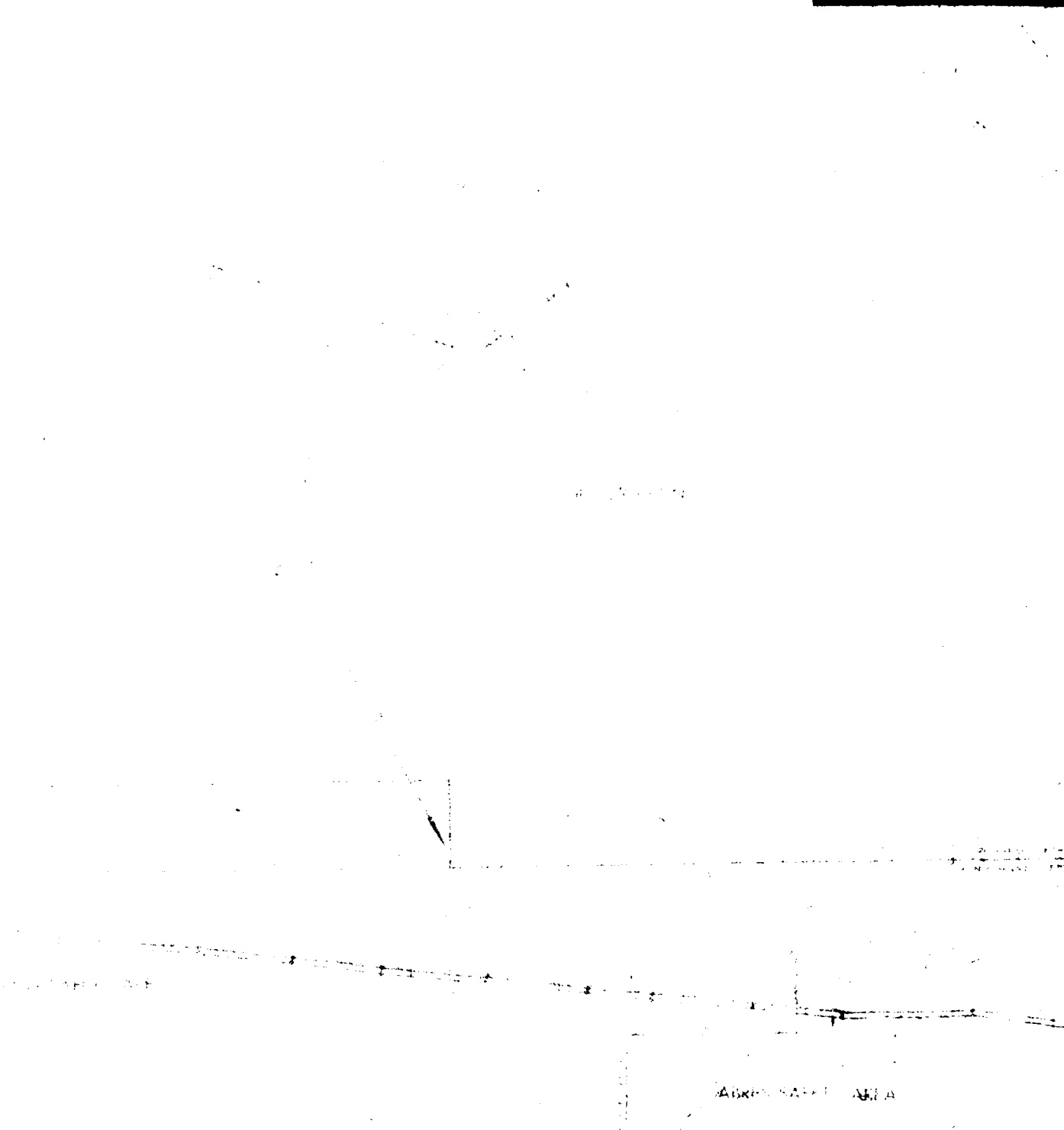
BUILDING PERMANENT
ROAD AND DAM PERMANENT
BUILDING TEMPORARY
DITCH TEMPORARY
TOWER
PAVE, WOODS AND HERBAGE
GRADE RYAL
RAILROAD
FENCE
DIKE OR DAM
DEPRESSION
WASH ARRAYS



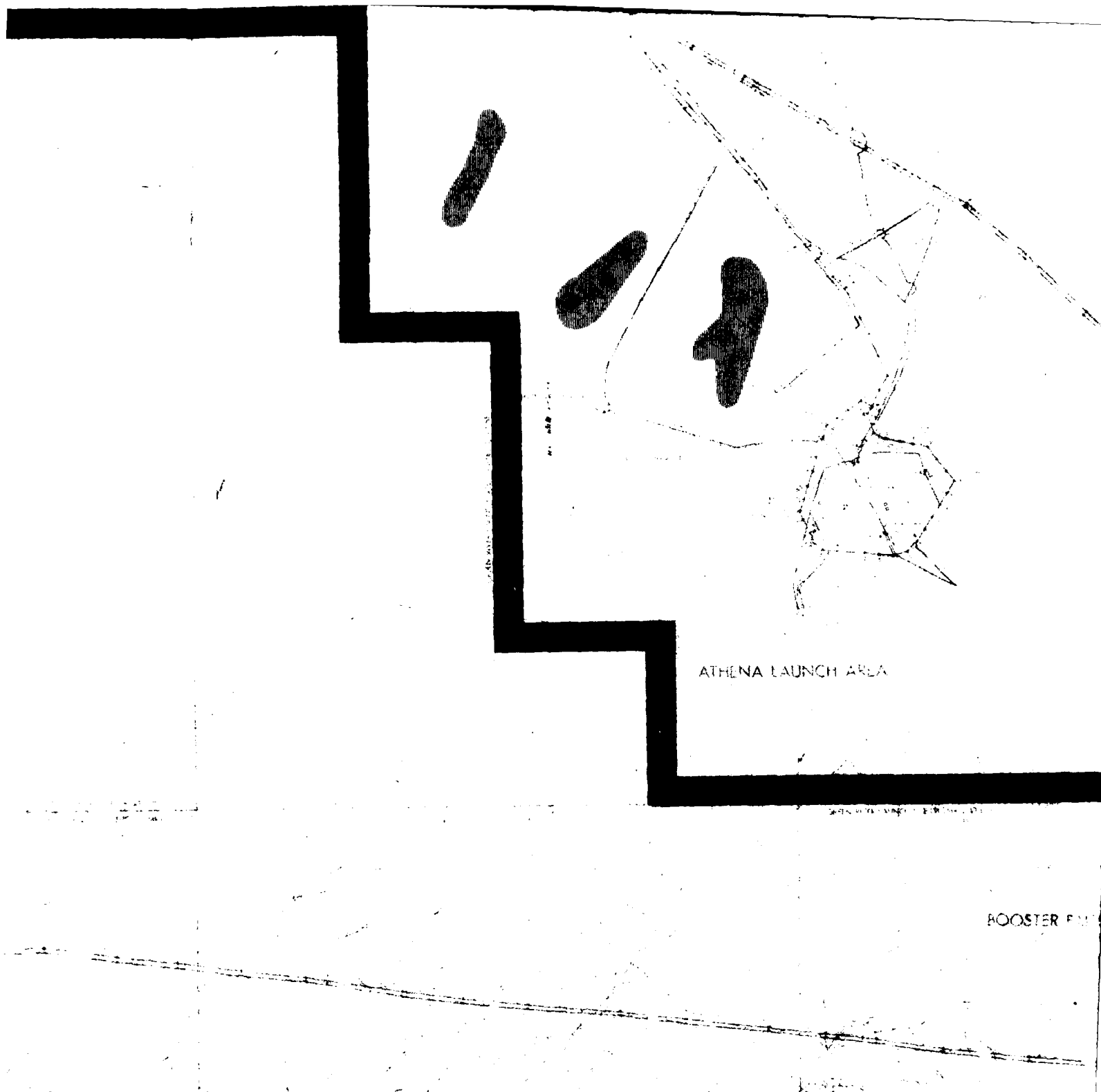
li

REPLYING SAFETY

12



ABR. 1911



ATHENA LAUNCH AREA

BOOSTER PATH

2000



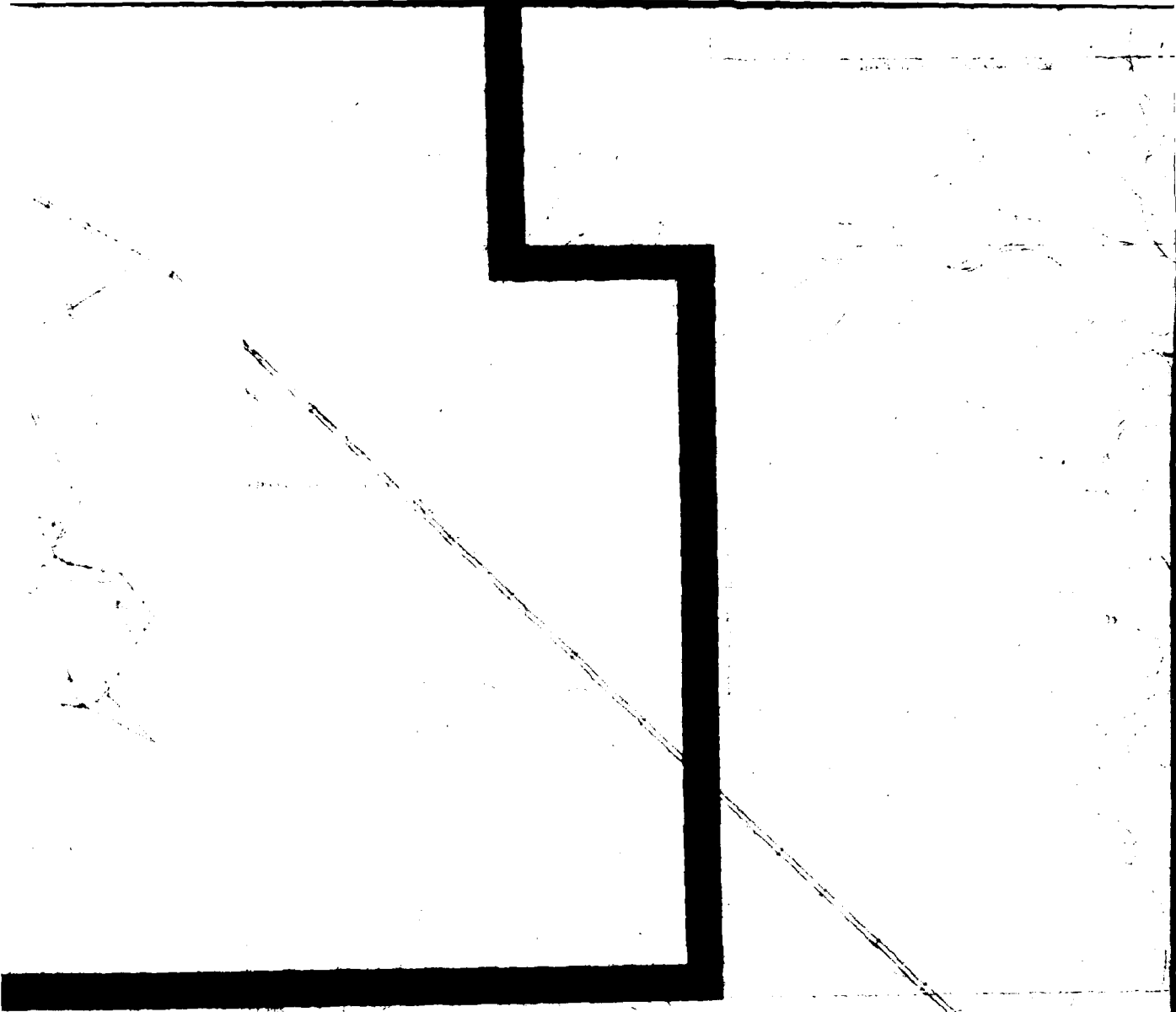
WHITE SAND

GREEN

DATE REVISED
OCTOBER 1972

SCALE
1" = 1

10



BOOSTER FALLOUT AREA

WHITE SANDS MISSILE RANGE, NEW MEXICO

MASTER PLAN
BASIC INFORMATION MAPS

GREEN RIVER - GENERAL SITE MAP INDEX GR-G7/G8 SPECIAL

DATE REVISED

OCTOBER 1972

SCALE

1" = 1000 FEET

DRAWING NO

PE-OM-692-GR

SHEET

1 of 6

PLATE

1

extinct animals, i.e. mammoths (Clovis Period) and Bison antiquus (Folsom). Sites attributable to these periods are extremely rare in Utah.

As far as the early Archaic Period is concerned, any site that contains data on the very early Desert Culture adaptations (Early Archaic) by human groups are particularly important to our understanding of the origins of the desert way of life particularly as they apply to life on the Colorado Plateau.

In terms of the Fremont Period, the proximity of Anasazi cultural entities to the south of the area raises the question of Fremont origins. Did the Fremont develop out of the preceding Archaic, does it have a plains origin, or is it an offshoot of the Anasazi? Certainly, resolution of the question of Fremont origins could go far in aiding our perception of Utah prehistory.

5.2 IDEAL GOALS AND OBJECTIVES

An ideal cultural resource management program would consist of 1) identification of resources, 2) evaluation of these resources as to their significance and potential to provide useful scientific data, and 3) an active program of conservation of these resources.

Identification would be accomplished through a two-phase program. Phase I would consist of a literature review to identify any known archeological and historic properties located on the Launch Complex.

Phase II of the identification program would consist of a field survey of the undisturbed portions of the complex in order to locate and identify surface evidence of prehistoric and/or historic sites. This survey program would include a close-interval pedestrian survey supplemented by detailed topographic maps and aerial photography. Standard forms as specified by the State of Utah Archeologist and supplementary forms should be completed for any prehistoric and historic materials found. Artifacts collected during the course of the survey should be kept to a bare minimum and all materials removed from the site should be fully documented and appropriately curated.

In some instances it may be necessary to include subsurface investigations (e.g., augering, test excavation, remote sensing) in order to determine site content, extent, and significance.

It is during this phase of the identification program that important research values as well as other values will be identified to serve as a basis for the development of future research designs and to serve as the basis for a variety of management options.

All sites located during the survey should be evaluated, in consultation with the State Historic Preservation Office (SHPO) for the State of Utah, regarding eligibility for nomination to the NRHP. In accordance with Section 106 of the Historic Preservation Act, any plans to modify or disturb a site 1) determined to be eligible for nomination to, 2) pending nomination to, or 3) listed on the NRHP will have to be submitted to the Advisory Council on Historic Preservation (ACHP) for comment.

Active conservation as an ideal concept embodies the idea that archeological resources are a non-renewable resource and once they are destroyed the research value can never be recovered. Consequently, it is critical that the cultural resources manager be able to exercise management options in a nonreactive manner (i.e., being presented with decisions which

may influence cultural resources). In other words, the greater the input of the cultural resource manager into the planning process, the better the management decisions.

Full-scale excavation and analysis of any resource is a course of action that should only be taken where the resource is threatened with unavoidable destruction or damage. On the otherhand, excavation and analysis should take place if site destruction is inevitable. It is important to the data recovery and the mitigation process that the archeologist be placed in a non-reactive situation (e.g., the site being threatened with immediate destruction). Again, the greater the archeologist's lead time, the greater and more efficient the data recovery process will be.

In either case, conservation or excavation, an ideal program also would incorporate an interpretative component in which the public is provided with the substance of the information values that are inherent in the resources present.

SECTION 6

CHAPTER 6.0 A RECOMMENDED ARCHEOLOGICAL MANAGEMENT PLAN FOR THE GREEN RIVER LAUNCH COMPLEX

6.1 FACILITY MASTER PLANS

Based on the Installation Assessment (Ludeman et al. 1982), Master Plan, maps, and an interview with Albert Johnson, Environmental Coordinator, White Sands Missile Range (WSMR), no plans exist for any future ground disturbing activities at the Launch Complex. Activity at the installation has been reduced to caretaker status, and the Army will not commit to any future projects at the installation (Table 6-1).

6.2 APPROPRIATE ARCHEOLOGICAL MANAGEMENT GOALS WITHIN GREEN RIVER LAUNCH COMPLEX

This section presents appropriate and efficient cultural resource management objectives for the Launch Complex. The basis of management objectives are the installations long-range and short-term projected land disturbing activities.

6.2.1 General Facility Planning

The Draft Army Regulations, 420.XX, prescribes Army policy, procedures, and responsibilities for compliance with the National Historic Preservation Act (NHPA), for maintaining state-of-the-art standards for preservation personnel and projects, and for the timely implementation of a historic preservation program. The AR 420.XX requires that each U.S. Army Materiel Development and Readiness Command (DARCOM) installation develop and implement an Historic Preservation Plan (HPP).

Following are the objectives of the DARCOM HPP:

- Integrate historic preservation requirements with military needs, construction activities, and real property and land use decisions.
- Provide cultural resources data for the installation information system.
- Provide guidelines for the management of historic properties.
- Prioritize the acquisition of additional information to determine if there may be additional cultural properties not yet located or identified.
- Prioritize installation undertakings by their potential effect on historic properties.

Criteria for the necessity to develop a plan is based on evidence of known cultural properties that may be eligible for inclusion on the National Register of Historic Places (NRHP). Because there is one potentially significant archeological property on Green River Launch Complex (GRLC), the installation meets the criteria and should develop a HPP. The information provided in this report will provide the basis from which the plan may be developed and implemented.

Table 6-1. A SUMMARY OF ON-GOING AND PLANNED ACTIVITIES ON THE GREEN RIVER LAUNCH COMPLEX THAT COULD AFFECT ARCHEOLOGICAL RESOURCES

| Activities | | Associated Resources | | | | Impacts | | | | | |
|-------------|------|----------------------|-------------------------------------|----------------------------------|----------------|------------------------------|-------------|-------------|--------|----------|--------------------|
| Description | Date | Area (ac.) | Estimated Depth Below Surface (ft.) | Ratio of Disturbed to Total Area | Resource Class | Resources Known or Predicted | NHHP Status | Other Value | Direct | Indirect | Mitigation Options |

Not applicable. No ground disturbing activities are planned for Green River Launch Complex.

The identification procedures have been initiated by the completion of this overview and recommended management plan and with the identification of the quarry site and mining claim on the Launch Complex, and the number of sites identified in the Bureau of Land Management (BLM) records which are located on the periphery of the installation (Figure 6-1). This needs to be followed by a complete identification and evaluation program, including an extensive oral and archival review, field surface, and subsurface inventory on all accessible undisturbed land and an evaluation of resource significance by the criteria established in 36 CFR 60.6. The HPP would be the basis for developing a Memorandum of Agreement (MOA) with the Advisory Council on Historic Preservation (ACHP). Intensive field surveys could be postponed until there are specific ground disturbing projects, or a sale, lease, or trade of any of the property is considered.

Under any schedule, until known archeological properties have been determined to be not significant, they must be treated as if they are significant for compliance with the NHPA. NHPA states that, "Each Federal agency shall exercise caution to assure that any such property that might qualify for inclusion is not inadvertently transferred, sold, demolished, substantially altered, or allowed to deteriorate significantly." It is recommended that the archeological property be professionally evaluated for significance and be managed in the interim as if the property was eligible to the NRHP. It is further recommended that the site be avoided by any Army activities and the area restricted to prevent vandalism.

The recommended next stage in the assessment of the importance of facilities historic and historic archeological properties is an extensive review of archival materials and analysis of *regional historic research* objectives. The archival review would include information contained in Emery and Grand County land records, county libraries, the National Archives and Records Service, BLM records, as well as other pertinent local documents and interviews with pre-1940 residents in and around the Launch Complex. The review should include consultation with the Utah State Historic Preservation Officer (SHPO) to determine if known historic and archeologic sites on the installation will answer specific regional research questions.

Executive Order 11593 and Section 110(a)(2) of the NHPA, as amended, requires that each federal agency establish a program to locate and nominate to the Secretary of the Interior all cultural properties under its control or ownership, that appear to qualify for inclusion on the NRHP. The identification stage of the recommended archeological management consists of a field surface survey and subsurface evaluation to locate archeological properties to determine their integrity and boundary extent and subsurface potential. Rather than require a 100 percent survey as the legislation implies, the current federal policy for implementing this requirement states that there should be a reasonable program consistent with schedules, budget, and multiple objectives of the land managing agency. While no ground disturbing activities are proposed for the installation, it would be most cost-effective to complete a professional archeological inventory for future installation management needs, especially if all or part of the property under Army jurisdiction is considered for lease, sale, or trade.

Based on the historic research and field inventory information, all identified sites, including the quarry (DARCOM GR-1) site, should be evaluated for inclusion in the NRHP by the criteria set forth in 36 CFR 60.6

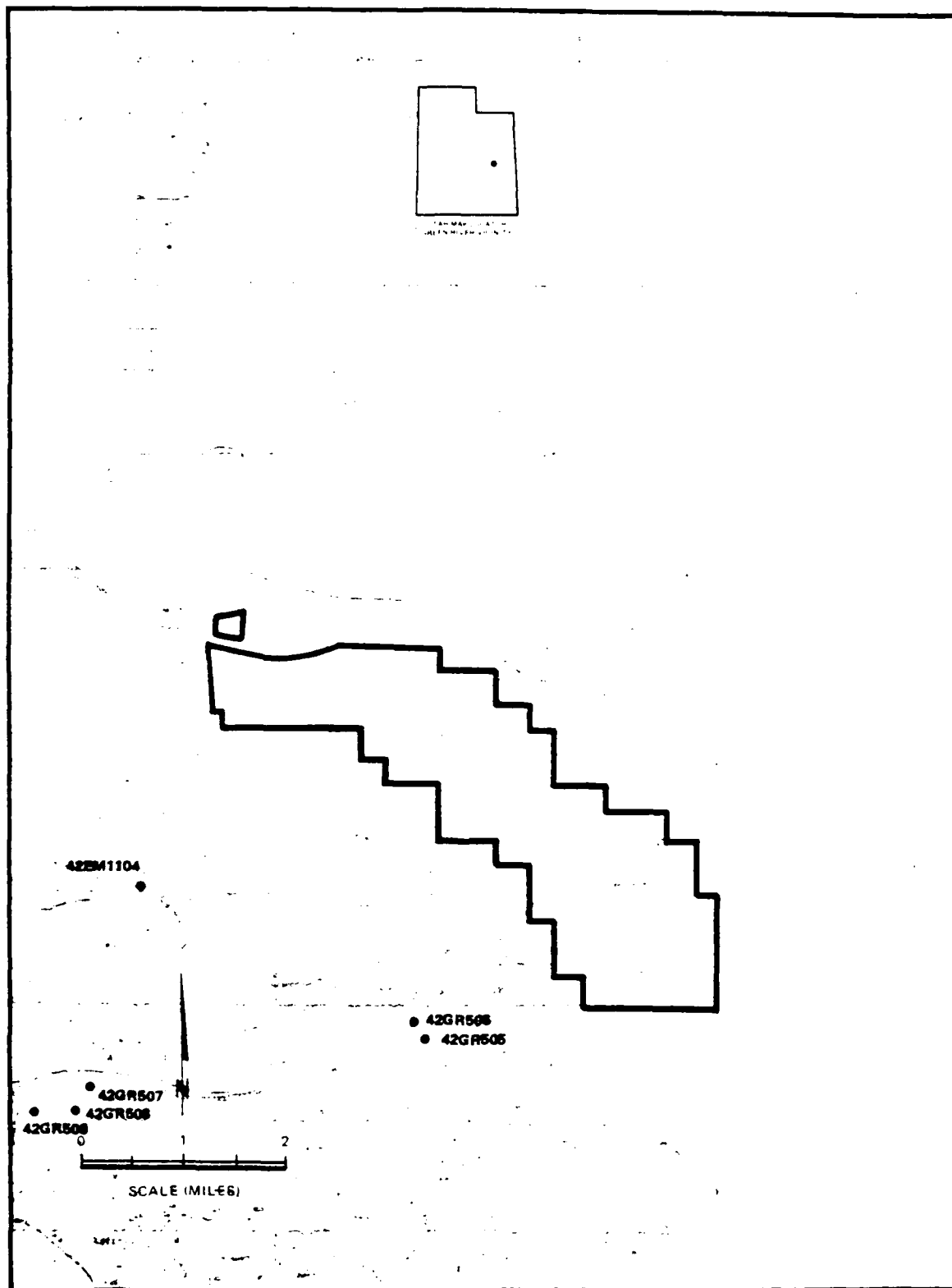


Figure 6-1. SITE LOCATIONS FOR KNOWN ARCH. PROPERTIES
NEAR THE GREEN RIVER LAUNCH COMPLEX

and by the research objectives of the Utah SHPO. If sites are determined to be significant, a long-term management plan should be incorporated in the installation's property management plan. Management considerations may include preservation and conservation with an annual field review of site condition or scientific investigation of sites to answer important research questions and to fill in research gaps.

The HPP containing the information in this report would constitute the basis for a preliminary case report required for a MOA with the ACHP. Procedures are outlined in 36 CFR 800.6(c). The Utah SHPO should be consulted and his written concurrence included in the ACHP request. A ratified MOA would contain comments of the Council and complete the Army's compliance responsibilities under Section 106 of the NHPA. The MOA reduces timely and often costly delays in compliance procedures that occur when significant cultural properties may be affected on a project by project basis.

It is further recommended that an individual be appointed who will be responsible for all historic preservation planning and who will act as the Army liaison among the SHPO and ACHP. It is recommended that the installation Preservation Officer provide the Utah SHPO and the ACHP an opportunity to review the installation's HPP. The plan should include information on any on-going activities or any special projects that may adversely affect any eligible properties. Alternatives should be developed that will reduce or mitigate any adverse effect.

However, if, after consultation with the SHPO, none of the identified sites are eligible, the installation should obtain a letter of agreement from the SHPO. With this correspondence and supporting documentation, the facility's historic preservation compliance responsibilities are completed.

6.2.2 GRLC Resource Protection or Treatment Options

While no ground-disturbing activities are planned for the installation, there is one known potentially significant archeological site on the installation. If plans are developed for lease, sale, or trade or future modification or land use, it is recommended that an intensive field survey be conducted by a professional archeologist to identify unknown, potentially significant properties. The Army would then be in compliance with Executive Order 11593 and Section 110 of the NHPA.

Quarry Site

The quarry site, DARCOM GR-1, may have potential historical archeological significance and should be professionally evaluated. The site should be properly recorded on Utah site forms and given a Utah site number. It appears that the Army has no plans to impact the area. The most appropriate and most cost-effective goal consistent with the Master Plan and the Utah SHPO, would be to protect and preserve the site. When a resource is selected for preservation, a management program that minimizes deterioration or destruction of the scientific, cultural, and associated values is required. In situ preservation, including avoidance by Army ground disturbing activities and restricted access with monitoring of the area to prevent vandalism, is recommended as the more responsible management procedure.

All of the project-specific management recommendations require consultation with the Utah SHPO. If eligible, properties will be affected by project activities, compliance with Section 106 is required and the Army is obliged to request ACHP comment. Figure 6-2 outlines the procedure for compliance with the ACHP regulations, 36 CFR 800 and AR 420.XX.

Mining Claims

The mining claim corners DARCOM GR-2, are probably not eligible to the NRHP in isolation, but should be recorded on site forms using sketches and photographs as required by the Utah SHPO. The site forms should be submitted to the Utah SHPO for recording in their inventory files.

Town of Elgin

The town site of Elgin, while outside the present installation boundary, should be protected through avoidance or monitoring, if Army activities resume and expansion is undertaken.

6.2.3 A Summary of Recommended Management Direction and Priorities for Effective Compliance and Program Development

It is recommended that a professional archeological inventory and evaluation be completed to identify archeological sensitive areas for compliance with Executive Order 11593 and Section 110 of the NHPA. The quarry site should be evaluated by a professional archeologist for inclusion in the NRHP. The mining claim corners should be recorded on Utah site forms and forwarded to the Utah SHPO for inclusion in the inventory file. The town of Elgin should be protected from vandalism and further destruction by Army activities.

6.3 ESTIMATED SCOPES OF WORK AND COST LEVELS FOR PRESENTLY IDENTIFIABLE MANAGEMENT NEEDS

6.3.1 Recommendation I

Executive Order 11593 and Section 110 of the NHPA require a land holding agency to identify significant cultural properties under their jurisdiction for future planning needs. Due to the lack of knowledge about the resources regionally and on the installation, there may be the potential for archeological resources to answer important research questions. Therefore, the first long-range management recommendation includes a field inventory. Green River covers 3546 acres (1435 hectares).

An intensive archival and historical review should precede the field survey and require an estimated 10 days for completion. The field inventory should be conducted by a professional archeologist who meets the qualifications outlined in Appendix C of AR 420.XX, the National Park Service (NPS) Regulation 36 CFR 61.4 and/or the Society of Professional Archeologist

ADVISORY COUNCIL REGULATIONS FOR THE PROTECTION OF HISTORIC AND CULTURAL PROPERTIES, 36 CFR.800

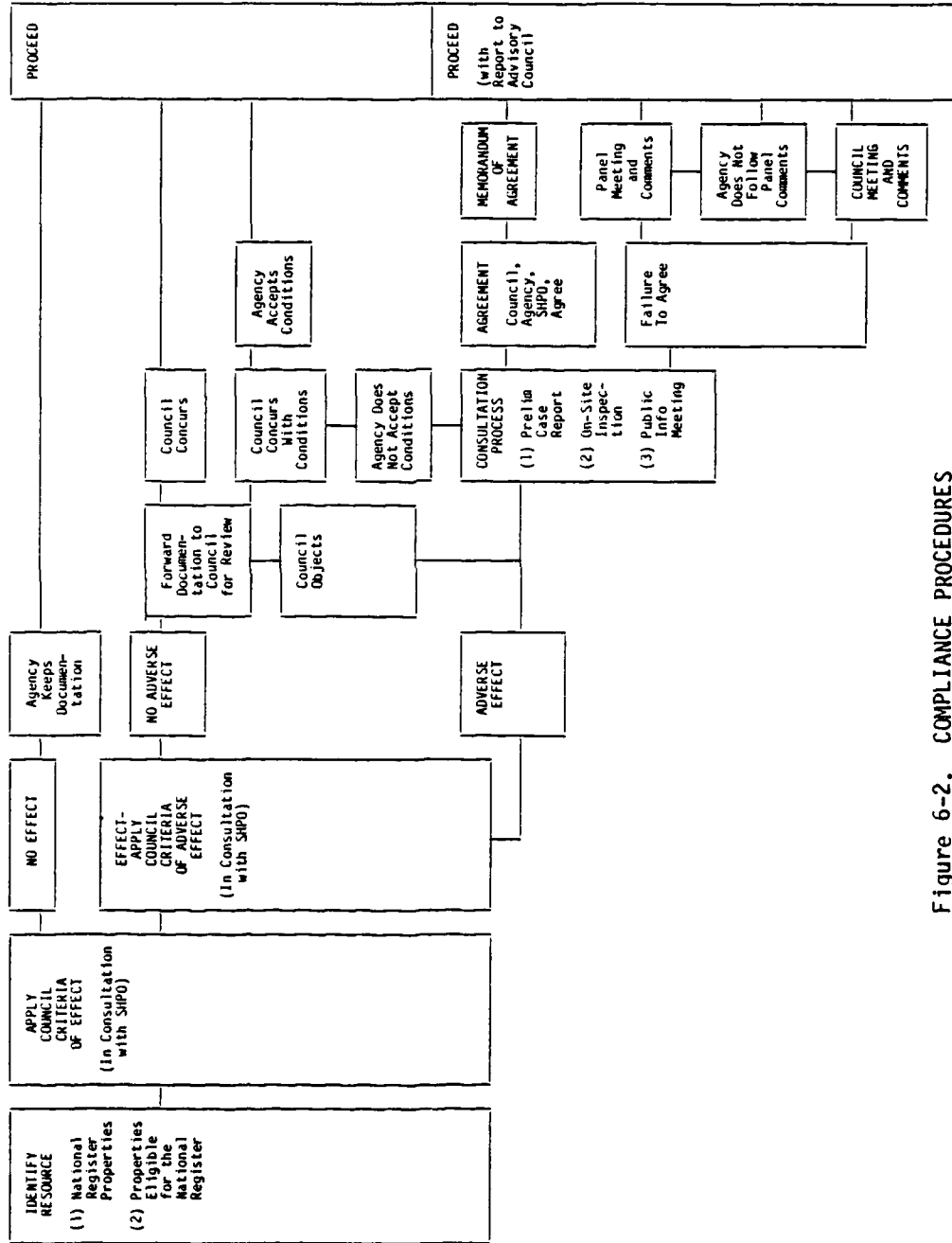


Figure 6-2. COMPLIANCE PROCEDURES

(SOPA), and have obtained an Antiquities permit issued by the Secretary of the Army, granted in accordance with AR 405-80. The archeologist should have demonstrated expertise on the Colorado Plateau. The inventory should be conducted with field personnel at close intervals. All cultural resource locations and required information should be incorporated on the Utah Intermountain Antiquities Computer System (IMACS) site form. Only diagnostic artifacts, i.e., projectile points and pottery, or artifacts in danger of being lost should be collected. Any artifacts recovered should be properly curated in an institution approved by the Army. All cultural properties should be evaluated for inclusion in the NRHP, and recommendations should be made for an appropriate management program.

At a rate of 100 acres a day with an assumed site density of five sites per square mile, field operations are estimated to require at least 36 days. The field inventory does not include costs for subsurface investigation. The field inventory, analysis, and evaluation program including travel (local expertise), communication, and report preparation expenses average \$20 to \$25 per work hour. Archival review, and supervisory expertise average between \$25 to \$35 per work hour. The costs of this optional management recommendations are shown on Table 6-2 and are calculated in 1983 dollars. The estimated cost does not cover more than routine involvement of the consultant in the federal and state consultation process.

Table 6-2

COSTS OF OPTIONAL MANAGEMENT PLAN*

| | <u>Acres</u> | <u>Acres Per Day</u> | <u>Man Days</u> | <u>Man Hours</u> | <u>Dollars</u> |
|-----------------|--------------|--------------------------|---------------------|----------------------|-------------------|
| Archival | | -- | 10 | 80 x 25 x 35 | \$ 2,000 2,800 |
| Field Survey | 3546 | 100 | 36 | 288 x 20 x 25 | 5,760 7,200 |
| Report Analysis | | | 72 | 576 x 20 x 25 | 11,520 14,400 |
| | | | | Lowest | \$19,280 |
| | | | | Highest | \$24,400 |

*Estimated costs do not include administrative costs or profit/fee.

Milestones for recommended sequential procedures are:

- Complete archival and oral historical review to document potential significance of any historic archeological resources which might be located on GRLC.

- Complete field inventory and evaluation of all identified archeological, historical, or architectural resources with the completion of subsurface investigations to support evaluations.
- Complete draft report on field investigations, recommended evaluations, development of predictive model, mapping archeologically sensitive areas, and management program for DARCOM review.
- Complete review by DARCOM with acceptance letter and approval for interagency review.
- Complete consultation among Utah SHPO, DARCOM and the cultural resource consultant concerning evaluations and HPP.
- Complete review by the Keeper of the NRHP for evaluation submitted by DARCOM (a letter of agreement will complete documentation).
- Initiate consultation process among DARCOM, SHPO, and ACHP on the HPP submitted as a basis for a Preliminary Case Report for MOA.

6.3.2 Recommendation II

The quarry site, DARCOM GR-1, should be evaluated for inclusion in the NRHP by determining the present condition of the site and assessing if the site will yield information important to the prehistory or history of the area and the Ute tribe. A field investigation would include locating and mapping the site, followed by on-site testing to determine if there are subsurface remains, and the extent and condition of the site. The archeology site should take two people two days to complete with subsurface testing. The mining claim corners, DARCOM GR-2, should be mapped and photographed and the Utah site form complete and submitted to the Utah SHPO for inclusion in the state inventory files. This should take one person two days. All qualifications outlined in Recommendation I should be met.

It would be more cost-effective to combine all investigations into one time frame to minimize travel and per diem expenses. The cost estimate assumes that the field investigation will be coordinated. Cost for the labor rate are \$20 to \$25 in 1983 dollars. It would be necessary to perform a historical and archival review only if this had not been completed in connection with Recommendation I. Costs do not include historical and archival review. The estimated costs for the quarry site are between \$1,920 and \$2,400, for documenting the mining claim corners between \$320 to \$400. Both estimates include the evaluation program with field survey and mapping including necessary local travel, communications, data management, and report preparation. These costs include preparation of Utah state site forms, completion of analysis and report, and limited participation in the Utah SHPO consultation process.

Milestones include:

- Complete field investigation including mapping and subsurface testing.

- Complete Utah site forms for submittal to the SHPO.
- Complete evaluation of significance.
- Complete NRHP inventory forms, if appropriate.
- Complete consultation process with Utah SHPO for eligibility determination with necessary documentation, if appropriate.
- Complete review by the Keeper of the NRHP (a letter of agreement will complete documentation).
- Complete management procedures to protect significant properties from further vandalism or destruction.

The appropriate state and federal consulting authorities are: The Utah State Historic Preservation Officer, 300 Rio Grande, Salt Lake City, Utah, 84101. (He is the consulting agent for compliance responsibilities outlined in 36 CFR 800 and should be contacted for any problems relating to cultural resource management.); the Utah State Archeologist, 300 Rio Grande, Salt Lake City, Utah 84101; Advisory Council on Historic Preservation, Western Division of Project Review, 730 Simms St., Room 450, Golden, Colorado, 80401; Department of the Interior, National Park Service, Interagency Archeological Services, 655 Parfet Street, P.O. Box 25287, Denver, Colorado, 80225.

SECTION 7

CHAPTER 7.0 SUMMARY

Prehistoric and historic archeological resources are known or presumed to exist on the undisturbed portions of the Green River Launch Complex (GRLC). Prehistoric resources considered to be critical are archeological sites of the Paleo-Indian stage particularly the Clovis and Folsom Periods; the Early Archaic Period of the Archaic Stage; and the Fremont Period of the Formative Stage. It is also true that our knowledge of the Pre-Clovis and Plano Periods of the Paleo-Indian Stage, the Middle and Late Archaic Periods and the Past Formative Stage is incomplete and any resource assignable to these periods should be carefully managed to insure that their potential information is not lost.

Compliance with the various provisions of the National Historic Preservation Act (NHPA), the Archeological and Historic Preservation Act, 36 CFR 800 and Draft Army Regulations AR 420.XX requires the identification, evaluation, and where practical and feasible, positive management of significant prehistoric and historic archeological resources. Draft Army Regulation 420.XX also requires that each U.S. Army Materiel Development and Readiness Command (DARCOM) installation develop and implement an Historic Preservation Plan (HPP).

Consequently a series of management recommendations are presented in this report. These recommendations are as follows:

1. An archival and historic review of the literature plus an intensive surface survey or inventory of the surface area of the complex should be undertaken by a professional archeologist. It is estimated that this inventory program will range in cost between \$19,280 and \$24,400 in 1983 dollars.
2. The quarry site (DARCOM GR-1) and the mining claim site (DARCOM GR-2) should be evaluated for inclusion in the National Register of Historic Places (NRHP). Estimated costs for evaluation will range between \$1,920 and \$2,400 for the quarry site and between \$320 and \$400 for the mining claim site in 1983 dollars.

If eligible resources are found during the course of survey, they should be evaluated for inclusion in the NRHP.

SECTION 8

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APPENDIX A

APPENDIX A CLASSIFICATION METHODS FOR SITE AND LANDFORM TYPES

Classification methods used to describe site type and landform (Table 4-2) are drawn from Intermountain Antiquities Computer System Users Guide (Tables A-1 and A-2) currently in use in the State of Utah.

Table A-1. LANDFORM NAMES FOR DARCUM ARCHEOLOGICAL OVERVIEWS AND MANAGEMENT PLANS

| Geographic Reference (a) | Primary Landform | Primary Position | Secondary Landform | Secondary Position | On-Site Content |
|--------------------------|----------------------|-----------------------|---------------------------|-------------------------|--------------------------------------|
| Desert West | Mountain Hill | Top/Creek/Peak Edge | Alluvial Fan | Top/Crest/Peak Edge | Fan |
| | Tableland/Mesa Ridge | Slope | Ancove/Rock Shelter | Slope | Talus |
| | Valley | Toe/Foot/Bottom/Mouth | Arroyo | Toe/Foot/Bottom/Mouth | Dune |
| | Plain (upland) | Saddle/Pass | Basin | Interior | Stream Terrace |
| | Canyon | Bench/Ledge | Cave | Riser | Shore Feature, Extinct Lake |
| | Coast/Shoreline | Rimrock Interior | Delta | Patterned Ground | Shore Feature, Existing Lake |
| | | | Detached Monolith | Face (i.e., Cliff Face) | Alluvial Plain (Canyon, Valley Fill) |
| | | | Floodplain | Face | Colluvium |
| | | | Ledge | Saddle/Pass | Moraine |
| | | | Mesa/Butte | | Flood Plain |
| | | | Playa | | Marsh |
| | | | Portable Geological Plain | | Landslide/Slump |
| | | | Ridge/Knoll | | Delta |
| | | | Rockshelter | | Desert Pavement |
| | | | Slope | | Outcrop |
| | | | Terrace/Bench | | Stream Bed |
| | | | Talus Slope | | Aeolian |
| | | | Island | | None (Rock Art, No Soil) |
| | | | Outcrop | | Residual |
| | | | Spring Mound/Bog | | |
| | | Valley | | | |
| | | Cutbank | | | |
| | | Riser | | | |

(a) Intermountain Antiquities Computer System (IMACS) Users Guide: Instruction and Computer Codes for use with the IMACS Form. Univ. of Utah, Bureau of Land Management, U.S. Forest Service. 1982.

Table A-2. RESOURCE TYPE NAMES FOR THE DARCUM ARCHAEOLOGIC OVERVIEWS AND MANAGEMENT PLAN

| Prehistoric Components | | Historic Components | |
|------------------------------------|--|----------------------|--------------------|
| | Themes | | Structure/Function |
| Agricultural fields | Agriculture and Ranching (AR) | Lean-to | |
| Bedrock mortars | Commercial (C) | Mill | |
| Burial | Domestic (D) | Mine shaft | |
| Burial mound | Education (ED) | Monument | |
| Butchering station | Exploration (EX) | Quarry | |
| Camp | Government (political, economic aspects (G)) | Pipeline | |
| Cemetery | Government (political, economic aspects (G)) | Ranch | |
| Fieldhouse | Manufacturing craft (MC) | Railroad bed/trestle | |
| Fortification | Manufacturing, industrial (MI) | Road | |
| Fortified village | Military (MT) | Shed/garage | |
| Habitat site | Recreation (RC) | Springhouse | |
| Irrigation ditch/dam/system | Religious (RL) | Tramway | |
| Kill site | Transportation and Communication (TC) | Trestle | |
| Limited activity area | | Town | |
| Lithic workshop | | Village | |
| Medicine wheel | | Wall | |
| Midden | | Well/cistern | |
| Mound | | Windmill | |
| Plant gathering site | | | |
| Quarry | | | |
| Road | | | |
| Rock art (pictography, petroglyph) | | | |
| Rock circles | | | |
| Scarred tree | | | |
| Tipi rings | | | |
| Trail | | | |
| Village | | | |
| | | Barn | |
| | | Barracks | |
| | | Bridge | |
| | | Bulkhead | |
| | | Cabin | |
| | | Cairn | |
| | | Cemetery | |
| | | Church | |
| | | Dam | |
| | | Ditch | |
| | | Dock | |
| | | Dump | |
| | | Farm | |
| | | Fire tower | |
| | | Flume/raceway | |
| | | Fort | |
| | | Fortification | |
| | | Granary | |
| | | House | |

APPENDIX 8

APPENDIX B RESOURCE LOCATIONAL DATA

Table B-1. LOCATIONAL DATA, KNOWN ARCHEOLOGICAL RESOURCES ON THE GREEN RIVER LAUNCH COMPLEX

| Site Number | UTM(a) | | Legal Reference | | | USGS Quad Map (b) | CR (c) |
|-------------|----------|---------|-----------------|-------------|-------------|-------------------|---------|
| | Northing | Easting | Reference | Township | Range | | |
| DARCOM GR-1 | 4311020 | 579460 | Zone 12 | SW 1/4 T21S | NW 1/4 R17E | NE 1/4 31 | G1554 3 |
| DARCOM GR-2 | 4311020 | 579960 | Zone 12 | SW 1/4 T21S | NW 1/4 R17E | NE 1/4 31 | G1554 3 |

NOTE: The two sites overlap with GR-2 overlying GR-1.

(a) Universal Transversal Mercator (UTM), zone 12 SWU

(b) U.S. Geological Survey (USGS)

G1554 = Green River, UT 15 min (1954)

(c) Confidence rating (CR) ranging from 0 (no value) to 5 (highest value)

Table B-2. LOCATIONAL DATA, POTENTIAL ARCHEOLOGICAL RESOURCES ON THE GREEN RIVER LAUNCH COMPLEX

| Northing | UTM(a) | | Legal Reference | | | USGS Quad Map (b) | CR (c) |
|----------|---------|--|----------------------------|----------------------------|----------------------------|-------------------------|-----------|
| | Easting | Reference | Township | Range | Section | | |
| 4311020 | 579460 | Zone 12 | SW 1/4 T21S | NW 1/4 R17E | NE 1/4 31 | G1554 | 3 |
| 4310620 | 579700 | Section 31 | NE 1/4 SE 1/4 T21S | NE 1/4 NE 1/4 R17E | | | |
| 4311440 | 579160 | Section 30 Section 31 Section 30 | SE 1/4 NE 1/4 SW 1/4 | SE 1/4 NE 1/4 SW 1/4 | SW 1/4 NW 1/4 SE 1/4 | | |
| 4311520 | 578600 | Section 14 Section 23 Section 23 | T21S T21S T21S | R16E R16E R16E | SW 1/4 NW 1/4 NE 1/4 | | |
| 4314540 | 575500 | Section 24 Section 24 | T21S T21S | R16E R16E | SW 1/4 SE 1/3 | | |
| 4315400 | 575500 | Section 25 | T21S | R16E | NE 1/4 | | |
| 4312590 | 578600 | Section 30 | T21S | R17E | MW 1/4 | | |

NOTE: The two sites overlap with GR-2 overlying GR-1.

(a) Universal Transverse Mercator (UTM), Zone 12 SWU

(b) U.S. Geological Survey (USGS)
G1554 = Green River, UT 15 min. (1954)

(c) Confidence rating (CR) ranging from 0 (no value) to 5 (highest value)

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