

TO PRESERVE THE SENSE OF EARTH FROM SPACE



A Report to the National Commission on
Libraries and Information Science

NATIONAL COMMISSION ON LIBRARIES AND INFORMATION SCIENCE

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TO PRESERVE THE SENSE OF EARTH FROM SPACE

Report of the

NATIONAL COMMISSION ON LIBRARIES AND INFORMATION SCIENCE
PANEL ON THE INFORMATION POLICY IMPLICATIONS
OF ARCHIVING SATELLITE DATA

Regarding the

Archiving Requirements of the Proposed Transfer
to the Private Sector
of the U.S. Civil Space Remote-Sensing Satellite Systems

August 1984

NATIONAL COMMISSION ON LIBRARIES AND INFORMATION SCIENCE

The views and opinions expressed in this report do not
necessarily reflect the official position or policy of the
National Commission on Libraries and Information Science.

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Dear Miss Hashim:

As Chairman of the Senate Subcommittee on Science, Technology, and Space, Committee on Commerce, Science, and Transportation, I wish to thank the National Commission on Libraries and Information Science for assisting in the preparation of the "Land Remote Sensing Commercialization Act of 1984", Public Law 98-365.

Your advice on the government's responsibility to maintain an archive of Landsat data and your recommendations on how and why that archive should be maintained were most helpful. As you know, Section 602 of this legislation incorporates much of what you suggested.

I appreciate your contribution to our efforts to guide the commercialization process of Landsat.

Sincerely,



SLADE GORTON
United States Senator

SG:bkv

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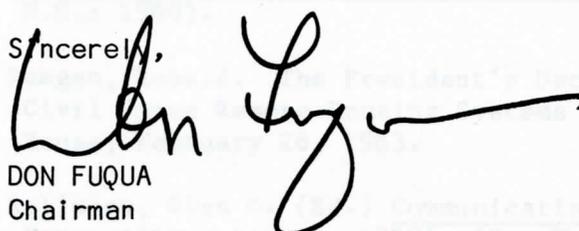
Dear Ms. Hashim:

As Chairman of the House of Representatives Committee on Science and Technology, I am writing to express my appreciation for the assistance of the National Commission on Libraries and Information Science provided to the Congress as we drafted the "Land Remote Sensing Commercialization Act of 1984", now Public Law 98-365.

Section 602 of this Act describes the government's responsibility to maintain an archive of land remote-sensing data for historical, scientific, and technical purposes. The report from your panel on the Information Policy Implications of Archiving Satellite Data significantly influenced and greatly facilitated the development of this section. I am particularly grateful for your willingness to give us a copy of an early draft of this report at a time when we most needed sound advice on archiving principles.

I believe this legislation demonstrates our commitment to fostering commercialization of space technologies while also protecting the needs of the public and insuring continued access to satellite data.

Sincerely,


DON FUQUA
Chairman

DF/RB:ld

Dr. Lee S. Levine, Director, NASA Data Center, U. S. Geological Survey
 Dr. John W. Gordon, Jr., Chairman, State University of New York
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PREFACE

When the National Commission on Libraries and Information Science asked me to chair their Panel on "The Information Policy Implications of Archiving Satellite Data", I said yes even before I knew more than the barest of details about the project. The future success of research in all areas of inquiry depends upon the availability of raw data. The data that are currently archived from the civil space remote-sensing satellites support many areas of inquiry. If these satellites and all the data they collect became commercially owned, would researchers, especially those in academia, continue to have low-cost access to that data? As Chancellor of a major research university I felt obliged to help shape a satisfactory answer to that question.

As former Director of the National Science Foundation I was challenged by the national policy issues that we would be considering during the course of this project. With the transfer of the remote-sensing satellites to the private sector, the government would no longer own the data they generated. Yet the government would continue to have need of some of the data, both for its own specific purposes as well as for the general public good. How could the government's needs be accommodated and the owner's proprietary rights be protected at the same time? The United States has treaty obligations regarding the international availability of its satellite generated data. What were the implications to foreign users of our satellite data should ownership be transferred to the private sector? The specific charge to our Panel was to advise the Department of Commerce on the policies that ought to govern the archiving of data produced by commercially operated satellites. Obviously we had to be aware of the larger national policy issues in order to address those concerning archiving.

We started with some fundamental assumptions. Our task was to advise the Department of Commerce on the archiving requirements that ought to be included in its request for proposals for transfer of the civil space remote-sensing systems to the private sector. We would concern ourselves with the need for and uses of data whose value lasted beyond "real time." Data that would not or should not be kept for archival purposes was beyond our concern. Throughout our deliberations we would consider the three stages or aspects of the archival process: 1) determining what data are to be kept and for how long; 2) preserving and conserving the data; and 3) organizing the data for efficient retrieval in response to requests by users.

The findings and recommendations of the Panel are presented in detail in our report to the Commission. They are based on the following principal conclusions: 1) it is in the public interest for the federal government to maintain and control an archive of land remote-sensing satellite data; 2) the owner of the satellite data should provide a basic data set to the federal government at a reasonable cost; and 3) the owner should have the exclusive right to sell the basic data set to all purchasers on a discriminatory basis. The Panel arrived at these conclusions quickly and easily. In less than four months we completed our deliberations and presented our report to the Commission. I attribute the success of this

project to the guidance offered by the Commission Members and staff, the assistance provided by the project staff, and most of all, the sharp minds and sense of purpose the members of the Panel brought to the effort.

Richard C. Atkinson, Chairman
Panel on the Information Policy
Implications of Archiving
Satellite Data

As former Director of the National Science Foundation I was challenged by the national policy issues that we would be considering during the course of this project. With the transfer of the remote-sensing satellites to the private sector, the government would no longer own the data they generated. Yet the government would continue to have need of some of the data, both for its own specific purposes as well as for the general public good. How could the government's needs be accommodated and the owner's proprietary rights be protected at the same time? The United States has treaty obligations regarding the international availability of the satellite generated data. What were the implications for further work of our satellite data should ownership be transferred to the private sector? The specific change to our Panel was to advise the Department of Commerce on the policies that ought to govern the archiving of data produced by commercially operated satellites. Obviously we had to be aware of the larger national policy issues in order to address these concerning archiving.

We started with some fundamental questions. Our task was to advise the Department of Commerce on the archiving requirements that ought to be included in the request for proposals for transfer of the civil space remote-sensing systems to the private sector. We would concern ourselves with the need for and uses of data whose value lasted beyond "real time." Data that would not or should not be kept for archival purposes was beyond our concern. Throughout our deliberations we would consider the three stages of aspects of the archival process: 1) determining what data are to be kept and for how long; 2) preserving and controlling the data; and 3) organizing the data for efficient retrieval in response to requests by users.

The findings and recommendations of the Panel are presented in detail in our report to the Commission. They are based on the following principles: 1) It is in the public interest for the Federal government to maintain and control an archive of land remote-sensing satellite data; 2) the owner of the satellite data should provide a basic data set to the Federal government at a reasonable cost; and 3) the owner should have the exclusive right to sell the basic data set to all purchasers on a discriminatory basis. The Panel arrived at these conclusions partly and early. In less than four months we completed our deliberations and presented our report to the Commission. I attribute the success of this

INTRODUCTION

Between June and December 1983, the National Commission on Libraries and Information Science (NCLIS) undertook the ambitious task of advising the Department of Commerce on the archiving of data from commercially operated satellites. In response to a Presidential initiative, the Department of Commerce had established a Source Evaluation Board (SEB) to prepare a request for proposals (RFP) for transfer of the civil space remote-sensing satellite systems to the private sector. The Board asked NCLIS to recommend archiving requirements that should be included in the RFP.

Under the direction of a committee of the Commission chaired by Mr. Francis Keppel, a Panel of experts in a number of fields was convened to develop recommendations for the SEB to consider. These men and women are recognized for their outstanding contributions in the areas of national policy, archiving, science and technology, library and information systems, and government service. Under the able leadership of Dr. Richard C. Atkinson and The Honorable Emilio Q. Daddario, the Panel met twice and with great efficiency produced the findings and recommendations that are reported here.

To aid the ten Panel members with their deliberations, both the first draft and the final statement of their findings and recommendations were widely circulated for comment within the federal government and among recognized experts in the field of space remote-sensing. Observers of the Panel's work praised their efforts. The Members of the National Commission were unanimous in their recognition of the excellence of the report the Panel produced.

The report was presented to the Commission in January 1984. Since that date two documents have been published that demonstrate the importance of the Panel's recommendations for insuring continued public access to the satellite data when the land remote-sensing satellite system is transferred to the private sector. These are the final RFP and the "Land Remote Sensing Commercialization Act of 1984", Public Law 98-365, which was signed by the President on July 17, 1984.

The Source Evaluation Board accepted most of the Panel's recommendations. The one issue that caused the Board some concern was the five-year limit on the contractor's exclusive right to sell the data. The RFP left this open to bidder response. The recommendations concerning charitable contributions by the contractor, government subsidy, and archival processes were not within the scope of the RFP, a fact that had been recognized by the Panel. The Board did not include the concept of an Advisory Committee on the Archive in the RFP.

The section of the RFP concerned with archives reads as follows:

"Data Inventory and Archives. Proposals shall address arrangements, plans and procedures for maintaining an active commercial inventory of data products to be sold. Many options are possible pertaining to existing Landsat data archives and those yet to be acquired by the Government from Landsat 4 and D' [5]. The Offeror must propose specific plans for establishing a commercial data inventory plus the interface to an historical archive that satisfies the Government's data needs.

"Proposals addressing takeover of the existing Landsat data archives must indicate an understanding that Landsat data have been made available to Government agencies and to the public, and hence are already in the public domain.

"The proposal shall address the Government's requirement to maintain an historical archive of remotely sensed data for research purposes and the public good. As a minimum, the proposal shall define the terms and conditions under which the owner/operator would make his commercial inventory available to the Government when found to have no further value to the owner/operator."

Other sections of the RFP concerned with international requirements and meeting federal data needs also show a responsiveness to the report recommendations.

The section on archiving in the "Land Remote Sensing Commercialization Act of 1984," discussed briefly in Section VI of the report, has changed dramatically since the drafting of the House and Senate bills and the issuance of the Panel's final recommendations. It follows the report's recommendations very closely and includes some that were not included in the RFP. For example, the law establishes a limit on the contractor's exclusive right to sell the data (602 (c)). It also refers to the need to follow archival processes (602 (b)) and to seek the advice of users and producers of remote-sensing data (602 (c) (3)).

"Archiving of Data. Sec. 602. (a) It is in the public interest for the United States Government--(1) to maintain an archive of land remote-sensing data for historical, scientific, and technical purposes, including long-term global environmental monitoring; (2) to control the content and scope of the archive; and (3) to assure the quality, integrity, and continuity of the archive.

"(b) The Secretary shall provide for long-term storage, maintenance, and upgrading of a basic, global, land remote-sensing data set (hereafter referred to as the "basic data set") and shall follow reasonable archival practices to assure proper storage and preservation of the basic data set and timely access for parties requesting data. The basic

data set which the Secretary assembles in the Government archive shall remain distinct from any inventory of data which a system operator may maintain for sales and for other purposes.

"(c) In determining the initial content of, or in upgrading the basic data set, the Secretary shall---(1) use as a baseline the data archived on the date of enactment of this Act; (2) take into account future technical and scientific developments and needs; (3) consult with and seek the advice of users and producers of remote-sensing data and data products; (4) consider the need for data which may be duplicative in terms of geographical coverage but which differ in terms of season, spectral bands, resolution, or other relevant factors; (5) include, as the Secretary considers appropriate, unenhanced data generated either by the Landsat system, pursuant to title III, or by licensees under title IV; (6) include, as the Secretary considers appropriate, data collected by foreign ground stations or by foreign remote-sensing space systems; and (7) ensure that the content of the archive is developed in accordance with section 607.

"(d) All original data (or copies thereof) shall, on request, be made promptly available to the Secretary by any system operator in a form suitable for processing for data storage, maintenance, and access. The Secretary shall (subject to the availability of appropriations) pay to such system operator reasonable costs for reproduction and transmittal of any such data.

"(e) Any system operator shall have the exclusive right to sell all data that the operator provides to the United States remote-sensing data archive for a period to be determined by the Secretary but not to exceed ten years from the date the data are sensed. In the case of data generated from the Landsat system prior to the implementation of the contract described in section 202(a), any contractor selected pursuant to section 202 shall have the exclusive right to market such data on behalf of the United States Government for the duration of such contract. A system operator may relinquish his exclusive right and consent to distribution from the archive before the period of exclusive right has expired by terminating his offer to sell particular data.

"(f) After the expiration of such exclusive right to sell, or after relinquishment of such right, the data provided to the United States remote-sensing data archive shall be in the public domain and shall be made available to requesting parties by the Secretary at prices reflecting reasonable costs of reproduction and transmittal.

"(g) In carrying out the functions of this section, the secretary shall, to the extent practicable and as provided in advance by appropriation Acts, use existing Government facilities."

This act, which authorizes the Secretary of Commerce to commercialize the Landsat system, lays out the procedures for moving the ownership of the satellite system from the public to the private sector.

Perhaps the most important policy consideration addressed in the Panel's report is the importance of protecting the needs of the public and insuring continued access to satellite data. This fits the Commission's mandate to insure the provision of library and information services adequate to meet the needs of the people of the United States (PL 91-345). The Panel emphasized the fact that the data are a national resource worthy of preservation and that it is "in the public interest to maintain an archive" of these data. They also emphasized that the "maintenance of such an archive is, therefore, a responsibility that should be borne by the United States Government."

There is also a major technical problem here, that of dealing with a massive data flow. Our attempts as a nation to process huge amounts of data and turn them into instantly available, useful information have just begun. The future promises only an increase in the amount of data available to us. We must learn how to determine what will be truly useful, both in the long and short term. We must also learn how to preserve what we keep and assure its ready accessibility.

The Commission believes that the information policy issues introduced by this report go far beyond the archiving issues discussed. As Dr. Atkinson points out in his Preface, the Panel had to "be aware of the larger national policy issues in order to address those concerning archiving." The findings and recommendations of this report may well have a value beyond the request to which they responded.

The Commission is extremely pleased to have helped shape both the Department of Commerce's RFP and the Land Remote Sensing Commercialization Act in a way that assisted the Administration and the Congress in reaching agreement on the archiving principles involved. The Commission is also proud to have played a leadership role in insuring that the needs of the public for satellite data are met. I take this opportunity to thank everyone who contributed to the success of this project. I am honored to have the privilege, as Chairman of the National Commission on Libraries and Information Science, to express the appreciation of the entire Commission for a job well done, and to note that we do so with pride.

Elinor M. Hashim, Chairman
National Commission on Libraries
and Information Science

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PANEL ON THE INFORMATION POLICY IMPLICATIONS OF ARCHIVING SATELLITE DATA

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SUMMARY OF FINDINGS AND RECOMMENDATIONS

This report presents the results of a three-month effort by the Panel on the Information Policy Implications of Archiving Satellite Data, which was convened by the National Commission on Libraries and Information Science in September 1983. The Panel held two meetings: the initial session on September 12, 1983 and the concluding one on November 28, 1983.

On the basis of its consideration of the archiving requirements that should be imposed in the event of a transfer of the U. S. land remote-sensing satellite systems to the private sector, the Panel reached the conclusions outlined below.

It should be emphasized that the Panel was not asked to judge the desirability of the proposed transfer but, rather, to recommend the archiving requirements that should be included in the government's request for proposals (RFP) from potential bidders.

The findings and recommendations of the Panel are as follows:

Findings

- o It is in the public interest to maintain an archive of land remote-sensing satellite data for historical, scientific and technical purposes.
- o The data in question are a national resource worthy of preservation for the advancement of science and other applications, and while the cost of archiving these data is not insignificant, it is extremely small relative to the investment in the space segments of the satellite remote-sensing systems.
- o It is in the public interest to control the content and scope of the archive and to assure the quality, integrity, and continuity of the data.
- o The maintenance of such an archive is, therefore, a responsibility that should be borne by the U.S. Government.

Recommendations

1. The RFP should specify that the U.S. government will bear the responsibility and costs of maintaining an archive for land remote-sensing satellite data.
2. The contractor should provide a basic data set to the U. S. government for the archive.

3. (a) Because the Source Evaluation Board is unable at this time to specify either the data requirements of the U.S. government or the characteristics of the basic data set, the RFP should elicit proposals from bidders on the basic data set they would provide for the archive and on what terms.

(b) In their consideration of the basic data set they would offer for the archive, bidders should be urged to use as a baseline the Multi-Spectral Scanner data currently archived.
4. The nature of the basic data set should be subject to renegotiation in light of future developments and the recommendations of the Advisory Committee on the Archive (see Recommendation No. 11, below).
5. (a) The RFP should distinguish the basic data set for the archive from the inventory of data the contractor may maintain for its own purposes.

(b) Special remote-sensing tasks, which are beyond the data requirements for the basic data set, and which the contractor may perform for customers by special arrangement, need not be provided to the archive.

(c) Accordingly, it should not be a requirement that all sensed data be archived.
6. The data required for the archive should be made available to the U.S. government promptly upon reception and preprocessing by the contractor; the U.S. government should reimburse the contractor for the costs of reproduction and transmittal of the data for the archive.
7. (a) The contractor should have the exclusive right to sell all data it provides to the United States government archive for a maximum period of five years from the date the data are sensed, or for a lesser period if the contractor relinquishes its exclusive right and consents to distribution of the data from the archive before the five-year maximum period has expired.

(b) After the five-year period, or a lesser period, as determined by the contractor, the data should be in the public domain and should be made available to requesting parties at prices reflecting the costs of reproduction and transmittal.

(c) All requests for data subject to sale exclusively by the contractor should be serviced by the contractor and not by the government archive.

(d) Accordingly, the contractor should be required to maintain a physical inventory of data to service customer requests in a timely manner.

8. All data in the basic data set that are subject to the contractor's exclusive right to sell shall be made available by the contractor to all purchasers on a non discriminatory basis; provided, however, that this requirement should not be construed to preclude special concessions in the nature of charitable contributions that the contractor may wish to grant in support of basic research projects that rely on remote-sensing data.
9. In the absence of such concessions, the government should offset any adverse impacts of a nondiscriminatory price structure on basic research programs that rely on land remote-sensing data and are deemed to be in the national interest. In providing this offset, the government would be serving, in effect, as the surrogate customer for the data required in research programs that qualify for support. (As noted in Section VII of this report, the Panel recognizes that the Source Evaluation Board is not empowered to determine this question but, nevertheless, wishes to record its strong concern over the adverse effects on basic research that would occur if the government did not take appropriate action and the contractor was unable to justify concessions.)
10. The archive should follow standard archival practices to assure proper storage and preservation of the data and timely access for parties requesting the data.
11. An advisory Committee on the Archive should be established to periodically review and assess archival policies, practices and requirements, including the characteristics of the basic data set required for the archive, in light of changing user needs and new and emerging technologies.
12. The membership of the Advisory Committee should be broadly representative of the needs and expertise of users and should include archivists with expertise in the scientific data field.

13. The RFP should make clear that the archival requirements recommended above are intended to be consistent with United States treaty and international obligations and should be so construed.

All data in the basic data set that are subject to the contractor's exclusive right to sell shall be made available by the contractor to all purchasers on a non-discriminatory basis; provided, however, that this requirement should not be construed to preclude special arrangements in the nature of charitable contributions that the contractor may wish to grant in support of basic research projects that rely on non-commercial data.

In the absence of such consent, the Government should effect any adverse impact of a non-discriminatory price structure on basic research programs that rely on lead research data and are deemed to be in the national interest. In providing this relief, the Government would be acting in effect, as the surrogate customer for the data required in research programs that qualify for support. (As noted in Section VII of this report, the Panel recognizes that the Senate Evaluation Board is not empowered to determine this question but nevertheless wishes to record its strong concern over the adverse impact on basic research that would occur if the Government did not take prompt action and the contractor was unable to justify its position.)

The contractor should follow standard archival practices to ensure proper storage and preservation of the data and clearly address any parties requesting the data.

An Advisory Committee on the Archive should be established to periodically review and assess archival policies, practices and requirements, including the characteristics of the basic data set reported for the archive, in light of changing user needs and new and emerging technologies.

The responsibility of the Advisory Committee should be broadly representative of the needs and expertise of users and should include archivists with expertise in the scientific data field.

I. BACKGROUND

On March 8, 1983, President Reagan selected the option to "Transfer to the private sector, via competitive means, the current operational civil weather and land satellites." The other option presented to the President in a memorandum from the Cabinet Council on Commerce and Trade called for "bringing the operational land remote sensing systems in the Government to a close nominally by 1988 and retain the civil weather satellites under Government control."

Events leading up to this decision began in 1978 when President Carter signed a statement of national policies to guide the conduct of U.S. activities in space. Later that year he endorsed private sector involvement in the establishment and operations of civil remote-sensing systems. A year later he set a goal of eventual operation by the private sector of civil land remote-sensing activities. In June 1980 the Department of Commerce published a "Transition Plan for Civil Operational Land Remote-Sensing from Space."

The civil remote-sensing satellite systems are operated by the National Oceanic and Atmospheric Administration (NOAA), U. S. Department of Commerce. The Landsat system (land remote-sensing satellites) consists of two satellites, Landsat 4, and Landsat 5, which are in sun-synchronous polar orbit. The weather satellite systems consist of two satellites in sun-synchronous polar orbit, NOAA 7 and 8, and two satellites in geostationary orbit, GOES East and GOES West.

Early in 1981 COMSAT General requested that the Administration consider transferring simultaneously both the civil weather and land remote-sensing satellite systems to the private sector. In revisions to the FY 1982 Budget, the Administration had already stated its intention to transfer operational responsibility for the Landsat system to the private sector by the mid to late 1980's. Before the end of 1982, the Department of Commerce issued a Request for Information from potential private sector owners or operators of Landsat. The Request noted that "While it is the current policy of the Administration . . . to retain the civil weather satellites in the Government, that policy will be reexamined if commercialization of both systems is shown to produce cost savings to Federal agencies." By the end of 1982 the Cabinet Council had decided that the Department of Commerce should oversee the transfer of the civil operational remote-sensing satellites to the U.S. private sector as soon as possible.

The proposed transfer would be guided by the following principles:

- o National security and foreign policy concerns must be appropriately addressed in preparing legislation, requesting proposals, and overseeing the private entity.
- o The selection of the private entity would occur through a competitive process.

- o Bids could be made separately for the land or weather satellite systems, or a joint submission for both could be made.
- o The Department of Commerce would establish an interagency coordination body as soon as possible.

In response to the President's decision, the Secretary of Commerce established a Source Evaluation Board (SEB) to prepare a request for proposals for transfer of the civil space remote-sensing systems to the private sector. In particular, the Board was directed to:

- o Develop and issue a request for proposals for the transfer of satellite systems for land remote-sensing and civil weather observation
- o Evaluate bids and report results to the Secretary of Commerce
- o Ensure that:
 - National security and international commitments are addressed
 - Weather Service data needs are guaranteed.

One of the questions the Source Evaluation Board faced in developing the request for proposals is the policies that should govern the archiving of the data produced by commercially operated satellites. What should be the requirements for archiving in the RFP? For assistance in addressing this set of issues, the Source Evaluation Board turned to the National Commission on Libraries and Information Science. The Commission, in turn, established a Panel on the Information Policy Implications of Archiving Satellite Data.

At their first meeting, the Panel members determined that the land and weather data should be treated separately, and that the government should continue to have the responsibility for archiving weather data. Prior to the Panel's second meeting, the United States Congress barred the Department of Commerce from further consideration of the commercialization of the weather satellite system. The Panel then focused its attention exclusively on archiving issues concerning the Landsat system and delivered its report to the SEB prior to the issuance of the final RFP.

This report, which describes the work, findings, and recommendations of the Panel, is presented in three parts. Part one introduces the reader to the Landsat archive and some uses for Landsat data. Part two presents the Panel's preliminary findings and recommendations as well as comments from the federal representatives and others on these findings and recommendations. It also outlines how the draft RFP interpreted the recommendations for archiving. Comments from potential bidders on the archiving requirements are included. Part three lists and discusses the final recommendations of the Panel.

II. THE LANDSAT ARCHIVE

Overview of the Landsat Spacecraft and Sensors

The satellite data that are now archived in the EROS Data Center are products of four Landsat satellites that have been launched over the past decade. Landsat 1 was launched in July 1972; and Landsat 4, 10 years later in July 1982. Landsat 2 and Landsat 3 were launched in the intervening years. The Landsats are polar-orbiting, sun-synchronous satellites that scan the Earth's surface systematically and repetitively. Landsat 4 circles the Earth approximately every 100 minutes at an altitude of about 700 kilometers. Every 16 days it cycles back to image the same area on the Earth spinning below.

Landsats 1, 2, and 3 have ceased to function, as expected, having served their useful lives. Landsat 4 has experienced several failures since its launch, including a serious reduction in solar-electric power and a complete loss of its X-band down link for the Thematic Mapper data. (A follow-up satellite, Landsat 5, was launched in March 1984 to replace Landsat 4.)

The Thematic Mapper (TM) is carried on Landsat 4 and 5 and is one of two sensors on the spacecraft. The other is the Multi-Spectral Scanner (MSS), which has been the primary sensor employed in the Landsat series.

The two sensors sense electromagnetic radiation from Earth. All objects radiate electromagnetic energy as a function of their black body temperatures. They also reflect electromagnetic energy as a function of their absorption and reflection characteristics. These distinctive characteristics of an object determine what is called its "spectral signature." It is this signature that is sensed by sensors on board a remote-sensing satellite, and is carried from Earth to the spacecraft in the form of electromagnetic waves of distinctive wavelength and at the speed of light. The signature tells a lot. If the object is a pine forest or a field of wheat, for example, its signature will tell us whether it is healthy or blighted. If it is a lake, it will tell us its temperature and the roughness of its surface.

The Multi-Spectral Scanner (MSS) is a radiometer that collects and measures these spectral signatures in discrete bands of the electromagnetic spectrum. It has four spectral bands in the visible and near-infrared portions of the spectrum. The picture elements of the MSS are 80 meters, when projected on the ground from the Landsat orbit.

The Thematic Mapper collects and measures spectral signatures in seven spectral bands within the visible, near-infrared and thermal-infrared portions of the electromagnetic spectrum. It is a high-resolution scanner with 30-meter picture elements for all bands except the thermal infrared, which has 120-meter elements.

Each of the sensors on board the Landsat spacecraft collects, filters and detects radiation from the Earth in a swath 185 km (115 mi.) wide, then quantizes and multiplexes signals from its detectors into a serial

data stream for transmission to Earth. The data rate from the Multi-spectral Scanner is 15 million bits per second. The Thematic Mapper's output is 85 million bits per second. Thus, when fully operational, the spacecraft will transmit 100 million bits of data to Earth each second. Ultimately, these data are delivered to the EROS Data Center.

The EROS Data Center

The Earth Resources Observation System (EROS) Data Center is the Landsat archive. It is operated, under contract to NOAA, by the U. S. Geological Survey of the Department of the Interior and is located in Sioux Falls, South Dakota. The Center's primary functions are data storage, retrieval, reproduction, and dissemination in response to requests; user assistance and training; and research on techniques for handling digital spatial data.

The Center's computer system controls a data base of over 6,000,000 satellite images and aerial photographs. The computerized data storage and retrieval system is based on a geographic system of latitude and longitude, supplemented by information about image quality, cloud cover, and data type.

Until 1979, all Landsat data were converted to 70-mm black-and-white film. Selected scenes ordered by users were converted to computer compatible tapes (CCTs) at the Goddard Space Flight Center and shipped to the EROS Data Center for archiving, reproduction, and distribution.

Beginning in January 1979, fully processed (that is, radiometrically and geometrically corrected) high-density tape data were transmitted to the EROS Data Center from Goddard via the Domsat communications satellite. From these data, the EROS Data Center then created archive film and CCTs, as requested by users.

Beginning in June 1981, partially processed (radiometrically corrected, but not geometrically corrected) high-density tape data were relayed to the EROS Data Center, which then applied the geometric corrections and created archive film for all Landsat data, as well as CCT's requested by users. This partial processing scheme continues for MSS data from Landsat 4. Between 100 and 200 scenes of MSS data are received each day at the Center via Domsat and recorded on high-density tapes (HDTs), each of which holds about 25-30 scenes.

The primary interface media for TM data are 241-mm black-and-white film and CCTs. These are mailed from Goddard to the EROS Data Center for archiving, reproduction, and dissemination.

Standard photographic products are produced from archived working masters by a high-throughput production photographic laboratory. Fully corrected photographic products are produced on film and paper, in positive and negative format, in black-and-white and color, and in sizes ranging from 70-mm to 40 inches. After products have been inspected,

they are shipped to customers either by mail or parcel delivery services. When CCTs are ordered by customers, they are produced from HDTs or the CCT library.

Archive Contents at the EROS Data Center

At the end of July 1983, approximately 600,000 scenes of data acquired by Landsats 1, 2, 3, and 4 were archived at the EROS Data Center. The distribution of these data among the different archive media is as follows:

Archive Media (Number of Scenes as of July 1983)

	<u>Total # of Unique Scenes</u>	<u>Computer- Compatible Tape (CCT)</u>	<u>High- Density Tape (HDT)</u>	<u>70-mm Film (Roll)</u>	<u>241-mm Film (Chip)</u>	<u>Color Composite Film(Chip)</u>
Landsat 1	145,860	15,290	-----	145,870	-----	9,670
Landsat 2	185,105	6,820	46,500	143,700	40,840	7,740
Landsat 3	237,075	1,060	141,315	112,730	117,227	2,730
Landsat 4	<u>16,600</u>	<u>-----</u>	<u>17,984</u>	<u>-----</u>	<u>16,414</u>	<u>46</u>
TOTAL	584,630	23,170	205,799	402,300	174,481	20,186

Lifetime of Tapes and Film

The EROS Data Center is environmentally controlled for temperature and humidity to optimize storage conditions. With proper environmental conditions and handling procedures, HDTs, CCTs, and black-and-white film are expected to be good for 20 years--color film for 10 years.

In addition to the physical archive, reference information about each archived scene (e.g., sensor type, scene ID, date acquired, area covered, cloud cover, and quality) is maintained in a computerized data base which can be accessed by users through remote terminals. The data base is updated whenever new data arrives at the EROS Data Center. The data base also includes information about the data holdings of participating foreign data receiving stations.

Customer Services

Landsat data customers are served through the EROS Data Center's User Services Division and a network of 30 National Cartographic Information Center offices across the country. The major functions performed include: processing user requests for data acquisition, responding to inquiries about data availability, processing orders for data products, accounting and billing, and handling customer complaints.

Several Landsat accession guides are produced to help users determine data availability. These include the Worldwide Reference System (WRS) maps that show the Landsat path and row intersections (nominal scene centers); microfiche catalogs of available MSS and TM scenes; and 16-mm microfilms of available Landsat scenes. The computerized data base supports these customer interface functions through on-line terminals in the User Services Division and outlying offices.

Customers inquiring about the availability of Landsat data do so by defining a geographic point location or a rectangular area specified by the latitude and longitude coordinates of its corners. After the geographic search is complete, the computer prints out a listing of available images from which the requester can make a final selection. Receipt of a prepaid order initiates processing.

Elasticity of Demand

Funds collected from the sale of Landsat data are used by the U. S. Treasury to offset the costs incurred in operating the system. There was a three-fold increase in price of Landsat data products in fiscal year 1983 accompanied by almost a three-fold decrease in demand for data products (it was greater than three-fold for the digital items, which are more expensive). Moreover, gross sales revenue decreased by 15 percent. The demand was therefore shown to be elastic.

This is evidence, or at least an indication, of what might be expected if full cost recovery for a twenty-fold increase in data prices became necessary.

III. ILLUSTRATIVE USES OF LANDSAT DATA*

Agriculture

Landsat data are used for crop assessments and predictions. The data are used to detect the onset of crop stress, revealing not only disease and weather or insect problems, but also such events as malfunctions in center-pivot irrigation systems. Buyers of crop futures include derived Landsat information in their market assessments, and international farming interests use the information to make crop selections and planting-time decisions.

Spectral reflections of crop varieties are so distinctive that Landsat imagery can readily distinguish between them through appropriate image processing techniques. Accurate inventories can be compiled, especially in areas such as the western U.S. and the USSR, where field sizes are relatively large. Seven states and a number of foreign countries do crop classification in this way.

An experiment called Large Area Crop Inventory Experiment established the ability of Landsat data, when combined with ancillary information, to measure growth, stress, and the state of maturity of wheat crops and to predict yield. Although this program has yet to be fully developed, the results of the experiments on large USSR fields yielded sample accuracies of up to 95%.

Forestry

Forest interests use Landsat products to monitor the condition of their holdings, to make economic judgments about harvesting, and even, in some cases, to determine payments to the owner based on surface samplings of tree extractions that can be correlated with Landsat observations.

Landsat imagery can be used for broad forest surveys, but it cannot yet provide sufficient resolution for detailed forest inventories. It cannot, for example, determine the crown sizes or log lengths of various forest species, and hence an accurate inventory of the extent of commercially valuable timber cannot be made with the current state of the art. But methods can be used to estimate, demarcate, and measure the areas under various kinds of forest cover by general tree types. In tropical forests or in other forests where species are mixed, Landsat cannot pick out and measure the extent of the different species unless there are contiguous areas of several acres of the same species of trees, as might be found in rubber plantations or teak forests.

*See World Bank, Landsat Index Atlas, and Daniel J. Fink, Earth Observation: Issues and Perspectives, cited in Appendix 3

Leaf size and shape, hue and spacing differences give forest species distinctive spectral signatures. Six states and at least two foreign countries have conducted forest inventories using Landsat data.

Geology

The making of geologic maps showing lithology (rock type and formations) from reflectance differences and showing structure on the basis of linear and curvilinear features is greatly improved by Landsat imagery. The large area encompassed by Landsat images often permits recognition of geologic structures that are too large to be seen during ground surveys or from aerial photographs. The imagery is also able to detect subtle discolorations that may not have been detected on aerial photographs or ground surveys. Such features can provide strong indications of the existence of mineral deposits. Not only is such imagery an important new tool in mineral exploration, but it can also have major implications in the search for subsurface water resources.

Geologic fault zones, lineaments, and other geologic features, which are sometimes undetectable from ground level or by aerial photography, are often visible in Landsat imagery. The siting of atomic power plants, dams, and other structures is greatly aided by the use of this information.

Fracture zones in the earth's crust, distinguishable in Landsat imagery, are excellent areas in which to prospect for minerals and hydrocarbons. Uranium, copper, and petroleum are only three of the valuable resources known to have been explored through the use of Landsat imagery. The petroleum industry uses Landsat data extensively for this purpose and is said to be the largest Landsat data user in the private sector.

Land Use

One of the most valuable uses of Landsat imagery is in classifying and monitoring changes in land cover such as forests, irrigated cropland, rainfed cropland, fallow rangeland, swamps, rivers, lakes, and urban growth.

The end-user frequently is a governmental planner or manager. Using Landsat products to assess an existing problem or to detect the onset of a new one is relatively easy. But the planner or manager needs a broader range of information from Landsat and other sources to work out acceptable solutions. As a simple example, the march of gypsy moths and their destruction of trees has been monitored routinely by Landsat for some years. Measuring the destruction is not enough, however. Planners in the path of this march also need Landsat information about population concentrations, river drainage, and the abundance of threatened tree species.

Soil scientists, resource managers, and engineering interests use Landsat data to determine the type and extent of surface clays. Detecting changes in topsoil patterns and observing sediment burdens in run-off waters is an important Landsat application.

The differing tonal values of vegetation and over-burden in strip mining areas enable Landsat analysts to monitor strip mining to ascertain whether it is done in conformance with environmental requirements.

Hydrology and Marine Resources

Typical applications of remote-sensing imagery in hydrologic and marine studies are surface area measurement of bodies of water; depth analysis where water clarity permits; and recording of turbidity, sediment and solid waste discharges, coastal currents, aquatic interfaces, and changes in sandbars and beaches. An example of the use to which Landsat imagery can be put was in the demarcation of the extent of flooding in the Indus Basin in Pakistan. Flooded cropland could be readily distinguished from flooded semi-arid or arid land. Glacial inventories, showing changes in area over time, and seasonal variations in snowcover can also be monitored from Landsat imagery.

Through the use of Landsat imagery and other data sources, hydrologists are able to calculate the water content and the probable run-off rate of snow masses which feed large irrigation complexes, aiding in water resource management. At least 20 states and many foreign countries use Landsat imagery for hydrology and water resource management.

Pollution Monitoring

The monitoring of the environment for pollution of various kinds can be aided by using Landsat imagery, especially with its sequential detection capability. Water circulation, siltation, and pollution trajectories can be traced to minimize pollution from waste disposal. Soil erosion can be detected and monitored qualitatively by observing suspended sediment in streams and standing bodies of water. The extent of forest and grassland burns can be determined, as in the Sahel region of Africa.

The distinctive spectral reflectance of crude oil enables Landsat imagery to provide accurate estimates of the extent of a spill, and to track and forecast the probable direction of its spread. Many types of water pollution and contamination are readily detectable through Landsat imagery.

Transportation and Communications

The demand for transport is largely a derived demand, dependent on the goods that must be transported. Hence, the extent to which Landsat imagery can help in this sector depends upon the extent to which it can help to survey and evaluate data in sectors other than transport. This

capability becomes more important the lower the level of a nation's development. Hence, Landsat imagery is likely to be particularly helpful in planning rural roads of all kinds, particularly in remote and inaccessible areas and especially where topographic and thematic mapping is either nonexistent or deficient. It can be useful also in planning and routing electric power lines, telecommunications networks, and pipelines of various kinds in developing countries where topographic maps are lacking or outdated.

Developing Nations

Developing nations are confronted with special kinds of problems, such as poverty, hunger, disease, illiteracy, and short life expectancy. The magnitude and complexity of the problems facing these countries—especially nations with large populations and limited access to natural resources—requires coordinated planning, often in the regional context. Remote-sensing through satellites has now made it possible for developing countries to obtain quickly, and at frequent intervals, the data on natural resources and land use that such planning requires.

Basic Research

One important but often overlooked factor that is becoming apparent from experience with the Landsat program is the potentially unifying influence of a global environmental data base with uniform characteristics that can serve scientists in many disciplines. Scientists in different disciplines are communicating better and understanding better the relations of their scientific disciplines to one another. Moreover, international scientific communication has been improved, because scientists from all nations are able to obtain data of uniform characteristics and compare the results of their analyses and their analytical methods. And the availability of repetitive data of dynamic environmental phenomena permits the establishment of wholly new types of scientific studies, many of enormous potential value to an understanding of the global environment.

IV. THE PRELIMINARY ASSESSMENT

Fundamental Assumptions

It is important to understand the assumptions that the Source Evaluation Board specified be used in the Panel's deliberations. First, the Panel was not asked to consider national security issues or classified information. Second, the Panel was asked to assume a transfer to the private sector of the civil operational land and weather satellite systems. The Panel's assessment was made, therefore, on the basis of a "what if the systems were transferred?" approach to the archiving issue. The Panel was not chartered to judge whether or not they should be transferred. A third assumption was that all data produced by the satellite systems after the transfer would be owned by the private entity that operated them and that any data required by the government thereafter, including data to be archived, would have to be purchased by the government.

Thus, the focus of the Panel's inquiry and the key question the Panel addressed was what principles or criteria should govern the archiving of data produced by commercially operated satellites. The data stream is immense, and although much of it loses its commercial value after a brief period, its value to basic research continues for decades and even centuries in fields such as climatology.

If the satellite systems were transferred to the private sector, the private operator, rather than the government, would own the data and would have to charge prices for them that would make the operation commercially sound. Under those circumstances, how would the data needs of the basic research community be met? What would be the impact on the developing countries that are becoming increasingly dependent on satellite data for resource and environmental assessments? These are the kinds of questions that concerned the Panel.

The Work Plan

The Panel's review was geared to the needs and schedule of the Source Evaluation Board and therefore had to be conducted over a relatively brief period. The controlling events were the dates on which the Board would issue the draft RFP (mid-October 1983) and the final RFP (mid-December 1983).

The Panel relied heavily on comments and views from knowledgeable people, both in and out of government, representing a broad spectrum of opinion and interest with respect to the potential impacts of the proposed transfer of the satellite systems.

The Panel's first meeting was held on September 12, 1983. Its purpose was to make tentative recommendations for the archiving requirements of the draft RFP.

On October 21, 1983 the Source Evaluation Board issued the draft RFP on the proposed transfer of the land and weather satellite systems to the private sector. It included provisions for archiving that were based on the Panel's tentative recommendations. Potential bidders and other interested parties were given one month to comment on the provisions of the draft RFP. The comments were due on November 21, 1983.

The Panel's second and final meeting was held a week later on November 28, 1983. Its purpose was to reconsider the archiving issue in light of the comments made by the potential bidders and other interested parties and to make recommendations for the final RFP. In addition to the comments made by bidders on the draft RFP, the Panel also considered the views of a wide variety of other sources, including the results of a survey of selected federal government agencies. These comments and views are highlighted in Sections V and VI of this report.

Presentations at First Meeting

At its first meeting on September 12, 1983, the Panel was briefed on the objectives and the schedule of the Source Evaluation Board for Civil Space Remote Sensing Satellite Systems. To place the archiving functions of these systems in context, the Panel received a comprehensive briefing on the satellite programs of the National Oceanic and Atmospheric Administration in a presentation by Dr. John H. McElroy, Assistant Administrator of NOAA and Director of the National Environmental Satellite, Data, and Information Service (NESDIS).

The current archiving practices for land and weather satellite data were discussed in presentations by Mr. Russell Koffler, Director of the Office of Satellite Data Processing and Distribution in NESDIS, and Mr. Greg Hunolt, Chief of the Satellite Data Services Division, also in NESDIS. The Panel also received a briefing on the Earth Resources Observation System (EROS) Data Center, U. S. Geological Survey, which has responsibility for the Landsat archive. The presentation was given by Mr. Gary Metz, Assistant Chief for Programs at the EROS Data Center.

And, finally, the Panel discussed the perspectives of two classes of users of land and weather satellite data. One of the presentations was given by Dr. Frederick B. Henderson III, President of the Geosat Committee, Inc., who discussed the Landsat situation and prospects. The other presentation, which focused on the meteorological area, was given by Professor Peter Cornillon of the School of Oceanography at the University of Rhode Island.

It should be noted that the Panel focused its attention on the needs and uses of so-called "retrospective" data, which are of interest for archival purposes, and not on the needs and uses of "real time" data that have no archival merit beyond their immediate uses and which were outside the scope of the Panel's assignment. It should also be noted that references in this summary report to "archiving" encompass the three stages or aspects of the archival process--namely, determining

what data are to be kept and for how long, preserving and conserving the data, and organizing the data for efficient retrieval in response to requests by users.

Tentative Findings

On the basis of these presentations and discussions, the Panel reached some preliminary positions regarding the archiving requirements that should be specified in the draft request for proposals. The tentative findings of the Panel were as follows:

- o The data in question are a national resource worthy of preservation for the advancement of science and other applications, and while the cost of archiving these data is not insignificant, it is extremely small relative to the investments in the space segments of the satellite remote-sensing systems.
- o The meteorological and Landsat data should be treated differently in the RFP from an archival standpoint.
- o The government will continue to need all of the weather satellite data output for its domestic programs and international arrangements. Therefore, the market for meteorological data is established and guaranteed.
- o In contrast, the market for Landsat data is uncertain, virtually embryonic, and elastic to price considerations -- even now under relatively generous government terms.
- o Under private ownership, a dramatic increase in data prices could result if full operational costs of the Landsat system were to be recovered.
- o There are no assurances, under those terms, that there would be any government customers for Landsat data.

Basic Research as a Special Case

A major observation made by the Panel was that a number of basic research programs would be placed in a precarious position if Landsat data on which they rely were to be priced beyond their ability to purchase without government support. The support of basic research has been recognized as a public responsibility by every Administration over the past 30 years, including the current Administration. Therefore, appropriate archiving of Landsat data to meet basic research needs deserves special consideration in any transfer to the private sector.

Tentative Recommendations for the Draft RFP

On the basis of these preliminary findings and observations, the Panel made the following tentative recommendations to the Source Evaluation Board for consideration in preparing the draft request for proposals:

1. Meteorological Data.

- a. The government should continue to have the responsibility for archiving meteorological data.
- b. The Request for Proposals should not require that the vendor maintain such an archive.
- c. At the same time, the vendor should not be prohibited from maintaining an archive of meteorological data, should it choose to do so.
- d. Moreover, bidders who may wish to operate the national meteorological data archive for the government may propose to do so as an option.

2. Landsat Data

- a. Bidders should be required to archive all Landsat data, in accordance with the archival policies presently used by the federal government, for a transition period of three years, while the market potential for such data is being explored and developed.
- b. If, at the expiration of this period, the vendor decides to discontinue or retire any data in the archive, reasonable notice (say, six months) shall be given to the government and other known users of Landsat data to afford them an opportunity to review the matter with the vendor and to make new or other arrangements for retaining any or all of the data proposed to be discontinued or retired.
- c. All data in the Landsat archive shall be made available on a nondiscriminatory basis to all purchasers.
- d. The Government should offset the adverse impacts of this nondiscriminatory price structure on basic research programs that rely on Landsat data and are deemed to be in the national interest. In providing this offset, the government would be serving, in effect, as the surrogate customer for the data required in basic research programs that qualify for support.

V. COMMENTS ON TENTATIVE FINDINGS AND RECOMMENDATIONS

After forwarding its tentative findings and recommendations to the Source Evaluation Board for consideration in the preparation of the draft Request for Proposals, the Panel also provided them to selected Federal agencies, other organizations, and individuals for comments.

The following comments have been excerpted from the replies received by the Panel. Only those comments pertinent to archiving are reproduced here.

COMMENTS OF THE EXECUTIVE BRANCH AGENCIES

Agency for International Development (Dr. Nyle C. Brady, Senior Assistant Administrator)

"The Agency for International Development... has contributed to the operation of three regional remote-sensing centers in Nairobi, Kenya, Upper Volta and Bangkok, Thailand. These centers house regional sets of scenes acquired by U. S. Landsat satellites and probably represent the second largest repository for such information, surpassed only by the EROS Data Center in Sioux Falls, South Dakota. Our objective in these initiatives is to assist developing countries (LDCs) use remote sensing as a diagnostic tool to monitor the status and changes in land use and the natural resource base.

"We would agree with your premise that Landsat data represents a national resource and would add that the data also are international in scope and 'worthy of preservation for the advancement of science and other applications....' Our program in remote sensing provides the operational proof of the positive impact the data have made on advancing the LDC natural resources knowledge base and stimulating activities to prevent environmental deterioration and increase agricultural production.

"A technical point that arises when considering the mechanics of archiving Landsat data that has no doubt been considered by the Commission is the deterioration of data products. Such spoilage has been occurring to the stored data at the EROS Data Center. As you know, these data sources have a finite life due to the demagnetization of tapes and tone loss on photographic products.

"Great care will have to be taken on the types and numbers of scenes preserved and the medium on which they are stored. No doubt much of your analysis will be devoted to determining which scenes at which seasons during which years will be permanently stored for the entire world. This is a difficult exercise, especially in view of the fact that there are many users with needs and desires for retrospective data. NASA Goddard Space Flight Center and the EROS Data Center have faced this dilemma before when the large volume of data and limits of resources dictated the discontinuance of certain kinds of data products and the need to eliminate some older Landsat information.

"The 'Tentative Observations and Suggestions' for Landsat data contained in the Panel's report seem most appropriate given the continued likely need for data by researchers and other users."

Department of Agriculture (Dr. J. D. Ahalt, Deputy Assistant Secretary for Economics)

"The Department of Agriculture (USDA) is now engaged in an extensive research program to determine applications of data from U.S. civil weather and land-observing satellites in existing and future information systems. The Department has also begun to use satellite data routinely in monitoring domestic and foreign crop conditions. Archived satellite data that are accessible and affordable will be important in maintaining our research effort and in facilitating comparison of current data with previous coverage for operational analysis."

Department of Defense (Dr. Donald C. Latham, Deputy Undersecretary of Defense)

"We share your concern that these archives be maintained and available to both the public and the government as a national resource."

"With the exception of maintaining some selected LANDSAT data at the Defense Mapping Agency, the Defense Intelligence Agency, and the Corps of Engineers, virtually all DOD use of remote sensing satellites is near real time. Consequently, we do not maintain extensive archives of data from these satellites but rely on facilities operated by the Departments of Commerce and Interior for historical information. While we do not have a large need for historical data, we want to insure that it will be available to meet sporadic needs."

Department of Energy (Dr. A. W. Trivelpiece, Director, Office of Energy Research)

"We agree with the premise that the data in question are a national resource worthy of preservation for the advancement of science and other applications. However, it is not at all clear why '... meteorological and Landsat data should be treated differently from an archival standpoint...' merely on the basis of the markets presently identifiable for the two systems. The value of seasonal, long-term data, from the research point of view (the Department's principal use) would appear to apply no less to Landsat than Metsat."

Department of Health and Human Services (Dr. Harold Schoolman, Acting Director, National Library of Medicine)

"It is our view that the government must protect the data resulting from remote sensing satellite operations, regardless of who operates the satellites and acquires the resulting data. In the long pull, only the

government is interested in the archival responsibility, since the possibility of making profits from old data are remote for the commercial sector.

"It seems to me that greater weight must be placed on the need to keep our science and technology more productive, more innovative, and more concerned with mining the technical knowledge that is generated in Federal R & D programs as a national resource. This does not imply that the policy to encourage the private sector to take over some programs that it can do better and more efficiently than the public sector should be set aside. It does mean, however, that the test of private sector involvement must always be, first, does it impair achievement of the social goal for which the government agency was established and to which it is mandated? This test must take precedence over whether the private sector involvement will be stimulated."

Department of the Interior (Dr. Dallas L. Peck, Director, U. S. Geological Survey; comments are keyed to the subsections a, b, c, and d of the Panel's tentative recommendations regarding Landsat data--see Section IV, above.)

"(a-b.) We believe it is premature to recommend any specific strategy for deciding who should maintain archives and for what periods of time the data should be preserved. However, we believe that some level of data archiving should be continued in the future because certain of the Department's land management and research activities require that comparisons must be made between historical and current sets of Landsat data.

"(c.) We agree that all data in the Landsat archive should be made available on a non-discriminatory basis to all purchasers.

"(d.) We do not agree that university researchers who use Landsat data should receive special consideration. If researchers are performing federally-funded research, the research grant should include the full cost of Landsat data. Although the price of Landsat data may increase substantially under commercial operation, we do not believe it is practical or equitable to provide assistance to only one segment of the user community that would be impacted by these high prices."

National Archives and Records Service (Dr. Robert M. Warner, Archivist of the United States)

"The issues surrounding the disposition of information produced under government contract or grant are complex. The National Archives, under the Records Disposal Act and the Federal Records Act, as amended, has final authority over the disposition of Federal records. Federal records, as defined in the statute (44 U.S.C. 3301), may or may not encompass those created by private companies or institutions that perform work or research under contract with or grant from a Federal agency. If, as your letter states, the data would be owned by the

contractor, it would not be subject to National Archives regulations. Only the satellite data provided to Federal agencies under contract provisions would be Federal records.

"As we understand this proposal, the private operation of the civil remote sensing systems will remove data now generated by the National Oceanic and Atmospheric Administration National Environmental Satellite, Data and Information Service and Earth Resources Observation System Data Center from Federal control in the first instance. However, documentation sub-sequently acquired by Federal agencies, for whatever purposes, would be subject to National Archives appraisal for determination of retention period and possible archival preservation by the Federal government.

"If therefore, as the Panel has assumed, the Metsat data will be purchased by the Federal Government, it will be treated as a Federal record; the government would be responsible for its appraisal and preservation according to NARS standards and policies. On the other hand, if the Panel's assumptions about the lack of Federal need for the Landsat data are correct, i.e., limited, if any Federal acquisition, then this data would fall outside NARS' area of authority, and we could take no official position on its archival value or on government policy concerning its preservation."

COMMENTS OF CONGRESSIONAL AGENCIES

Congressional Budget Office (Dr. David L. Bodde, Assistant Director, Natural Resources and Commerce)

"The preliminary suggestions of the Panel... raise a number of issues that it might want to consider as it completes its work.

"First, the value of the raw data for basic research is not likely to diminish as rapidly as its commercial value. This is because basic research on complex and subtle phenomena such as changes in climate or land use requires long term, time series data. By contrast, data of commercial value tends to be more short-term in nature. Thus, a commercial establishment cannot be counted on to retain data over the period of interest to basic research.

"Second, much of the value of information to a commercial enterprise depends upon the exclusivity of that information. The only way a satellite data system can operate as a business is to deny access to those who are unwilling or unable to pay for the service. This implies that data in government archives must also be sequestered until its commercial value has passed.

"Third, it is important to distinguish between raw data and data that have been translated into useful information through analysis. The former has no value except as it can be made into the latter. This suggests that the raw data may have many characteristics of a public

good, much like data from the Bureau of Labor Statistics or the Bureau of the Census. By contrast, the value added to raw data by analysis can readily be captured by private firms.

"Finally, the implications of suggestion 2(d)--that the government provide financial assistance for universities that cannot afford to pay commercial rates for Landsat data--vary with the size of the university market. If university research comprises a large portion of the demand for raw data, then the government as 'surrogate customer' would wind up paying commercial rates for the same data it once bought at government cost."

Office of Technology Assessment (Dr. John L. Gibbons, Director)

"Although the archives for meteorological data are important, it is clear, as your 'Tentative Observations and Suggestions' points out, that the Government will have plenty of incentive to maintain its own archives for the meteorological data. The case of Landsat data, we agree, is quite different, and a clear policy to solve the archival problem will need to be instituted.

"For land remote sensing data, we believe it important to maintain a global set of cloud-free MSS images both for research purposes and for the use of those land planners and resource managers who would benefit most by having a baseline set of data of moderate resolution. Because of their importance as reference data, these images should be maintained for a much longer period than the three years you propose in your 'tentative suggestions.'

"The Thematic Mapper, with its much higher spatial and spectral resolution, presents a problem of an entirely different order of magnitude. The TM data are inherently more valuable to some potential customers than the MSS data, and a private owner is likely to be much more willing to maintain long-term archives for them or for other comparable data. Yet, assuming that the TM sensor and transmitters aboard Landsat D [Landsat 5] operate as designed, they will generate vast amounts of data. Each scene, comparable in extent to the MSS scene, will contain about 12 times as many data points. Therefore, it will be important to put considerable effort into designing appropriate techniques to store these data. Perhaps some of the techniques known to the Commission for archiving other data would be of help.

"Finally, we agree strongly with the Panel's recommendation concerning the university research community. The present uncertainties have caused the universities to reduce their research programs. The Panel's recommendation, if codified in the terms of transfer to the private sector, would go far to alleviate the universities' concerns, and to assure that research on Landsat data would continue."

Library of Congress (William J. Welsh, Deputy Librarian)

"The Library of Congress agrees fully with the Panel that it is in the public interest to archive remote-sensing satellite data selectively and to take steps to insure its continued availability, whether provided by government or from the private sector. We also endorse the idea of establishing an oversight committee to work with public or private agencies responsible for policies, practices, and requirements. The idea of a 'basic data set' ^{1/} should be pursued, and we suggest that the archiving and preservation solutions be evaluated in terms of new technologies. The Library of Congress has a great concern for preservation and has developed a pilot program to explore the use of optical disk technology. This technology, as it develops and improves, may be a good candidate for the density and durability needed for archiving digital data for long-range storage and rapid retrieval. We will of course be sharing our pilot program experiences with others."

COMMENTS OF OTHER INSTITUTIONS

National Academy of Sciences (Dr. Frank Press, President)

"First some general comments. The definition of archiving needs to be more rigorously stated. At the present time, the government has an archiving policy that applies to most of the digital tapes that have been put in computer compatible form and also to many tapes which are as-received by the ground stations. However, many scenes are stored only in a film format, which is considered inadequate for archiving. Further, the tapes are, in general, not preserved in a manner appropriate to retain their information over a substantial period of time. The point is that it is not sufficient to say that data should be archived unless detailed archiving procedures are specified.

"Second, the cost of appropriate archiving could be quite high and non-trivial from a bidder standpoint. Technological advances, such as the use of optical disks, may reduce the expense in the future, but at present archiving is a serious cost issue.

"Third, archiving, is, in some respects, a public interest activity and it seems reasonable to some of our advisors that the cost should be borne by the government, at least in the early years of any transfer of operations to the private sector.

"With regard to the data from meteorological satellites, we agree with the statement of your Panel that 'The government will continue to need all of the weather satellite data output for its domestic programs and international arrangements. Therefore, the market for meteorological data is established and guaranteed.' However, this statement correctly applies to current (and highly perishable) information, used in weather

^{1/} Concept discussed during second meeting of the Panel.

forecasting, and is not valid for archived records. The market for archived (historical) meteorological data is far from 'established and guaranteed.' These data are essential for research but have lost much of their value to the government once they have been used in making operational weather predictions. As a result, the government has not in the past expended sufficient funds or manpower to develop a satisfactory archival and retrieval system. This shortcoming should be corrected. Since part of the research in meteorology will remain with the government, it is appropriate that 'the government should continue to have the responsibility for archiving meteorological data,' as your Panel suggests. However, a satisfactory archival system could be operated by the government under contract with industry.

"With regard to land remote sensing data, if the system is operated by private industry, it also makes sense to contract out the archival portion. Also it is reasonable to set up a transitional period in which present archival policies will be continued. During this transition the government should be obligated to review its own need for archived information, both for in-government programs and for research programs sponsored by the government, with the aim of correcting the inadequacies of the present system. Some initial suggestions for Landsat data storage criteria are:

All cloud-free Landsat data of good quality should be stored in a global data base. When repeat data sets are available, the global set should be updated, to provide users and investigators with a current data base. The early data should not be discarded, but should be available for climate, land use, environmental, hydrological, and other studies. Data bases should be maintained in form that can be browsed and accessed electronically.

"The suggestion that 'all data in the Landsat archives shall be made available on a non-discriminatory basis to all purchasers' requires definition as to the meaning of non-discriminatory.

"Finally, the last suggestion that the government should offset the adverse impacts of a non-discriminatory price structure on university basic research programs that rely on Landsat data, is unlikely to be resolved in the context of the commercialization process, but may be treated in the way government contracts are administered with universities."

Smithsonian Institution (S. Dillon Ripley, Secretary)

"Historians of science and of American culture should be consulted in the decision making process leading to the definition of the archiving responsibilities of owners of Landsat and the weather satellites.

"Although it will be difficult to establish appropriate criteria for long-term retention of these vast data bases, your Panel seems to be addressing these issues. You do not appear to be addressing the

question of archiving of the administrative and organizational records for the satellite program, whether that program is administered federally or privately, and I would urge you to do so. It is equally important that you press the National Archives to employ the same standards in their retention of these data which you would impose on private purchasers of the satellites, should the satellites remain in federal hands."

OTHER COMMENTS

"For university research programs that are considered to be in the national interest, I think there should be no change in the price structure. Instead, the sponsor of the research should be expected to provide funds for the purchase of the data, just as the sponsor of chemical research is expected to pay for the chemicals used in the program he sponsors." (Dr. Edward L. Brady, Associate Director for International Affairs, National Bureau of Standards)

* * * * *

"If the price of original data is set to achieve full cost recovery for the whole system, the 'archive' will have to be either kept in Fort Knox or encrypted so that there is no possibility of unauthorized access.

"Both weather satellite and Landsat data clearly have a 'public good' aspect, so that there is no sense in recovering full cost from users retail. There has to be some general public subsidy which reflects the 'positive externality' aspect of both meteorological and resource information. Basic research is only one tiny segment of this externality and it would be unreasonable for basic research to bear the full cost of protected archiving. In fact, if the data were available for basic research, how could one avoid the 'free rider' problem? Commercial or government agency users could just bootleg it from the archive. I am sure a tremendous black market in data would soon arise." (Professor Harvey Brooks, Benjamin Peirce Professor of Technology and Public Policy, Harvard University)

* * * * *

"The Blue Ribbon Panel will undoubtedly reassess their recommendations on Landsat archival policy.... We have some experience in the archiving of commercial geological data.... From our experience, we question the significant archival requirements which would be imposed on any commercial operator who bid for the Landsat business. It appears that the retention of Landsat data for university basic research is desirable. However, the government will have to pay the costs for Landsat data storage under any scenario. The market for these data appears to be fairly small and doesn't justify the costs." (Dr. J. Fred Bucy, President, Texas Instruments, Inc.)

* * * * *

"The Geosat Committee believes that a central national archiving facility for Landsat-type and other remote-sensing data in the B-tape or equivalent 'raw' data format should be established. These data should be available to all on a rapid delivery, reasonable price basis. We believe that only through access to such raw data will a strong, multi-tiered, value-added industry develop which, in turn, will help create and serve the multi-tiered user market that must be developed in order to commercialize any satellite system.... In particular, I recommend that your Panel endorse the concept of establishing such a national archive, and that a Program Board of both government and private sector users be created to guide the archive as to what data should be retained." (Dr. Frederick B. Henderson, III, President, GeoSat Committee, Inc.)

* * * * *

"The private operator will eye the short term bottom line and cut back services which do not contribute effectively. Yet these unprofitable services may well be the ones we need desperately for long-term pay-off in the national interest. From whence I conclude:

1. Some provision must be made to ensure continuity of service for those services with long-term importance. This should not be decided from time to time by a stockholders' meeting or by an industrial board of directors.
2. Some provision must be made to prevent the operator from freezing out the users who are making the long-term research and can't pay the costs for data they use. (Dr. Robert D. Huntoon, President, Measurement, Evaluation and Management Organization, Inc.)

* * * * *

"I question your tentative decision concerning Landsat data. If no provision is made for permanently archiving at least a portion of the Landsat data, I believe we may lose information of considerable value to future researchers.

"Further, all of the Landsat data may be quite important for a few years; for example, to support the study of an event like the Mt. St. Helens eruption.

"I believe, therefore, that the vendor should be required to archive all Landsat data, in accordance with the archival policies presently used by the federal government, for the most current three years, on a continuing basis rather than just for the first three years as proposed. Alternatively, the government could elect to archive this three year data under the same plan proposed for meteorological data.

"In addition, some effort should be made to determine the feasibility of permanently archiving a condensed version of the Landsat data--for example, 10% of the total. A continuing record of land changes over a long period is important, but since such changes are generally slow an abbreviated version of the data should suffice for future research purposes.

"Unless absolutely necessary to elicit vendor interest, the proposal for the government to act as a 'surrogate customer' for university research should be dropped. In suggesting this, I assume the Commission's [sic] tentative plan envisions that the government will make a blanket payment to cover all requirements for Landsat data by universities involved in basic research 'deemed to be in the national interest.' The only practical way to administer that would be to include all university requirements because it would be difficult to differentiate basic research "deemed to be in the national interest." A much better approach is for the government to merely include the commercial cost of Landsat data when making specific grants for research." (Dr. John W. McNair, Jr.)

* * * * *

"The announcement of the proposed transfer brought forth a large body of negative comment, including Congressional opposition. My initial reaction was also negative because a change in ownership of the data, without appropriate safeguards, could lead to less work on environmental topics, and underdeveloped countries could lose access to information they cannot gain from their own activities....

"The tentative suggestions of the Blue Ribbon Panel seem to protect the archival data requirements of academic basic research." (Dr. Clifton R. Wharton, Jr., Chancellor, State University of New York)

VI. THE DRAFT RFP PHASE

Archive-Related Provisions of Draft RFP

The Source Evaluation Board issued the draft request for proposals on October 21, 1983. The heart of the solicitation was the Technical Requirements Section, which included provisions relevant to the data archiving requirement. The especially pertinent provisions were as follows:

- o Defined "satellite system" in terms of functions and components, including the data output to be available for archiving--namely, "Data pre-processing to geographically located geophysical units and computer-compatible tape (CCT) and/or master film images calibrated and quality checked."
- o Incorporated the Panel's recommendations regarding the archiving of meteorological satellite data as follows: "The Government currently intends to continue maintenance of meteorological satellite data archives in association with the archives of more traditional meteorological information. Information from these archives is primarily for a variety of Government uses which include making the information available to the public. Offerors are not precluded from proposing the establishment of archives of meteorological satellite data. Such proposals should address details of archival plans and, if applicable, alternatives which might satisfy Government needs in this regard."
- o The requirement regarding the archiving of Landsat data reflected some of the features of the Panel's tentative recommendations (see Section IV, above): "Proposals addressing takeover of the existing Landsat data archives must indicate an understanding that many of the Landsat data have been made available to Government agencies and to the public, and hence are already in the public domain. The government requires that Offerors include provisions to offer return of the archives to the Government if they are found to be of no value to the Offeror. Proposals must address arrangements for maintaining archives of Landsat data which will be collected by the Offeror, including offer of the archived data to the Government, at no cost, prior to purging or destruction. In addition, the proposal shall address any proposed restrictions on Government dissemination of such data."

Congress Bars Transfer of Meteorological Satellites

As the draft RFP phase was drawing to a close, Congress precluded any further consideration of transfer of the meteorological satellites to the private sector. An amendment to the Department of Commerce appropriations bill for fiscal year 1984 prohibited the use of any funds

by the Source Evaluation Board or NOAA related to the sale or lease of the meteorological satellite system or any of their components, including the development of issuance of an RFP on the meteorological satellite system. The bill did not affect the proposed transfer of the Landsat system. The appropriations bill passed the Congress and was signed into law by the President on November 28, 1983.

Comments of Prospective Bidders

The Source Evaluation Board received responses from seven prospective bidders prior to November 21, 1983, the deadline for comments on the draft RFP. Five of these responses specifically addressed the archiving requirements of the draft RFP. Most of the responses did so in reference to draft legislation for which a joint hearing had been held on November 8 and 9, 1983, by the Subcommittees on Natural Resources, Agriculture Research and Environment, and on Space Science and Applications of the House Committee on Science and Technology. The draft legislation is entitled "**Land Remote-Sensing Commercialization Act of 1983**" and includes a section (Section 602 of Title VI) specifically directed to the "Archiving of Data." Because it is incorporated by reference in the potential bidders' comments, it is reproduced here.

Archiving of Data

"Sec. 602. (a). In order to preserve many of the public benefits of civil remote-sensing from space, including long-range global environmental monitoring, the Secretary shall provide both for long-range storage and maintenance of data as described in subsection (b) and for access to those data.

"(b) (1) The Secretary shall provide storage, maintenance, and access for digital remote-sensing data from the Landsat system.

(2) The Secretary shall provide storage, maintenance, and access for digital remote-sensing data generated pursuant to title III.

(3) The Secretary may provide storage, maintenance, and access for digital remote-sensing data generated by license holders under title IV if the Secretary finds that such data have sufficient immediate or potential public benefit.

"(c) Original data or copies thereof shall be promptly made available to the Secretary by the system operator in a form suitable for processing for data storage, maintenance, and access. The Secretary is authorized (subject to the availability of appropriations) to pay to such system operator reasonable costs for reproduction and transmittal of the data.

"(d) (1) Copies of stored data may not be made available from the archive except (A) to the system operator originally providing

the data or (B) pursuant to paragraph (2) or (3) of this subsection.

(2) Copies of stored data may be made available to persons requesting them if the system operator originally providing the data so authorizes the Secretary in writing.

(3) Copies of stored data may be made available to persons requesting them without authorization of the system operator 15 years after the date of the generation of the data.

(4) Persons or system operators requesting and receiving data from the archive shall pay to the Secretary reasonable costs of reproduction and transmittal.

(5) Nothing in this subsection shall release the Secretary from his obligation to provide data storage, maintenance, and access.

"(e) In carrying out the functions of this section, the Secretary may use existing facilities or he may contract with a private sector party or parties for the performance of such functions, subject to the availability of appropriations therefore."

What follows are comments pertinent to the Panel's assessment that have been excerpted from the responses to the draft RFP. These responses were received by the Source Evaluation Board from potential bidders on the satellite systems.

Space America

"The Landsat RFP should be consistent with the draft Landsat commercialization legislation now being considered by the Congress. The terms of the contract are not identical and archiving requirements differ.

"We support the draft legislation which provides that the Federal Government will continue to archive land remote-sensing data, rather than the contractor as proposed in the RFP."

Bendix

"We believe the U.S. government should continue to be responsible for archiving data, as proposed in the draft legislation from the Space, Science and Applications Subcommittee, rather than being a contractor responsibility as proposed in the RFP."

Hughes Aircraft Company

"With respect of the government use of operator-owned data, we perceive no serious issues if the conventional rules of copyright are adhered to. In our mind this includes recognition of the need for payment for secondary uses within the government and transmittal of copyright restrictions in any dealings between the government and third parties...."

"The draft RFP requires 'that the contractor is to acquire and maintain Landsat data archives.' Shall this be interpreted to include the acquisition and management of existing Landsat data archives at the EROS Data Center, or does this apply only to data newly obtained under the commercial operator's purview? If 'acquire and maintain Landsat data archives' only applies to newly obtained data, it is not clear whether the government intends to continue to sell the products currently archived or whether the private operator has the marketing rights to these data."

Control Data

"The price to be charged for Landsat data and the future earth remote-sensing satellite system would be that deemed competitive by the private entity. Lower prices for USG [U.S. government] preferred customers could be effected by USG subsidy of the standard price to that customer. Included could be universities and third world countries."

"If the USG desires the private entity to assume responsibility for the data archive, the bidder may propose assuming archive functions and receive a value rating equivalent to the estimated annual cost of archive operation."

"[We] recommend that terms in the RFP be defined precisely and that the definitions be consistent with any pertinent legislation. Optimally, your RFP and the proposed legislation in Congress will contain the same factors and conditions in order to prevent confusion on the part of the bidders."

RCA

We believe the Source Evaluation Board should...modify the RFP to be consistent with the provisions of the emerging legislation.

"Does the Source Evaluation Board interpret the nondiscriminatory data access policy to allow the exclusive collection and sale of data to a specific customer without placing the data in a public archive?'"

VII. REASSESSMENT AND FINAL RECOMMENDATIONS

The Panel held its second and final meeting on November 28, 1983 to reassess the archiving issue in light of the comments that had been made on the draft RFP by prospective bidders, as well as the comments on the Panel's tentative recommendations that had been received from government officials and other individuals.

The consequences of the Congressional action barring further consideration of the meteorological satellite system transfer were reviewed by Dr. Cary Gravatt, a member of the Source Evaluation Board. He revealed that the Secretary of Commerce had instructed the Board to delete the meteorological satellite provisions of the draft RFP and to proceed with the final RFP, which, accordingly, would be limited exclusively to the Landsat system. However, since the Panel had already recommended that the archiving of meteorological data continue to be a government function and responsibility (see Section IV), this turn of events did not seriously affect the Panel's remaining work.

The Panel discussed, at length, the archiving provisions of the draft legislation, "Land Remote-Sensing Commercialization Act of 1983," on which hearings had been held earlier in the month, and to which most of the prospective bidders had referred in their comments on the draft RFP. The Panel saw considerable merit in the approach taken by the draft legislation, but regarded the 15-year period of control over the data in the archive as too long.

U.S. Government Should Maintain Archive

In the final analysis, the Panel was persuaded by its own reassessment, as well as the many comments it had received, that the responsibility for archiving of Landsat data should continue to reside in the federal government.

After considerable discussion and a reconsideration of the tentative recommendations to the Source Evaluation Board it had made following its earlier meeting, the Panel reached the following conclusions:

- o It is in the public interest to maintain an archive of land remote-sensing satellite data for historical, scientific and technical purposes.
- o It is in the public interest to control the content and scope of the archive and to assure the quality, integrity, and continuity of the data.
- o The maintenance of such an archive is, therefore, a responsibility that should be borne by the U.S. government.

Accordingly, the Panel recommends:

Recommendation No. 1. The RFP should specify that the U.S. government will bear the responsibility and costs of maintaining an archive for land remote-sensing satellite data.

Basic Data Set

One of the problems repeatedly highlighted by potential bidders and others is the absence of any specification by the U.S. government of its own needs for Landsat data from a privately owned system. In contrast, the draft "Land Remote-Sensing Commercialization Act of 1983," referred to in the previous section, requires the contractor to deliver data at the volume and rate of federal usage during fiscal year 1983. The legislation provides for two stages of commercialization, in the first of which the contractor would be responsible for operation of the existing Landsat system (including Landsat 5) and for marketing of all new and archived data from the system. Data continuity would thus be preserved. The second phase calls for a six-year transition period to full commercialization. The government would assure data continuity during the second phase by providing a subsidy to help the contractor build and launch the follow-on system. The draft legislation thus provides a framework within which determinations can be made regarding the basic data set.

A basic data set for the Landsat archive would have to be paid for by the government if the RFP requires it. If a basic data set to be provided for the archive is not specified, how will bids be made? If decidedly different basic data sets are offered by bidders, how will the bids be compared? The draft RFP is vague and ambiguous on these questions.

One suggestion was that the requirement for the archive be "all data that are sensed, whatever they may be and whoever may purchase them," but this was rejected because it would be contrary to all of the principles of data continuity and would destroy the integrity of the Landsat data base. The capability of long-term monitoring of global environmental and ecological monitoring through Landsat would effectively cease. There would be little value to the public in maintaining such an archive.

Thus, the Panel, which is unable to specify what the U.S. government apparently cannot or will not delineate as its Landsat data requirements, makes the following recommendations regarding the basic data set. It will be noted that a baseline is provided from which bidders can work, namely, the current MSS data set. The Panel believes that without such a baseline, the bidding process would be erratic and the bids uncomparable.

Recommendation No. 2. The contractor should provide a basic data set to the U.S. government for the archive.

Recommendation No. 3. (a) Because the Source Evaluation Board is unable at this time to specify either the data requirements of the U. S. government or the characteristics of the basic data set, the RFP should elicit proposals from bidders on the basic data set they would provide for the archive and on what terms.

(b) In their consideration of the basic data set they would offer for the archive, bidders should be urged to use as a baseline the multi-spectral scanner data currently archived.

Recommendation No. 4. The nature of the basic data set should be subject to renegotiation in light of future developments and the recommendations of the Advisory Committee on the Archive (see Recommendation No. 11, below).

Recommendation No. 5. (a) The RFP should distinguish the basic data set for the archive from the inventory of data the contractor may maintain for its own purposes.

(b) Special remote-sensing tasks, which are beyond the data requirements for the basic data set, and which the contractor may perform for customers by special arrangement, need not be provided to the archive.

(c) Accordingly, it should not be a requirement that all sensed data be archived.

Timeliness

Continuity of data flow is a central consideration in the Landsat data system and one of the key factors is the timeliness with which the data are made available to the archive and to users. The data should be provided to the archive as soon as possible after sensing to ensure that they are protected through standard archival practices. Moreover, users requesting data would like to have them in a timely manner, dependent upon their particular applications. Delays can occur anywhere in the data system--for example, at NASA's Goddard Space Flight Center. Insofar as the timely flow to the archive is concerned, the Panel makes the following recommendation:

Recommendation No. 6. The data required for the archive should be made available to the U.S. government promptly upon reception and preprocessing by the contractor; the U.S. government should reimburse the contractor for the costs of reproduction and transmittal of the data for the archive.

Exclusive Right to Sell

The Panel reviewed a number of proposals regarding the period of exclusivity that will be granted to the contractor in terms of right to sell and the protection to be afforded for this. Regarding the latter,

the Panel is in no position to suggest the legal means for protecting the contractor's interest, nor was it chartered to do so. The Panel recognizes, however, that some form of copyright, contract or other protection would have to be provided.

As was noted earlier, the Panel regarded the draft legislation's 15-year period of control over data in the archive as too long. It was suggested as an alternative that the contractor should be allowed to exercise control over the data as long as it desired to, provided that a time-related fee were paid to the government to maintain the data in the archive during the period of control. The argument was that the fee would encourage the contractor to relinquish control sooner rather than later. This proposal was rejected because of the obvious accounting complexities that would be involved and the burdens that would be imposed upon the contractor as well as the government. Also, it is preferable that the contractor be required to maintain its own physical inventory and sales mechanisms. The proposed "control fee" would make the entire system unwieldy and prohibitively complex.

The Panel decided that a specified maximum period of exclusivity was preferable and believed it should be tied to some reasonable measure, such as typical look-back periods for land-use or agricultural users and the rate of turnover of spacecraft and sensors. The Panel believes that a maximum period of five years would be reasonable.

Recommendation No. 7. (a) The contractor should have the exclusive right to sell all data it provides to the U. S. government archive for a maximum period of five years from the date the data are sensed, or for a lesser period, if the contractor relinquishes its exclusive right and consents to distribution of the data from the archive before the five-year maximum period has expired.

(b) After the five-year period, or a lesser period, as determined by the contractor, the data should be in the public domain and should be made available to requesting parties at prices reflecting the costs of reproduction and transmittal.

(c) All requests for data subject to sale exclusively by the contractor should be serviced by the contractor and not by the government archive.

(d) Accordingly, the contractor should be required to maintain a physical inventory of data to service customer requests in a timely manner.

Nondiscriminatory Access

The Panel considered the question of nondiscriminatory access in terms of the basic data set that would be provided to the archive. As can be seen in Recommendation No. 5, the Panel does not recommend that it be a

requirement that data derived from special remote-sensing tasks or value-added products be provided to the archive. The Panel was in general agreement with the definition of the term "on a nondiscriminatory basis," which is employed in the proposed Land Remote-Sensing Commercialization Act of 1983. As defined in that draft legislation, the term means "without preference, bias, or any other special financial, delivery, or technical arrangement which would favor one buyer or class of buyers over another." However, the Panel felt that this restriction should not preclude contributions for basic research that would qualify, for example, under the Internal Revenue Code. Accordingly, the Panel makes the following recommendation, which should be understood to incorporate the definition of "on a nondiscriminatory basis", as employed in the draft legislation:

Recommendation No. 8. All data in the basic data set that are subject to the contractor's exclusive right to sell shall be made available by the contractor to all purchasers on a nondiscriminatory basis; provided, however, that this requirement should not be construed to preclude special concessions in the nature of charitable contributions that the contractor may wish to grant in support of basic research projects that rely on remote-sensing data.

Impacts on Basic Research

As in its initial meeting, the Panel expressed concern, time and again, over the adverse impacts that drastic increases in data prices could have on basic research, if adequate arrangements were not made to cover them. The Panel was assured that this factor would be taken into account with respect to research funded by NASA, which would be reflected in the final RFP. However, it is uncertain that this question would be satisfactorily resolved for other researchers (non-NASA-related) who rely on satellite remotely-sensed data in their research programs. It cannot be assumed that other agencies, such as AID and NSF, would be budgeted for it. Under those conditions--i.e., no additional appropriations for drastically higher data prices--there would be a net reduction in the research. Moreover, basic research programs in developing countries that have been weaned from AID support would be especially hard hit.

The Panel recognizes that the Source Evaluation Board is not empowered to determine this question but, nevertheless, wishes to record its strong concern over the adverse effects on basic research that would occur if the government did not take appropriate action and the contractor was unable to justify concessions, such as would be permitted by Recommendation No. 8. Accordingly, the Panel offers the following recommendation, not so much to the Source Evaluation Board as to the agencies of the Executive Branch and the Committees of the Congress that are responsible for the support of basic research that relies on satellite remotely sensed data:

Recommendation No. 9. In the absence of such concessions as may be economically justified by the contractor, the government should offset any adverse impacts of a nondiscriminatory price structure on basic research programs that rely on land remote-sensing data and are deemed to be in the national interest. In providing this offset, the government would be serving, in effect, as the surrogate customer for the data required in research programs that qualify for support.

Standard Archival Practices

The Panel heard many views regarding the need to follow standard archival practices in the operation of the archive. It was emphasized by members of the Panel and its advisors who are expert in the library, information, and archival fields that this requirement should apply to the policies and procedures governing the three stages of the archival process: (1) What data are to be kept and for how long; (2) the techniques for preserving and conserving them; and (3) the organization of the data for efficient and timely retrieval for users requesting them. The Panel endorses this view.

Recommendation No. 10. The archive should follow standard archival practices to assure proper storage and preservation of the data and timely access for parties requesting the data.

Advisory Committee on the Archive

Reference has already been made to the difficulties and confusion attending the question of what should be in the basic data set. This question will require assessment and periodic review. Archival practices should be reviewed periodically as well.

As the market for land remote-sensing data develops, the needs of users will change. These needs should be reassessed from time to time, and this should be done in consultation with the user community. The EROS Data Center and NOAA have already taken steps to include users in the review of these kinds of questions.

Not all of the land remotely-sensed data that are archived should be preserved indefinitely. How long specific scenes should be saved and when they should be replaced or purged are questions that will have to be reviewed as requirements change and additional acquisitions are made.

Finally, we can expect that technological innovation will render the current technologies of remote-sensing obsolete. One of the contributors to the Panel's work recalled that prior to the launching of the first Landsat experts had said that the return beam vidicon was going to be the main sensor. It would not be possible to do cartographic work with the multi-spectral scanner, they said, because of distortions. They were dead wrong.

Neither the Panel nor any other group can now foresee all of the changes that will occur as land remote-sensing technologies and systems develop. A process of continually assessing these changes and their consequences should be instituted. For this purpose, the Panel makes the following recommendations:

Recommendation No. 11. An Advisory Committee on the Archive should be established to periodically review and assess archival policies, practices and requirements, including the characteristics of the basic data set required for the archive, in light of changing user needs and new and emerging technologies.

Recommendation No. 12. The membership of the Advisory Committee should be broadly representative of the needs and expertise of users and should include archivists with expertise in the scientific data field.

The appointment authority for the Advisory Committee on the Archive could reside, for example, in the Secretary of Commerce or the Administrator of NOAA.

International Obligations

The Panel has conducted its assessment of the archival issues presented by the proposed transfer of the land remote-sensing satellite system within the overall framework and conditions that have governed the work of the Source Evaluation Board. One of the conditions specified for the transfer (see Section I of this report) is that the "transfer will proceed only if feasible terms meet all international law and treaty obligations [and] foreign policy requirements...." Therefore, the Panel's concluding recommendation is:

Recommendation No. 13. The RFP should make clear that the archival requirements recommended above are intended to be consistent with U. S. treaty and international obligations and should be so construed.

APPENDIX I

ACKNOWLEDGEMENTS

In addition to the Satellite Data System Expert Group and other individuals mentioned in this report, the Panel wishes to thank the following people who took time to provide information, comments, and suggestions regarding the issues addressed by the Panel. It should be understood, however, that neither the following individuals nor the members of the Expert Group and others are responsible for the conclusions and recommendations presented in this report of the Panel.

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APPENDIX 2

ACRONYMS

AID	Agency for International Development
CCT	Computer Compatible Tape
DOD	Department of Defense
EROS	Earth Resources Observation System
GOES	Geostationary Operational Environment Satellite
HDT	High-Density Tape
LANDSAT	U.S. Earth Remote Sensing Satellite
LDC	Less Developed Country
MSS	Multi-Spectral Scanner
NARS	National Archives and Records Service
NASA	National Aeronautics and Space Administration
NCLIS	National Commission on Libraries and Information Science
NESDIS	National Environmental Satellite, Data, and Information Service
NOAA	National Oceanic and Atmospheric Administration (The Polar-Orbiting Meteorological Satellites are also referred to as the NOAA Satellites)
NSF	National Science Foundation
RFP	Request for Proposal
SEB	Source Evaluation Board
TM	Thematic Mapper
USDA	United States Department of Agriculture
USG	United States Government

APPENDIX 3

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APPENDIX 4

SATELLITE DATA SYSTEM EXPERTS AND OTHER SPECIAL GUESTS

The Panel members depended on a team of satellite data system experts to brief them on a number of subjects concerning the commercialization of the remote-sensing satellite systems and the principles of archiving. The following were members of that team or gave a presentation to the Panel at one of its two meetings.

Peter Cornillon, Professor, School of Oceanography, University of Rhode Island, "User Comments on Data Archiving - Metsat," September 12, 1983.

Margaret E. Courain, Deputy Assistant Administrator for Information Services, NESDIS

Cary Gravatt, Deputy Director, National Measurements Laboratory, National Bureau of Standards and member of the SEB, "Status Report and Plans of the Source Evaluation Board," November 28, 1983.

Frederick B. Henderson, III, President, Geosat Committee, Inc., "User Comments on Data Archiving - Landsat," September 12, 1983.

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John H. McElroy, Assistant Administrator, National Oceanic and Atmospheric Administration, and Director, National Environmental Satellite, Data and Information Service, "NOAA Satellite Programs: A Briefing," September 12, 1983.

Gary Metz, Assistant Chief for Programs, EROS Data Center, U. S. Geological Survey, "Current Archiving Practices," September 12, 1983.

OTHER SPECIAL GUESTS

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