January 10, 1973

Memorandum

To: Mr. Edward W. Crump, Technical Officer

From: G. H. Simonson, U-619, Oregon State University

Subject: Progress report for period ending December 31, 1972, of SR-345 "Comparative Evaluation of ERTS-A Imagery for Resource Inventory In Land Use Planning."

Overall Objectives:

1. Use a multi-discipline team approach to determine features that can be successfully monitored by ERTS-A imagery for resource inventory, planning, land-use zoning and resource development.

2. Using carefully selected sample areas, develop a comprehensive resource inventory mapping system for use in planning, zoning, and resource development.

Work during the reporting period has included quick-look analysis of ERTS frames by the multidisciplinary team and filing of Image Descriptor forms on a continuing basis; color enhancement of selected frames for Timber Type Mapping; identification and delineation of Soil landscape, geologic strucutre, macrorelief and vegetation units at 1:1,000,000 scale on selected frames; aiding local users in applications of the imagery; testing extraction and reformating programs of digital data.

We have received at least one set of cloud free ERTS-1 coverage for all but one flight strip on the Oregon Coast. Using the red-band, black-and-white MSS prints from NASA, we laid an uncontrolled mosaic of all available frames at an approximate scale of 1:1,000,000. The mosaic will be completed as additional, useable imagery comes in. This mosaic will be useful as an uncontrolled base to put display overlays of various interpretations so they can be seen in state-wide perspective. Even where the area of interest is a restricted location, such as a county or council of government area, information displayed in overlay form for that area are immediately related to the resource and landform features of the study area and are seen in the readily comprehensible perspective of the surrounding area. Many resource characteristics of the state are immediately apparent, even to lay observers, from this mosaic because it is in photo form. If laid from color reconstituted prints, it would be even more valuable. Measurements of a number of disparities along matching lines showed a maximum offset of 3 mm and an average offset, or mismatch, of .4 mm. This, we think, is phenominal for a system that is not supposed to have high geometric fidelity.

With receipt of useable ERTS-1 data in our prime study area, Crook County Oregon, we re-established contact with local land-use planning groups during the last weeks of this quarter. The county planner requested assistance, through our Environmental Remote Sensing Applications Laboratory (ERSAL),

with an inventory of the developmental and building status in a large number of approved recreational home site subdivisions throughout the county. Because of image resolution limits in the photographic product and low scene contrast in some of the development areas, this interest could not be monitored from the ERTS imagery. We were, however, able to do so by the interpretation of NASA-Ames highflight photography. We used Color IR metric imagery in 9" x 9" format because of the more suitable scale. We could have used the Vinten 70 mm imagery by viewing with suitable stereo magnification from the contact scale transparencies. The data of interest were obtained for all 46 developments in the county, 2,892 square miles gross area, with 20 man hours of interpreter time. We have not been able to determine if these same features are discernable in the digital ERTS data.

The Environemtnal Remote Sensing Applications Laboratory is handling all data acquisition, indexing, and file management for personnel of our ERTS-1 participation project. In addition, the Laboratory is interacting with potential new users in the state. They are coming in increasing numbers to examine imagery and discuss potential applications of both the ERTS-1 and highflight data on problems peripheral to our project objectives. Where these people have an interest close to the objectives of this project they are encouraged to become involved. Four county agents outside of our concentrated study areas have ordered ERTS and Highflight imagery to display county data for land-use planning and for trials in the solution of other kinds of problems in their respective counties.

In an attempt to solve the data lag problem, we ordered some copies of selected imagery from the Sioux Falls data facility but it was destroyed in a train wreck on December 11, 1972 and is being reprinted. For our central Oregon intensive study area we have also purchased some band 4, 5, 6, as well as 4, 5, 7 color reconstitutions from General Electric. They have promised us a short turn-around time and the work is currently being done. Because of the excellent registry and resolution detail of these products, we felt that it is important to get one set more quickly than they can be provided at the present time through Goddard. We also have on order the materials for doing some Diazo color combinations but are experiencing most disturbing delays in delivery from all sources. It would appear that ERTS investigators together with regular users of these materials are oversaturating the supply capability of manufacturers and distributers.

We have received one Band 4, 5, 7 reconstitution from General Electric and one on a retrospective order from GSFC for the Willamette Valley. While it is now too late to positively confirm some of the signatures, it does appear that the 29th of July, 1972 ERTS imagery did an excellent job of recording all of the then burned grass seed fields in the entire valley. This is related to an important environmental quality problem. The State Department of Environmental Quality (DEQ) is concerned about administration of burning regulations. Their cumulative records of burned fields are not too accurate and dependent on the mail reporting of burning activity. Except for the fact that 18-day coverage (minus skips because of cloud cover)

is not as frequent DEQ needs, it does appear on cursory examination that ERTS imagery may have some value as a periodic cross check on accuracy of field burning records. Rate and timing of burning is a useful statistic in setting the burning schedules and in assessing the effectiveness of these regulations on visibility and air quality. We have received from DEQ a tabulation of their cumulative burning record as of July 31. We will shortly analyze the color reconstituted space photograph to determine how acreage from photo interpretation compares with the reported acreage. This will not be a positive check because we did not receive the imagery in time to perform a ground check and to determine the possible error in burned field identification. Since the appearance of fields has changed drastically by new green growth, confirmation of burn status may be possible only from a field check. For this peripheral interest to our project objectives, we will not be able to do this rather expensive work; but if our acreage comparison is close, we might be able to get DEQ to do some field checking for us in areas of uncertainty.

The Computer Center has tested extraction and reformating programs with ERTS digital imagery, and a set of these routines is now operational. Included are programs that not only produce subsets of digital imagery in a structure more compatible with the local computer system but also give several levels of statistical descriptions and warnings of bad data. As a result of the above testing, several improvements are under development for conclusion in future revisions of the utility packages.

Both program development and testing have been hampered by either the lack of digital imagery or errors in the data received. Our original request for bulk MSS data was made in mid-October, and we have yet to receive an error-free set of tapes for a single scene.

Work is continuing also on adapting the CALSCAN recognition program to the CDC 3300 computer.

Activity in PIXFL (Pictorial Information Extraction and Enhancement Laboratory) has centered in two major areas:

1. Fine textural features have been evaluated for their effectiveness classifying water resources, urban areas, forest areas, and agriculture.

   Preliminary indications are that texture is an extremely important feature in land use classification. Detailed results are being prepared for publication.

2. The laboratory has provided initial technical support to the forestry portion of the interdisciplinary team in an attempt to identify regions of Tussock Moth infestation. The results at this point are inconclusive.

During this period we have begun to evaluate the ERTS imagery of Crook County for use in landform interpretation and geologic mapping and interpretation. Highflight comparative imagery has just become available and has not yet been used extensively. Outside Crook County the geology team has been particularly impressed by the display of fault patterns in southeastern Oregon and has begun preliminary analyses of these. Consultation with E. Taylor on the imagery of the High Cascades near Bend, Oregon, indicates that both ERTS and highflight imagery display recent volcanic activity to advantage. Taylor, who has mapped most of the area in question from the ground, is impressed both by the synoptic view of ERTS and by the information content of the highflight. The latter displays relations in some places that are quite difficult to distinguish on the ground.

Using our color combiner we have completed a timber type map of (1) all the forest land within Crook County and (2) all of the Ochoco National Forest, part of which is outside Crook County. By doing this we will have a direct comparison between our inventory and a completely independent inventory being completed by the U. S. Forest Service. This map is at 1:1,000,000 scale. To complete the map we had to use ERTS frames 1076-18211, October 7, 1972 and 1021-18151, August 13, 1972. The timber types consist of five density classes which are correlated with different species compositions as the first step in the multi-stage forest inventory. The different density strata (from light to heavy stocking) are:

I less than 10% stocked with commercial trees or non-stocked forest land

II poorly stocked--mostly ponderosa pine

III poor to medium stocked - mixed larch and ponderosa pine

IV medium to well stocked - mostly Douglas-fir, larch, and true fir types

V very well stocked stands - mostly true fir on north slopes with associated species

These strata are correlated with timber volume. From this imagery a PPS sample will be selected for timber volume analysis on the 1:120,000 scale highflight photography received from NASA.

As a comparison with ERTS imagery we are now preparing a similar timber type map using the Vinton photography and the color combiner.

Using the ERTS magnetic tape data our computer center has produced a 12 by 25 mile strip printout of bands 5, 6, and 7 of portions of frame 1021-19151 dated August 13, 1972. Band 4 was not printed due to an apparent flaw in the tape. The computer printouts are to be analyzed for different timber types (species and density),possible insect damage.

Other observations to date:

1. The limited number of clearcuts in Eastern Oregon and in the Cascades are evident--down to five acres or less in size (about 400 feet in diameter). With the imagery we have of the west coast much larger clearcuts are not visible on band 5. This is probably due to the climatic conditions present during the late summer and fall season. Spring and summer imagery should be better.

2. When placed on the color combiner, band 7 is difficult to register--it appears to be a slightly larger scale than the other bands.

3. Positive transparencies of band 5 appear to be too dark for maximum information content of forested areas even though they are excellent for agricultural areas.

4. There appears to be much more information in the computer printouts of bands 6 and 7 than 5 when analyzing forest conditions.

An example of team mapping and interpretation of resource features is included as an appendix to this report. The mapping was done on ERTS frame #1076-18211-5 at a scale of 1:1,000,000 and is quite generalized. However, maps at this scale and level of detail appear to be highly useful for regional planning and resource inventory. We will be utilizing color reconstituted imagery and enlargements at 1: 250,000 scale for more detailed analysis of the Crook County portion of this area in the next stage of inventory and interpretation work.

GHS:dh

APPENDIX

TEAM INTERPRETATION OF ERTS FRAME 1076-18211-5

Vegetation and land-use

Timber type and density

Structural geology

Macrorelief geomorphology

Soil-landscapes

VEGETATION LEGEND NARRATIVE FOR ERTS FRAME 1076-18211-5

CROOK COUNTY AREA

131 Bedrock Outcrops

Major outcrops of mappable size and mountain peaks along the Cascade Range which do not support any major vegetation due to elevation, climate, and lack of soil.

132 Extrusive Igneous

Recent lava flows within the Cascade Mountains and in the adjacent flatter lands to the east of the mountains. The flows are recent enough that a soil mantle capable of supporting the vegetation of the surrounding types has not developed.

212 Man-made Reservoirs and Ponds

Reservoirs on the Crooked River (Prineville Reservoir) and Ochoco Creek (Ochoco Reservoir) primarily constructed for irrigation and recreation. The reservoirs on the Deschutes River (Lake Billy Chinook and Lake Simtustus) were primarily developed for hydro-electric power and recreation. Others may be seen, but are too small to be mapped at this scale.

316 Meadows

Mountain meadows (elev. 4,500-5,000 ft.) in the basins of the Ochoco Mountains at the headwaters of the Crooked River. Densely vegetated with a variety of grasses, sedges and forbs which are adapted to extreme seasonal moisture condition changes. Willows and rushes occur in pockets and stringers along the margin of the meadows where streams and springs enter. The meadows are bordered on all sides by Ponderosa Pine-scabland complex.

324.3 Greasewood

Small bottomland along the drainage with deep silty alkaline soils. Greasewood is the dominant shrub with Green Rabbitbrush and Tall Sagebrush present. The herbaceous layer is sparse with saltgrass dominant and few other grasses present. A high proportion of the soil surface has no vegetation cover.

325.1 Low Sagebrush

Gently rolling upland in the hills east of the Maury Mountains. Drainageways are shallow and there are several playas scattered over the type. Entire aspect dominated by Low Sagebrush. Herbaceous cover sparse, some bunchgrasses and few forbs. Soils are shallow with high clay content and a clay pan or bedrock limiting layer. Surface gravel and stone cover is high.

325.2/314/325.1 Tall Sagebrush/Bunchgrass Steppe/Low Sagebrush

Dissected and rolling uplands of the lower John Day and Deschutes drainages. Tall Sagebrush is dominant on the deep soiled uplands and rolling hills. The bunchgrasses (Bluebunch Wheatgrass, Idaho Fescue and Sandbergs Bluegrass) dominate on the deeper loessal soils of the uplands and on the protected slopes. Scattered Junipers occur throughout the southern portion of the type. The entire slope that ranges from the lowland to the rolling uplands in the southern portion of the type is dominated by Low Sagebrush on the ridges and the shallow stoney soils of exposed slopes. With this band and date of imagery, the grasslands cannot be distinguished from the shrublands or Juniperlands at this scale.

325.2 Tall Sagebrush

Gently rolling to flat valleys south and east of the Maury Mountains. Sandy loam soils supporting Tall Sagebrush and bunchgrasses. A few small areas of shallow stoney soils are dominated by Low Sagebrush.

341.01 Juniper

Dissected uplands bordering the interior mountains (Maury and Ochoco). High stone cover and roughness of the terrain gives the image its dark tone. Throughout the type the shrub layer is dominated by Tall Sagebrush, with the Sagebrush becoming dominant on some of the smoother areas in the eastern portion of the type. Several small meadows are along the drainages which support agricultural cropping. More mesic shrubs occur along rock outcroppings and major breaks in the ground.

341.01/325.2 Juniper/Tall Sagebrush

Gently undulating lands between the Cascade Range and the interior mountains. Shallow to deep sandy soils with protruding portions of lava flows. The area is deeply dissected along the major drainages. The Juniper cover ranges from very dense to areas which are dominated by Tall Sagebrush. Some agriculture is spreading into this type where the soils are suitable and irrigation is practical.

341.03 Ponderosa Pine

Eastern toe of the Cascade slope and the uplands of the interior mountains on soils of volcanic origin.

On the Cascades the upper limit of the type is the true firs. The site becomes more xeric as it goes down the slope. At the upper limits, the understory is dominated by Manzanita. Moving eastward through the type the understory changes to Bitterbrush and then Juniper and Tall Sagebrush.

In the interior mountains, this type ranges from the true fir on the protected slopes and higher elevations to Juniper, Sagebrush and Scablands at the lower limits. The herbaceous layer is dominated by Pinegrass and Sedge. There are inclusions of true firs

on the protected slopes and Low Sagebrush scablands on the exposed slopes and ridges. Some Juniper and more mesic shrubs occur near rock outcroppings and along the margins of the type.

325.1/341.03 Low Sagebrush/Ponderosa Pine

Highly dissected, dense drainage pattern area in the southeastern portion of the Ochoco Mountains. Overall slope aspect is south. Low Sagebrush and Low Sagebrush scablands (Stiff Sagebrush) occur on the shallower soils of exposed slopes, ridges and uplands. Herbaceous cover in the Low Sagebrush types is Sandbergs bluegrass with few other bunchgrasses and some forbs. The Ponderosa Pine predominates at the higher elevations in the type, along the bottoms and slopes with deeper soils and on breaks in the terrain where effective moisture is greater. Where the pine occurs on slope breaks and along the margins of the type, it is associated with Juniper, Tall Sagebrush and some of the more mesic shrubs. The understory within the Pine type is dominated by Pinegrass and Sedges.

341.03/341.04 Ponderosa Pine/Lodgepole Pine

Flatlands east of the Cascades along the Deschutes River. Pumice soils from more recent volcanic activity. Much of the lava protruding through the soil mantle. Several small cinder cones within the type. Understory ranges from Manzanita to Tall Sagebrush and Bitterbrush. The Lodgepole Pine occurs on the less well developed soils (frost pockets).

341.08 True Fir and Mixed Conifer

The crest and higher slopes of the Cascades and higher elevations and protected slopes of the interior mountains.

On the Cascades, it occurs where there is more available moisture in areas not affected by the rain shadow. A wide variety of Firs, Cedar, Spruces, and Hemlocks occur. Understory ranges from Vine Maple to Manzanita. Herbaceous cover sparse.

In the interior mountain areas, the true-firs occur only at the highest elevations or on protected slopes where there is more effective moisture. Generally, the south slopes and exposed ridges are Pine dominated. In areas of occurrence there is Douglas Fir, Grand Fir, and Western Larch. Understory is usually pinegrass and sedges.

410 Cover Crops

More recently developed agricultural lands along the river valleys and gently rolling to flat uplands where irrigation has been developed. Cropping is widely diversified ranging from cereal grains to alfalfa, mint and potatoes. Many of the areas on the uplands have been developed from Juniper-Sagebrush types where irrigation water is available.

411 Cereal and Grain Crops

Gently rolling uplands near the lower drainages of the Deschutes and John Day Rivers. Fields are cropped in alternate years lying fallow years in between, as is done with the majority of the Columbia Basin dry cropped wheatlands. The loessal soils are loam to sandy loam.

413 Forage Crops

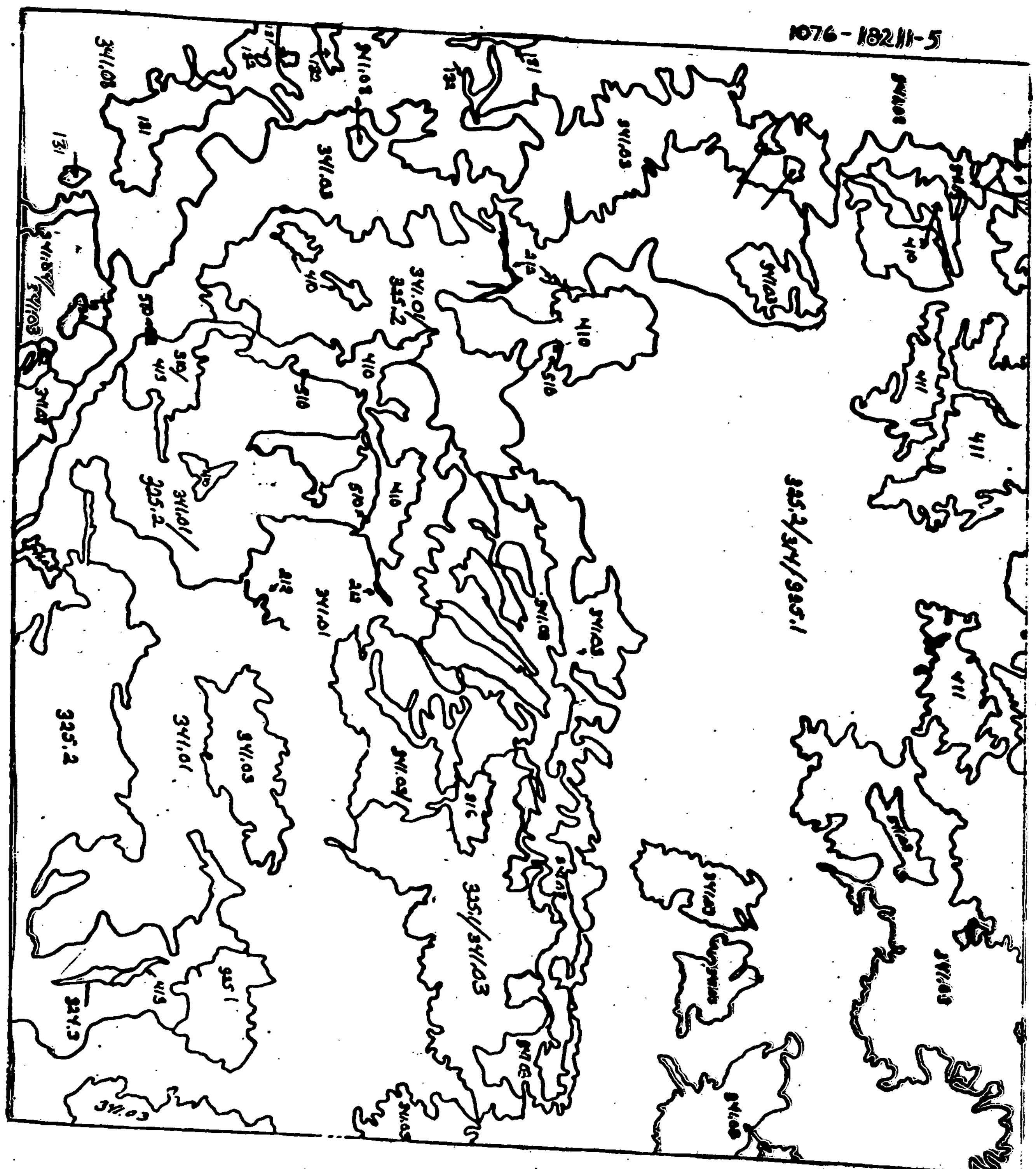
Recently developed agricultural land on deep silt loam soils along the stream bottom. Only recent irrigation development has brought the land into alfalfa production.

510/413 Residential/Forage Crops

Urban expansion from the population center is moving into agricultural lands. It is now developing into residential areas with small tracts of forage and pasture.

510 Residential

1076-18211-5



1076-18211-5

Macrorelief Geomorphology of ERTS Frame 1076-18211-5 David Mouat

The macrorelief of ERTS frame 1076-18211-5 was interpreted without field checking and with minimal assistance from 1:250,000 scale topographic maps. The purpose of the mapping exercise was to determine the facility with which skilled photo interpreters could interpret macrorelief without ground truth assistance. In the future, a macrorelief map will be compiled of the same frame utilizing extensive assistance from ground truth data. The two maps will then be compared. Descriptive and genetic landform maps will also be compiled for the frame.

The following legend symbols were used in the map:

1, 1.1, 1.2 - Flat landscapes

2, 2.1, 2.2 - Rolling and moderately dissected landscapes

3 - Hilly landscapes

4 - High relief landscapes

400 - Agriculture

500 - Urban

A partial descriptive legend of the above classes follows:

1 - A generally flat landscape with prominent slopes less than 10%. This class is used when the subclasses can't be determined.

1.1 - The landscape is essentially smooth. Dissection is minimal.

1.2 - The landscape is relatively flat; however, dissection is readily apparent though shallow.

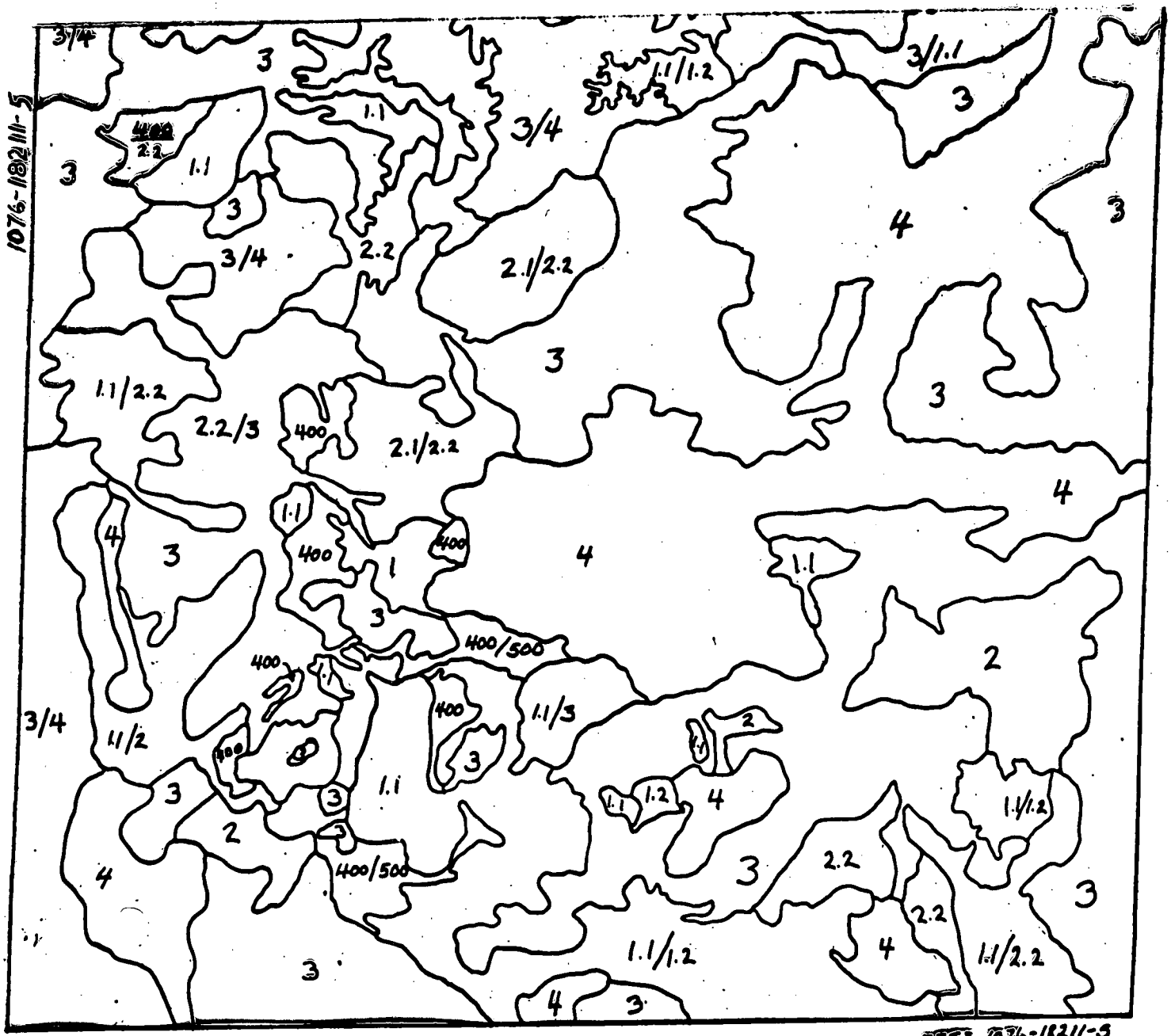
2 - Rolling and moderately dissected landscapes with prominent slopes 10-25%. This class is used when the subclasses can't be determined.

2.1 - The landscape is rolling or hilly. Relief tends to be low to moderate.

2.2 - The landscape consists of a moderately to strongly dissected planar surface. Relief is generally less than 100 feet.

3 - The landscape may be hilly or strongly dissected with relief greater than 100 feet but less than 1,000 feet. Slopes generally exceed 25%.

4 - The landscape has high relief (>1,000 feet) with slopes exceeding 25%.


1076-18211-5
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ERTS 1076-18211-5

Structural quick-look interpretation of the 7 October 1972 Ochoco frame
1076-18211-5

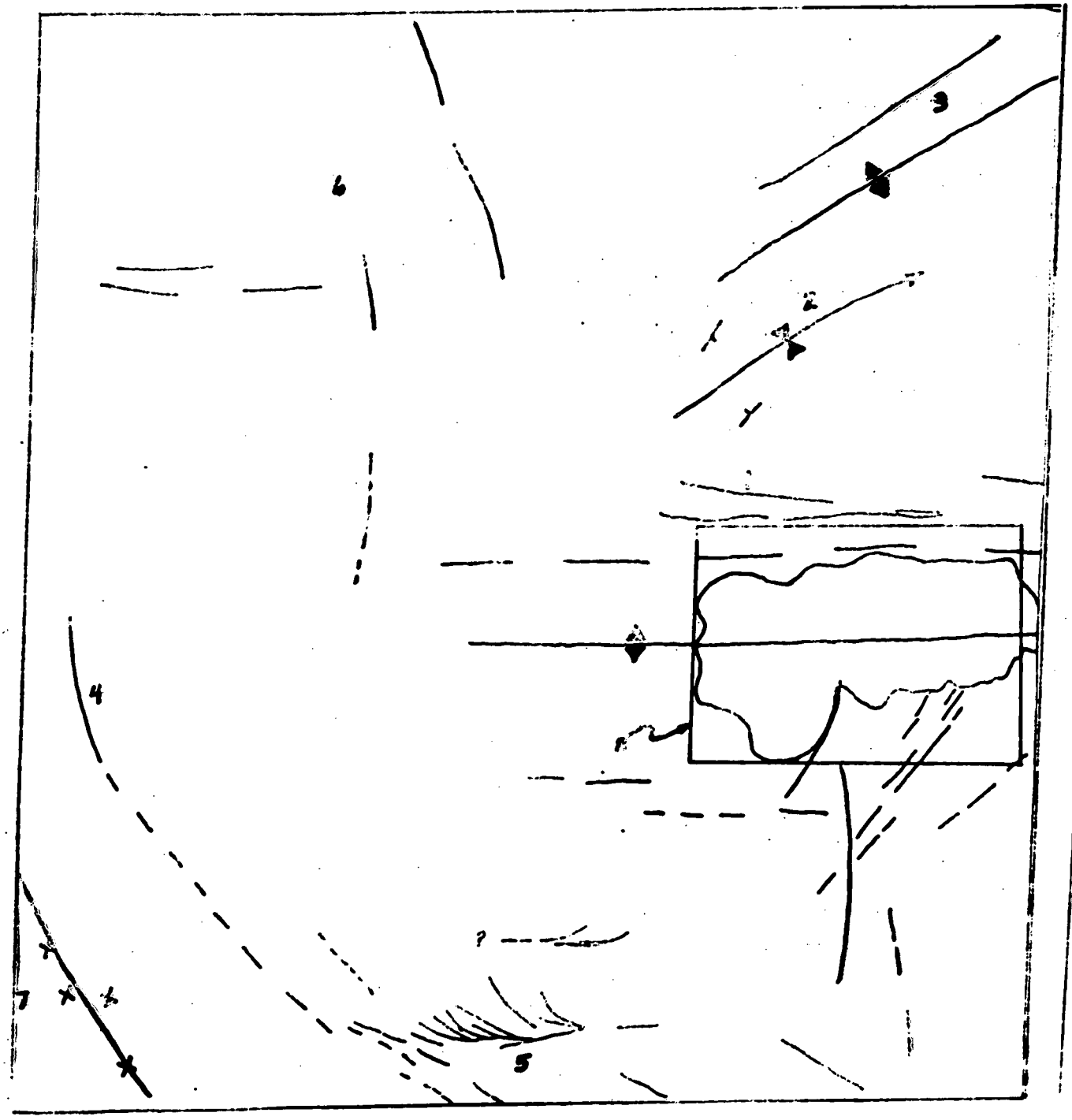
Preliminary structural interpretation indicates that some of the features are readily interpreted and others are quite obscure. A particular problem on this frame in the MSS-5 is the numerous structures in the area that trend essentially east-west parallel or sub-parallel to the scan lines. Where the feature is not clear interpretive difficulty is encountered. Significant features on the frame are as follows:

1. Structures of the Blue Mountains in the northeastern corner show clearly. The form of the Sutton Mountain syncline (2) is outlined by attitudes in the Colmbia River Basalts. The Blue Mountain anticline (3) is less distinct and the adjacent fault is obscure. The Mitchell Fault (1) is not clearly visible and must be interpreted from ground truth.

2. In the southwest corner of the frame the faulting at Green Ridge (4) is clear as is that south of Bear Creek Buttes (5). The space imagery shows an apparent connection between these fracture systems that is shown by dashes. Note that this trends parallel to the line of recently active volcanic centers of the high Cascades.

3. New fault trends that have not been mapped before are visible in the northwestern corner of the frame (6).

4. A detail map of area 8 prepared from a 1:500,000 enlargement of the ERTS MSS-5 shows the fracture system of the Columbia River Basalt which allows the general outcrop area of this unit to be mapped. The pattern is mapped in greater detail than on existing 1:250,000 maps. It results from sliding of the thin, brittle basalt on the underlying John Day Formation, a weak unit. The John Day is exposed at Big Summit Prairie, outlined on the detail.



OCHOCO FRANZE

7 OCT 72

AREA 8 ENLARGEMENT

1:500,000

Detail of joint pattern in Columbia River Basalt around Big Summit Prairie

Generalized Soil-landscape Map of Frame 1076-18211-5

The following generalized soil-landscape map is for the 7 Oct. 72 red band of the Ochoco Frame (NASA ERTS 1076-18211-5). A 9 inch black and white print at a scale of 1:1,000,000 was used. Delineations were based on comparison of image characteristics for land use, vegetation and topography. Fifteen units were distinguished, which resulted in approximatley 70 delineations, ranging from 10 to 700 square miles in area. Soils representative of these areas were determined from existing sources of ground truth (Soil Conservation Service, Oregon State Water Resources Board, U.S. Forest Service and Bureau of Land Management). In areas where soil series names are not yet established soil characteristics alone have been given.

Because resolution is quite good, two or three fold enlargement would allow this frame to be used for a more detailed map of the same type.

Legend for Generalized Soil-landscape Units of

ERTS Frame 1076-18211-5 7 Oct 72

Symbol	
1	Alluvium: Flood plains, terraces and Fans; including the Powder, Boyce, Prineville, Ochoco, Hack, Courtrock and Ayres series.
2	Gently sloping old lava flows, with uneven micro-relief: shallow and mod, deep, med. and coarse textured soils plus lava rock; including the Deschutes and Redmond series and Rockland
3	Rolling, loess-mantled plateaus: moderately deep and deep silty and loam soils; including the Walla Walla, Condon Morrow series in the north and east; and Dufur, Maupin and Madras series in the west and south
4	Volcanic plains, nearly level with smooth micro-relief: shallow and very shallow soils with clay or clay loam subsoils, which may be stony or very stony.
5	Rolling upland, somewhat dissected: clayey soils predominate, including the Simas, Sorf, Tub, Day and Ridgeway series
6	Strongly dissected soft rocks with numerous examples of badland topography: soils are similar to those of the previous unit but include steeper slopes and rocky escarpments.
7	Rolling uplands, moderately dissected: shallow and very shallow stony soils, including the Gwin, Snell, Waterbury, and Bakeoven series.

8 Steeply rolling, strongly dissected uplands: shallow and very shallow stony soils including; Lickskillet, Snell, Bakeoven, Rock Creek series.

9 Scabland-Forest complex: sparsely vegetated nearly level to gently rolling areas with very shallow and shallow soils, interspersed with deeply incised drainages whose slopes have deeper soils and a cover of coniferous forest, soils include Rock Creek, Anatone, Klicker, Hankins and Boardtree series.

10 Steeply rolling forested mountains; ponderosa pine is the predominant species. Soils include the Klicker, Hankins, Hall Ranch and Boardtree series.

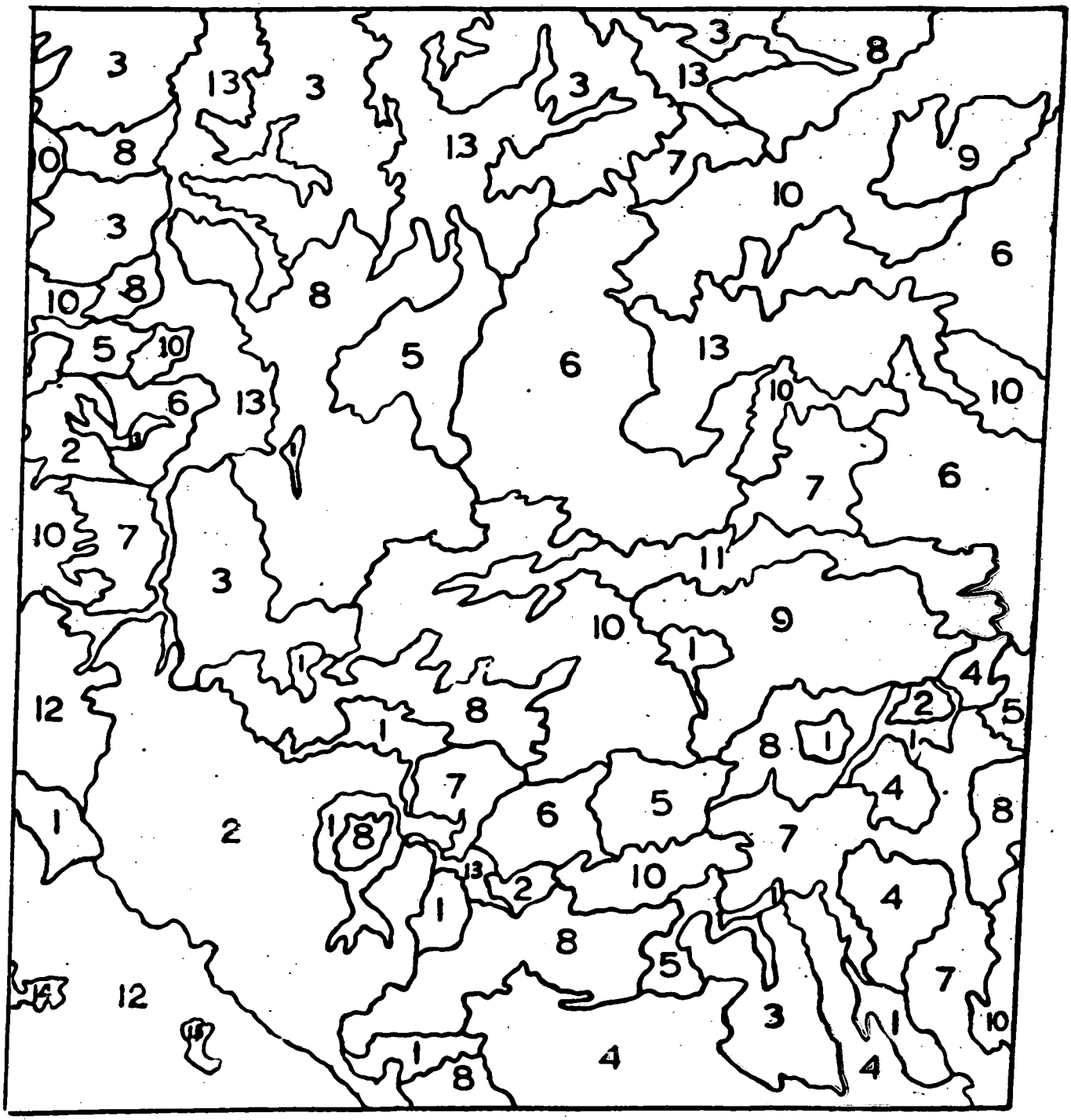
11 Northern slopes associated with the previous unit, true fir and Douglas fir are predominant species. Soils include the Boardtree, Tolo, Klicker and Hankins series.

12 Gently sloping, forested, volcanic uplands, somewhat dissected; sandy and loamy soil of volcanic ash predominate.

13 Canyons, deeply dissected with local relief of 500-2000 feet; shallow, stony and rocky soils predomininate and cliffs are common.

14 Alpine barrens, rock and snow.

15 Bare, recent lava flow.



Generalized Soil-landscapes

1076-18211-5

TIMBER TYPE AND DENSITY MAP OF OCHOCO NATIONAL FOREST
ERTS FRAME 1076-18211-5

SYMBOL	
I	less than 10% stocked with commercial trees or non-stocked forest land
II	poorly stocked--mostly ponderosa pine
III	poor to medium stocked - mixed larch and ponderosa pine
IV	medium to well stocked - mostly Douglas-fir, larch, and true fir types
V	very well stocked stands - mostly true fir on north slopes with associated species

image edge

Ochoco NF 1:1,000,000

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