PROJECT PLAN FOR IMPLEMENTING NAD 83 IN THE MINERALS MANAGEMENT SERVICE

PART II: Technical Aspects of Implementation

(INTERNET VERSION)

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FIGURES

i PREFACE TO INTERNET VERSION

This January 8, 1999, Internet version of "PROJECT PLAN FOR IMPLEMENTING NAD 83 IN THE MINERALS MANAGEMENT SERVICE, PART I: Responsibilities and Timeframes," is identical to the official May 3, 1993 version released by the Minerals Management Service except as noted below:

- The original document was developed using a Helvetica type style in WordPerfect version 5 and a Hewlett Packard LaserJet Series 2 printer. This Internet version was reformatted using an Arial type style in WordPerfect version 8, and a Hewlett Packard LaserJet 4MV printer. This has resulted in page numbering being slightly different from the original document.

- The name and phone number of the office within the Minerals Management Service responsible of developing and maintaining the offshore cadastres has been revised on the cover page.

- Figure 1 was redrawn using WordPerfect 8.

- Figures 2 and 3 were redrawn using Corel Presentations 8.

- Figure 4 was scanned in TIFF format from the original manually drafted figure.

- Figures 5 - 11 remain in the original document format, although the type style and point size of the figures has been change.

- A definition has been added on page 32.

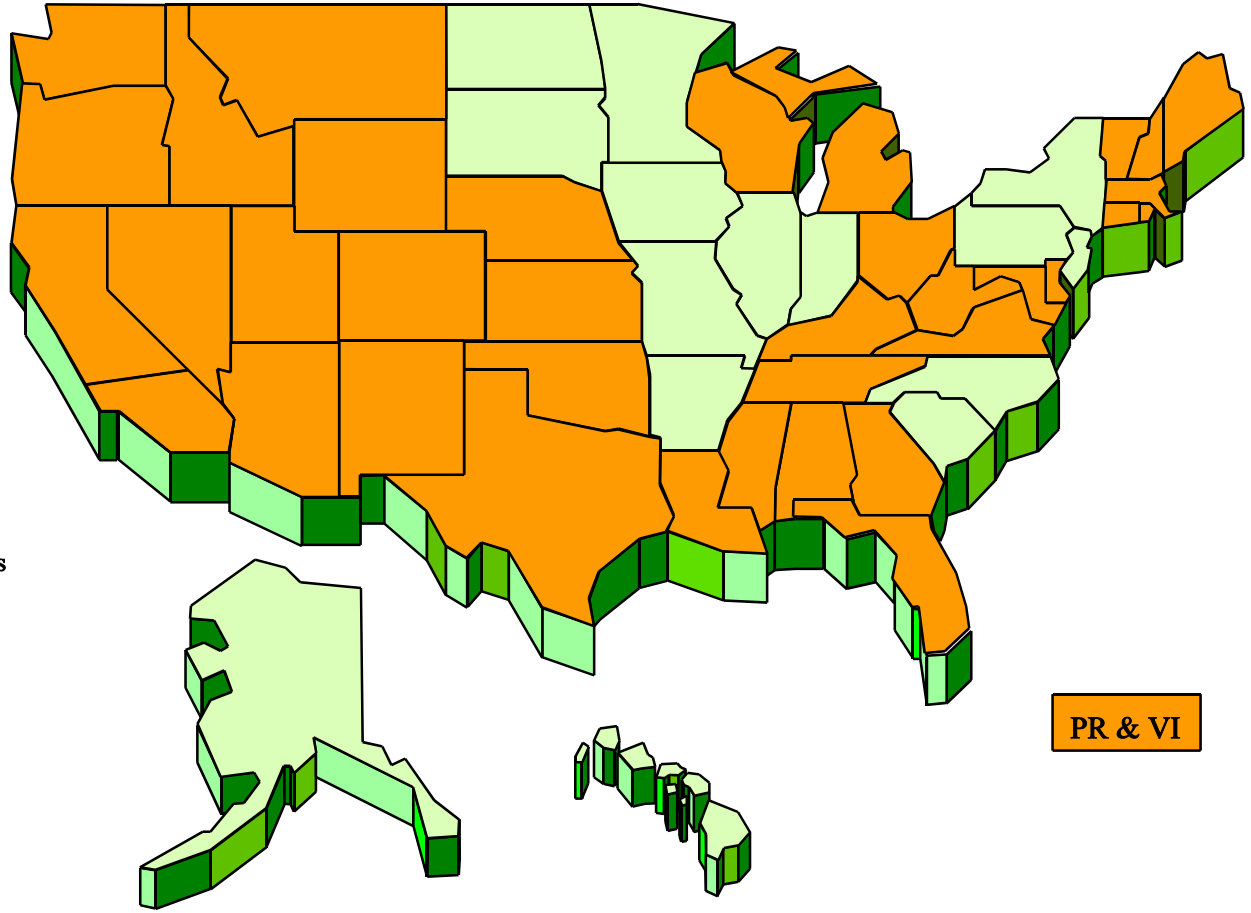
- A HARN/HPGN status graphic drawn using Corel Presentations 8 has been added on the following page.

- NAD 83 has been implemented in the Alaska, Atlantic, and Pacific OCS Regions. The Gulf of Mexico OCS Region continues on NAD 27.

HARN/HPGN STATUS AS OF 1/7/99

EXISTING

Alabama
Arizona
California (N & S)
Colorado
Florida
Georgia
Idaho/Montana (E & W)
Kansas
Kentucky
Louisiana
Maine
Maryland/Delaware
Michigan
Mississippi
Nebraska
Nevada
New England (CT, MA, NH, RI, VT)
New Mexico
Ohio
Oklahoma
Puerto Rico & Virgin Islands
Tennessee
Texas (E & W)
Utah
Virginia
West Virginia
Washington/Oregon
Wisconsin
Wyoming



PART II –Technical Aspects of Implementation
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ii. EXECUTIVE SUMMARY

Over the last five years (1987-92), the Minerals Management Service (MMS) has evaluated and tested various options for implementing the latest United States (U.S.) horizontal control datum--the North American Datum of 1983 (NAD 83). Initially the MMS examined not only what impact NAD 83 would have on the Agency, but also should the conversion be made from the North American Datum of 1927 (NAD 27) to NAD 83. In June 1989, the Federal Government officially adopted NAD 83 (54 FR 25318, June 14, 1989), rendering moot any option the Agency may have had in not converting. All efforts were then directed towards how to convert to NAD 83 **with minimal adverse program impact and expense**.

There are two major aspects to MMS implementation of NAD 83. First, the Agency has to implement NAD 83 with minimal program disruption, while maintaining the integrity of existing NAD 27 leaseholds. MMS's phased approach to NAD 83 implementation based upon the "Comprehensive Program" (Figure 1), specialized transformation procedures, and the parallel implementation of the Technical Information Management System (TIMS) accommodate this requirement.

OCS Region/* Planning Area	Sale** Number	Sale** Date	MMS Target Completion Date***	OCS Region/* Planning Area	Sale** Number	Sale** Date	MMS Target Completion Date***
Alaska/				**Atlantic/**			
Beaufort Sea	144	12/95	2/95	Mid-Atlantic	164	10/96	11/94
Chukchi Sea	148	6/96	2/94	South Atlantic	164	10/96	11/94
Cook Inlet/	149	9/94	10/93	**Gulf of Mexico/**			
Shelikof Strait				Eastern GOM	151	10/95	TBD
GOA (Yakutat)	158	8/95	12/94	**Pacific/**			
Hope Basin	159	7/97	9/95	Southern CA	N/A	N/A	TBD
St. George	153	12/96	3/95	Wash./Oregon	N/A	N/A	TBD

*Conversion schedule for planning areas not listed to be determined at a later date by the MMS NAD 83 Implementation Team.
**"Comprehensive Program 1992-1997," April 1992.
N/A = Not Applicable.
***Completed OPD's and SOBD's due to regional office.
MSS = Mapping & Survey Staff.
TBD = To Be Determined.

Figure 1. MMS NAD 83 planning area conversion schedule as determined by the MMS NAD 83 Implementation Team.

That is not to say that every conceivable issue or problem has been addressed in the project plan. At every level of government and private industry, NAD 83 implementation is a dynamic process as the advent of the High Accuracy Reference Networks (HARN's) illustrates.

HARN's are NAD 83 refinements, initiated by, and within, select individual States. However, technology, such as used in the Persian Gulf War, and the mushrooming use of Land and Geographic Information Systems (LIS/GIS), created a demand for more accurate positioning/surveying capabilities in the civilian sector than the original NAD 83

adjustment (NAD 83 (1986)) provided. In response to this need, the National Geodetic Survey plans to develop HARN's for all States over the next five years, effectively creating a second NAD 83-based horizontal control network (NAD 83 (199x)[1].

Second, MMS employees must become datum conscious and verify datum references. Prior to 54 FR 25318 most Agency employees did not have to relate coordinates to a specific datum. MMS coordinate and associated data referenced NAD 27, and although other datums existed, MMS did not develop data tied to them. However, the United States adoption of NAD 83 directly or indirectly affects every aspect of the Agency's mission. Since the adoption of NAD 83, every locational coordinate (e.g., shot points) and areal measurement (e.g., the number of 8(g) hectares on a Supplemental Official OCS Block Diagram (SOBD)) must carry a specific datum reference. Do they reference NAD 27? Do they reference the original NAD 83 adjustment--NAD 83 (1986)? Do they reference a HARN--NAD 83 (199x)? **Assumptions are no longer acceptable**; the mixing of datum-referenced data can cause major problems and expense for the Agency.

The MMS holds and develops data which **appear** to be non-datum dependent. Some of this data, however, has a **direct** relationship to coordinate data which are datum dependent. For example:

- Rental fees and royalties for blocks leased within a planning area are derived from areal measurements computed from cadastre grid and boundary coordinates which are datum-dependent.

- Recent *relative positioning*[2] well spots have probably been developed from cadastre grid and boundary coordinates, especially if Global Positioning System (GPS) surveying, navigation, and positioning techniques have been employed to spot wells.

This two part document amplifies the MMS NAD 83 Implementation Plan outlined in the 56 FR 20020, May 1, 1991. The first part, "Project Plan for Implementing NAD 83 in the Minerals Management Service, Part I: Responsibilities and Timeframes," details the various aspects of implementation, organizational unit responsibilities, and estimated timeframes. The second part, "Project Plan for Implementing NAD 83 in the Minerals Management Service, Part II: Technical Aspects of Implementation," details specific technical aspects of the MMS conversion from NAD 27 to NAD 83 and identifies associated organizational unit responsibilities.

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[1] The year in parenthesis after NAD 83 indicates the year of adjustment, with the main NAD 83 adjustment occurring in 1986. HARN adjustments will be dated sometime during the 1990's, with 199x indicating the year of adjustment is unknown at this time.

[2] Relative positioning is the location of features by relating their position in relation to known positions--e.g., well locations so many feet or meters south/north and east/west of block boundaries.

PROJECT PLAN FOR IMPLEMENTING NAD 83 IN THE MINERALS MANAGEMENT SERVICE

PART II
Technical Aspects of Implementation

1. INTRODUCTION

If switching from NAD 27 to NAD 83 were as easy as converting English measurements to metric or converting latitude and longitude to state plane coordinates, the conversion process for Minerals Management Service (MMS) would be relatively simple. Unfortunately, an exact transformation between NAD 27 and NAD 83 does not exist. They differ systematically because of a change in the reference ellipsoid and randomly because of errors in computations, known distortions in NAD 27, and the inclusion of many new observations in the calculation of NAD 83. Also, almost all of the new observations were made with newer, more accurate instruments.

There are two aspects to the MMS implementation of NAD 83. First is the creation of a cadastre based on NAD 83. Second, most of MMS's existing data and boundaries must be transformed from NAD 27 to NAD 83.

This two part document amplifies the MMS North American Datum of 1983 (NAD 83) Implementation Plan outlined in Federal Register (FR) Notice 56 FR 20020, May 1, 1991. The first part, "Project Plan for Implementing NAD 83 in the Minerals Management Service, Part I: Responsibilities and Timeframes," details the various aspects of implementation, organizational unit responsibilities, and estimated timeframes. The second part, "Project Plan for Implementing NAD 83 in the Minerals Management Service, Part II: Technical Aspects of Implementation," details specific technical aspects of the MMS converting from NAD 27 to NAD 83 and identifies associated organizational unit responsibilities.

The documents can be used independently. However, they are intended to be used in association with each other. Each document is cross-referenced to the companion document.

2. OFFICE OF MANAGEMENT AND BUDGET (OMB) CIRCULAR A-16
"Coordination of Surveying, Mapping, and Related Spacial Data Activities"

On October 19, 1990, the Office of Management and Budget (OMB) issued the revised OMB Circular A-16, titled "Coordination of Surveying, Mapping, and Related Spacial Data Activities." The revised Circular expands the breadth of coordination of spatial

data[3] and assigns leadership roles to Federal Departments for coordinating activities related to these data. The revised Circular also establishes a new interagency committee called the Federal Geographic Data Committee (FGDC). (See Figure 2.) The objective of the FGDC is to promote the coordinated development, use, sharing, and dissemination of surveying, mapping, and related spatial data activities. Therefore, data policies developed by this committee will directly affect the Agency's implementation of NAD 83.

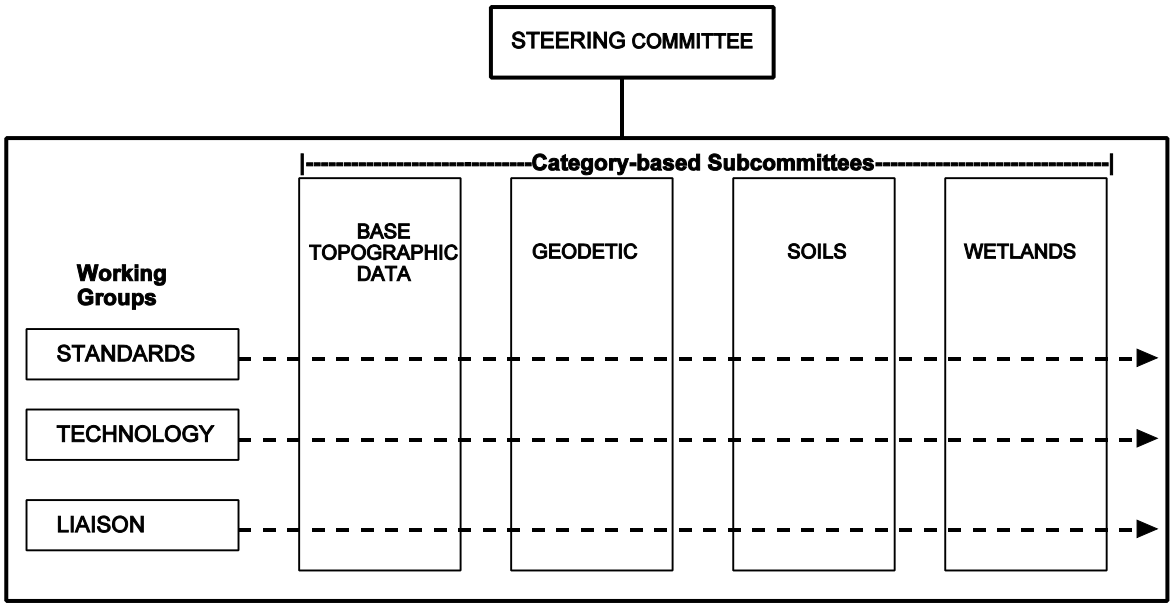

Figure 2. Structure of the Federal Geographic Data Committee (FGDC). The Steering Committee provides policy guidance and oversight to the activities of the Subcommittees and Working Groups. Subcommittees coordinate activities related to each spatial data category. Working Groups deal with issues common to all spatial data categories and promote consistency among the activities of the Subcommittees.

The Circular assigns to the Department of the Interior the responsibility of chairing the Committee. In order to provide effective government-wide leadership to this expanded spatial geographic data coordination process, the Department must update and enhance its internal spatial data coordinating mechanisms.

In addition, a new intradepartmental coordinating committee, called the Interior Geographic Data Committee (IGDC), was created with the primary objective to promote the coordinated development, use, sharing, and dissemination of surveying, mapping, and related spatial data within the Department of the Interior. (See Figure 3.) In addition, the IGDC will:

[3] Spatial data are geographically referenced features that are described by geographic positions and attributes in an analog and/or computer readable (digital) form.

- Advise and assist the Secretary of the Interior in developing and implementing policies and strategies to reduce duplication in spatial geographic data development, and to promote technology transfer and data exchange.

- Provide a focal point on Interior surveying, mapping, and related spatial data activities with the FGDC, and other Federal entities.

- Coordinate bureau viewpoints on surveying, mapping, and related spatial data issues.

- Coordinate the planning of spatial data technologies research (e.g., geographic information systems and remote sensing) within the Department of the Interior.

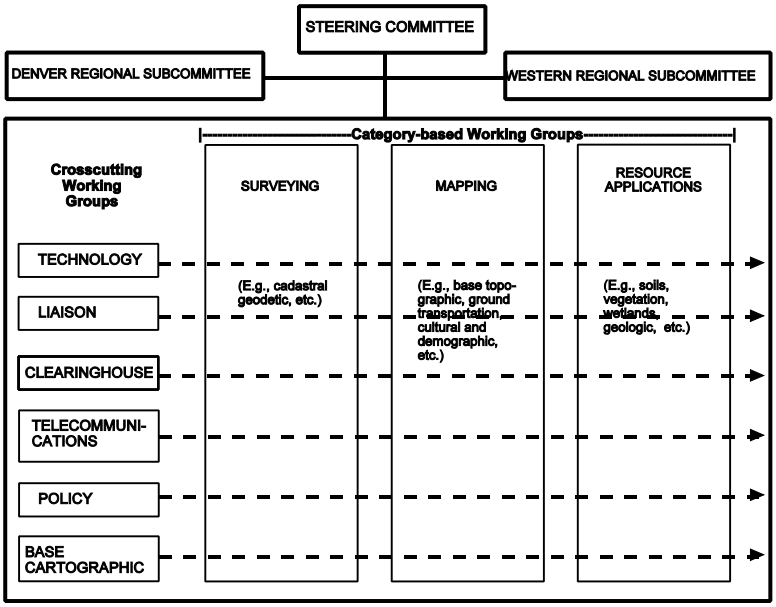

Figure 3. Structure of the Interior Geographic Data Committee (IGDC). The Steering Committee provides policy guidance and oversight to the activities of the Regional Subcommittees and Working Groups.

The committee will establish, in consultation with other appropriate Department organizations, such standards, procedures, interagency agreements, and other mechanisms as are necessary to carry out its department-wide coordinating responsibilities. Like the FGDC, the data policies developed by this committee will directly affect the Agency's implementation of NAD 83.

The Geological Survey has been assigned the responsibility of organizing, chairing, and providing staff support to the IGDC. The Geological Survey is also the chair of the FGDC, and this dual responsibility will ensure a strong linkage between Interior and

government-wide coordinating mechanisms for spatial data activities. The other members will include senior representatives from the Bureaus of Indian Affairs, Land Management, Mines, and Reclamation; the Fish and Wildlife Service; **the MMS**; the National Park Service; the Office of Surface Mining; and the departmental Offices of Information Resources Management and Program Analysis. Other senior officials will be invited to attend meetings of the IGDC as appropriate in light of the issues to be discussed. In addition, each bureau and office that has activities related to the development, use, sharing, and dissemination of surveying, mapping, and related spatial data should actively support and participate in the activities of the IGDC.

Subcommittees and working groups may be convened to support specific needs as identified by the IGDC. Initially, six working groups (Surveying, Mapping, Resource Applications, Standards, Geographic Information Systems, and Remote Sensing) and two regional subcommittees are recommended to carry out the IGDC's department-wide coordination responsibility. (See Figure 3.)

The IGDC will prepare and publish an annual report to the Secretary. This report will describe the activities conducted by, and accomplishments of, the committee during the fiscal year, including appropriate spatial data activities of the bureaus.

There are for MMS purposes three important documents developed as a direct result of the Revised OMB Circular A-16, they are in chronological order:

- The Secretary of the Interior's Memorandum, dated February 1, 1991, establishing responsibilities for bureaus in the Department of the Interior to execute the government-wide leadership roles assigned by the Circular.

- The Chairman, Offshore Information Management Committee's Memorandum, dated April 30, 1991, to the Associate Director Offshore Minerals Management describing the importance of participating in the FGDC and IGDC processes.

- The Associate Director for Offshore Minerals Management's Memorandum, dated May 21, 1991, to the Executive Secretary, FGDC naming representatives to committees and subcommittees and deferring representation to the various working groups until learning more about their specific functions, objectives, and needs.

Since that time, the MMS has become more active in the various FGDC and IGDC committees, subcommittees, and working groups. To date the MMS is represented on the following FGDC and IGDC committees, subcommittees, and working groups:

2.1. Federal Geographic Data Committee (FGDC)

A. Subcommittees

1. With MMS Representation:

a. Base Cartographic . . . . . Lee Thormahlen
b. Cadastral . . . . . Lee Thormahlen
c. Geodetic Control . . . . . Alice Drew
d. Geologic . . . . . Michael Hunt
e. Bathymetric . . . . . Lee Thormahlen

2. Without MMS Representation:

a. Ground Transportation
b. Soils
c. Vegetation
d. Wetlands

B. Working Groups:

1. With MMS Representation:

a. Under the FGDC Subcommittee on Cadastral data, the MMS is represented on two working groups.

1) Offshore Cadastral Working Group
. . . . . Lee Thormahlen

2) Land Records Working Group
. . . . . Paul Rogers

b. Under the FGDC Subcommittee on Geodetic Control, the MMS is represented on one working group.

1) High Accuracy Reference Networks (HARN's)
. . . . . Alice Drew

2. Without MMS Representation:

a. Information has been requested to determine if additional working groups exist.

C. Technical Advisory Groups (TAG's):

1. With MMS Representation:

a. Under the FGDC Subcommittee on Cadastral Data the MMS is represented on one TAG.

1) Development of spatial data standards for cadastral data . . . . . Lee Thormahlen/Richard Naito

2.2. Interior Geographic Data Committee (IGDC)

Tom Readinger, Program Director, Office of Program Development and Coordination is the MMS IGDC representative.

A. Subcommittees

1. With MMS Representation:

a. Steering Committee . . . . . Dave Bornholdt
b. Denver Regional Subcommittee . . . Lee Thormahlen

2. Mapping/GIS Implementation Plan Working Groups

a. Clearinghouse . . . . . Yvonne Morehouse
b. Telecommunications . . . . . Wally Macnow
c. Policy . . . . . Dave Bornholdt
d. Base Cartographic . . . . . Lee Thormahlen

3. Without MMS Representation:

a. Western Regional Subcommittee

B. Working Groups

1. With MMS Representation:

a. Geographic Information Systems . . Jake Lehman
b. Remote Sensing . . . . . Alice Drew

2. Without MMS Representation:

The IGDC Standards working group has been abolished, this function will be accomplished by the FGDC. Therefore, MMS is currently represented on all existing IGDC working groups. However,in mid-November 1992, a memorandum from the Chairman, IGDC requested bureaus to designate their representatives for four (4) new working groups.

On October 28, 1992, Yvonne Morehouse was appointed to coordinate an effort to

develop Offshore Cadastral Data Standards for the IGDC Mapping/GIS Implementation Plan. Tentatively these standards will be completed in DRAFT form by March 1993, and a DOI Manual Section will be prepared by April 30, 1993.

It is important that the readers of this paper make every effort to ensure that their respective areas of responsibility are represented in both the FGDC and IGDC processes. Currently both committees and their respective subcommittees and working groups are actively developing standards that will affect and regulate the development, use, sharing, and dissemination of surveying, mapping, and related spatial data activities within the Federal Government. Many of the ongoing efforts will ultimately lead to the development of Federal Information Processing Standards (FIPS) and will affect future budget processes related to surveying, mapping, and spatial data activities.

For more information regarding the FGDC you can request the following document from Mr. Michael (Mike) Domaratz, Executive Secretary, FGDC at (703) 648-4533:

A National Geographic Information Resource
The Spatial Foundation of the Information-Based Society

First Annual Report to the Director,
Office of Management and Budget
by the Federal Geographic Data Committee

December 1991

3. NAD 83 CADASTRE

The MMS will have a uniform NAD 83-based cadastre throughout the Outer Continental Shelf (OCS). The NAD 83 cadastre offshore of the continental U.S. will strictly adhere to the definitive parameters of the Universal Transverse Mercator (UTM) Grid system, using the Geodetic Reference System of 1980 (GRS 80) as the reference ellipsoid[4]. The NAD 83 cadastre will not supersede the NAD 27 cadastres[5]. When a planning area is converted to NAD 83, maintenance of the NAD 27 cadastre(s) for the planning area will cease, except for error corrections. That is, when a geographic area is converted to NAD 83, a new cadastre based on NAD 83 will be created. Thereafter, the new cadastre will be maintained as required. The old NAD 27 cadastre, which will still be required for certain purposes, i.e., maintenance of existing leaseholds, will be frozen in place and no longer maintained except for correcting computational or typographical errors:

- NAD 27 Official Protraction Diagrams (OPD's) and Leasing Maps (LM's) in effect in a planning area on the date of its conversion to NAD 83 will remain in effect perpetually. OPD's will not be revised unless they are found to contain an error which will adversely affect NAD 83 projected boundary and/or areal measurement computations.

- NAD 27 Supplemental Official OCS Block Diagrams (SOBD's) in effect in a planning area on the date of its conversion to NAD 83 will remain in effect perpetually. SOBD's will not be revised unless they are found to contain an error which will adversely affect NAD 83 projected boundary and/or areal measurement computations.

The Mapping & Survey Staff (MSS) will depict the NAD 83 cadastre on two standard computational products--OPD's and SOBD's. Upon OCS regional or Office of International Activities and Marine Minerals (INTERMAR) request, the MSS will depict the NAD 83 cadastre on two specialized computational products--Supplemental Official Composite Block Diagrams (SOCBD's) and Supplemental Official Lease Diagrams (SOLD's).

3.1. NAD 83 (1986) and High Accuracy Reference Network (HARN) (NAD 83 (199x)) Coordinates

[4] A reference ellipsoid is a geometric approximation of the earth with specified dimensions and is associated with a geodetic reference system or a geodetic datum. GRS 80 is the reference ellipsoid recommended by the International Association of Geodesists as the reference ellipsoid best defining the shape of the earth for NAD 83. It was adopted by the International Union of Geodesy and Geophysics in 1979.

[5] See Part I, sections 2.2. and 8. for a description and history of the NAD 27 cadastres.

The offshore cadastre described above is compatible with either NAD 83 (1986)[6] or the emerging State- or region-specific High Accuracy Reference Networks[7] (HARN's). However, unlike the datum change from NAD 27 to NAD 83 (1986), HARN (NAD 83 (199x)) coordinates are NAD 83 refinements.

3.1.1. HARN Status. As of October 1992, the National Geodetic Survey (NGS) status of coastal States (and/or coastal region) HARN's was:

- HARN's established for Florida, Maryland/Delaware, and Washington/Oregon.
- Computational adjustments in progress for Alabama, Alaska, California, and Louisiana.
- Field operations completed in FY 92 for Maine, Massachusetts, New Hampshire, New Jersey, New York, and Rhode Island.
- Field operations scheduled in FY 93 for Mississippi, Texas, and Virginia.
- Field operations highly probable in FY 94 for Georgia, North Carolina, and South Carolina.
- HARN's probable, but field operations not likely until at least FY 95, for Hawaii, Puerto Rico, and the Virgin Islands.

3.1.2. NAD 83 (1986)/NAD 83 (199x) Positional Differences. The NGS has predicted NAD 83 (1986) and NAD 83 (199x) coordinates for most positions in the conterminous U.S. to differ by less than one meter. However, portions of coastal Oregon exceed this difference. (See Part II, Appendix C.) Most differences in Alaska were predicted to be less than two meters; however, NGS has found differences of up to six meters.

Over large areas coordinate transformations between NAD 27 and NAD 83 exhibit nonlinear differences. The same is true for transformed NAD 83 (1986) and NAD 83 (199x) coordinates, albeit the differences are much reduced.

3.1.3. Adjoining State HARN Coordinate Compatibility. Although HARN's are being developed on a State by State (or regional) basis, the NGS has indicated that their field procedures and computational adjustments should ensure direct coordinate compatibility with an adjoining state. For example, HARN coordinates for California should be directly compatible with HARN coordinates for Oregon.

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[6] See footnote 1, page v.

[7] Although HARN's were initiated by individual States, the NGS plans HARN coverage of the entire U.S. using a 100 kilometer grid (control station) interval. If a State opts to enter into a cooperate agreement with the NGS, a denser HARN may be established.

3.1.4. HARN Impact on the MMS. The MMS is affected by HARN's primarily along a coastal State's land/water interface, i.e., the baseline. A baseline point's NAD 83 (1986) and NAD 83 (199x) coordinates are on the same datum. Both sets of coordinates correctly describe a point's NAD 83 location. Thus, boundaries projected seaward from the baseline, using either set of NAD 83 coordinates, can produce correctly projected NAD 83 boundaries. For example, either NAD 83 (1986) or NAD 83 (1991) coordinates can be used to project Oregon's NAD 83 State Seaward Boundary (SSB) from the baseline. Although the baseline points would be physically identical, their NAD 83 positional coordinate accuracy creates two different baselines and two different SSB projections. Both of these projected boundaries would correctly intersect the MMS NAD 83 offshore cadastre, but with coordinate differences that could approach 1.5 meters. (See Part II, Appendix C for NAD 83 (1986) and NAD 83 (1991) Oregon baseline transformation test results.)

3.1.5. MMS HARN Policy. First, since positional coordinates based on the 1986 adjustment and a HARN adjustment are both on NAD 83, the year of adjustment needs to be cited/identified for **all** NAD 83 coordinates developed or received by the MMS. For example, Oregon NAD 83 coordinates referencing the 1986 adjustment should be cited as: NAD 83 (1986); Oregon HARN referenced coordinates should be cited as: NAD 83 (1991).

Second, the MMS will use NAD 83 (1986) coordinates for all baseline, projected boundary, and other computations portrayed on the NAD 83 cadastre within each OCS region. HARN coordinates (NAD 83 (199x)) will not be used. However, once the NGS has established HARN's for all of the coastal States within an OCS region, this policy will be reconsidered. After the MSS has tested and evaluated HARN coordinates, a recommendation for a formalized policy will be made to the MMS Offshore Information Management Committee (OIMC). The OIMC will issue formal MMS policy statements related to HARN's.

Third, NADCON v2.10[8] (or later) will be used to transform between NAD 83 (1986) and HARN (NAD 83 (199x)) coordinates. Until HARN coordinate compatibility has been fully tested (probably not until at least late FY 93 or early FY 94) any coordinate transformations between NAD 83 (1986) and NAD 83 (199x) should identify the appropriate NADCON HARN grid(s) used to develop the coordinates (e.g., FL (or Florida) or WO (or Washington/Oregon)).

Fourth, the MMS is an active member of the FGDC, Federal Geodetic Control Subcommittee's (FGCS's) HARN Working Group. (See Part II, section 3.1.6.)

3.1.6. Mapping & Survey Staff (MSS). The FGDC, FGCS HARN Working Group will study and review the impact of HARN's on the Federal Government. On completion of the study, the Working Group will publish a report of its findings. The MSS Geodesist

[8] This version of NADCON recognizes the recently computed grids for the state and regional High Precision GPS Networks (HPGN's), now known as HARN's.

will represent the MMS on this Working Group. The MSS Geodesist will be responsible for recommending an Agency policy on HARN's upon completion of the Working Group's report.

3.1.7. Offshore Systems Center (OSC). As appropriate, the Offshore Systems Center (OSC) will revise the MMS Offshore Block, Boundary, and MAP/OPD Information System (OB2MIS)[9] to ensure compatibility with evolving MMS HARN policy.

3.1.8. OPDC Supervisory Program Analyst. The Supervisory Program Analyst in the Office of Program Development and Coordination (OPDC) will be the MMS NAD 83 Implementation Team liaison to the OIMC to develop MMS HARN policy. The OPDC Supervisory Program Analyst will ensure compatibility with FGDC policy, and as appropriate, publish the MMS HARN policy in the Federal Register.

3.2. Official Protraction Diagram(s) (OPD)

OPD's are the standard computational products which all other cadastre-related products supplement. NAD 83 OPD's will depict a metric grid, with full grid blocks being 4800-by-4800 meters throughout the OCS. Areal measurements for partial blocks along UTM zone boundaries will be shown on the OPD.

A standardized block numbering scheme will be based on the formula:

[(Row Number - 1) x 50] + Column Number + 6000 = Block Number.

For example, the OPD block number for the block in row 23, column 27 is 7127 ([(23 - 1) x 50] + 27 + 6000). The OPD block number for the block in row 1, column 12 is 6012 ([(1 - 1) x 50] + 12 + 6000).

The number of blocks per OPD will vary, based upon an OPD's latitude and location within a UTM zone. (See Part II, Appendix A., section 9.4.)

When required, OPD's for Hawaii and the U.S. Dependencies will also portray a metric cadastre based upon strict adherence to the definitive parameters of the UTM grid system. However, due to the physical separation of some of these areas from the continental U.S., the World Geodetic System of 1984 (WGS 84)[10] may be substituted as the reference ellipsoid in lieu of GRS 80.

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[9] When this document was written, OB2MIS was being converted to the Block and Boundary component of the MMS Technical Information Management System (TIMS). Throughout the remainder of this document, both OB2MIS and the Block and Boundary component of TIMS will be referred to as "B&B, TIMS."

[10] For MMS purposes WGS 84 is considered equal to NAD 83 offshore of Alaska and the conterminous U.S.

The first planning areas scheduled for conversion to NAD 83 are the Chukchi Sea and Cook Inlet. (See Part I, Appendix B.) Construction of these OPD's will establish one of two uniform, standardized MMS-wide NAD 83 OPD formats. (See Part II, Appendix A, section 9.4.)

3.2.1. Replacement of Leasing Maps (LM's). All LM's offshore of Louisiana, Texas, and a portion of southern California referencing NAD 27 State Plane Coordinate Systems (SPCS's) will be replaced by OPD's. The English systems of measurement (feet and acres) will be replaced by the metric UTM grid system (meters and hectares). These changes will correct distortions and errors associated with some NAD 27 cadastres.

3.2.2. Block/Boundary Coordinates and Areal Measurements. B&B, TIMS will be used to develop and maintain metric offshore block and boundary coordinates and areal measurements. UTM "X" and "Y" block corners and boundary intersections will be computed to three (3) significant decimal digits. Areal measurements will be computed in hectares to six (6) significant decimal digits. This level of significant digits will facilitate the numerous coordinate conversions and datum transformations between the various NAD 27 cadastres and NAD 83. It will also facilitate the integration of, and consistency between, existing and proposed information systems.

3.2.3. International Maritime Boundaries. NAD 83 OPD's will depict the Federal Government's position relative to international maritime boundaries. The MSS will determine the most appropriate portrayal of a boundary in consultation with the Department of State (DOS):

- For international maritime boundaries referencing NAD 83 or WGS 84, coordinates for initial, turning, end, and other points will be described on OPD's as specified in the treaty, agreement, or World Court decision establishing the boundary. A datum reference citation as part of the point description is redundant and will not be included. For example, the Initial Point on the U.S.-U.S.S.R. Provisional Maritime Boundary, would be depicted on NAD 83 OPD NQ 02-06 as:

  I.P. 65°30'00"N 168°58'37"W.

- For international maritime boundaries referencing datums other than NAD 83 or WGS 84, coordinates for initial, turning, end, and other points will be described on OPD's as specified in the treaty, agreement, or World Court decision establishing the boundary. A datum reference citation will be included as part of the point description. For example, Turning Point 12 on the U.S.-Canada Maritime Boundary, would be depicted on NAD 83 OPD NL 19-12 as:

  T.P. 12 (44°49'43.625"N 66°57'57.134"W NAD 27).

- Generally, transformed coordinate equivalents for international maritime

boundaries will not be depicted on NAD 83 OPD's. If, however, it is determined to be in the best interest of the Federal Government to cite transformed coordinate equivalents, coordinates for initial, turning, end, and other points as specified in the treaty, agreement, or World Court decision establishing the boundary will be transformed using the current NADCON version[11]. The word "Transformed" will be included as part of the point description and the following note included on the OPD collar:

The National Geodetic Survey (NGS) software NADCON [version number] is used by MMS to transform between NAD 27 and NAD 83 coordinates (55 FR 3494, February 1, 1990, and 55 FR 32681, August 10, 1990).

For example (hypothetical), for Turning Point 12 on the U.S.-Canada Maritime Boundary, the NAD 83 coordinate equivalents would be depicted on NAD 83 OPD NL 19-12 as:

T.P. 12 (44°49'43.91280"N 66°57'55.05356W" Transformed).

3.2.4. Provisional Maritime Boundary Note. In 1989/90 the DOS approved an explanatory note for inclusion on NAD 27 OPD collars relative to provisional international maritime boundaries. NAD 83 OPD's depicting provisional international maritime boundaries, will included the DOS approved collar note:

The United States-[name of country] maritime boundary depicted here is provisional, pending the entry into force of applicable boundary delimitation agreements and, beyond 200 nautical miles, pending the delimitation of United States continental shelf jurisdiction.

3.2.5. Exclusive Economic Zone (EEZ) Limit. NAD 83 OPD's will follow conventions developed by MMS and DOS for NAD 27 OPD's containing the Exclusive Economic Zone (EEZ) limit:

- OPD's will depict the cadastre for the full NAD 83 1° (of latitude) x 2° (of longitude) or 1°x3° OPD limit.
- OPD's will not depict the 200 nautical mile EEZ limit.
- The following note will be included on the OPD collar:

  Although not shown, the 200 nautical mile Exclusive Economic Zone (EEZ) limit lies within this diagram.

When the MSS geodesist has completed the ellipsoidal geometry-based programs for

[11] NADCON v2.00 (or later) is the standard MMS NAD 27/83 datum transformation software.

B&B, TIMS, MMS and DOS will reevaluate the policy of not depicting the EEZ limit on OPD's.

3.3. Supplemental Official OCS Block Diagram(s) (SOBD)

SOBD's are large-scale standard computational products which supplement OPD's. SOBD's graphically portray the final results of the computational process for boundaries projected offshore from a baseline (e.g., the SSB) and cadastre blocks adjoining non-projected international maritime boundaries (e.g., the U.S.-Canada Maritime Boundary on OPD NL 19-12). Unlike the depiction of international maritime boundaries on OPD's (Part II, section 3.2.3.), NAD 83 UTM coordinate equivalents will be used to compute the SOBD's. (See Part II, section 4.3. for a discussion of coordinate equivalents.)

SOBD's identify the OPD name and number, block number, datum, previous computation date, and planning area. They define the radius and types of boundaries intersecting the block, coordinates for arc and tangent segment offshore intersections, contributing baseline point coordinates, UTM "X" and "Y" coordinates of the block, areal measurements within the block, and ("for the Director, MMS") approval signature and date.

3.4. Supplemental Official Composite Block Diagram(s) (SOCBD)

SOCBD's are specialized computational products which supplement OPD's and SOBD's. These large-scale diagrams are portrayed on a format similar to the SOBD. They show ambulatory boundary changes through time within a single block, usually on the same datum[12]. Baseline ambulation occurs in areas where the baseline has not been fixed by court decree or in areas where straight baseline and other contention issues have been resolved.

For example, SOCBD's are needed for areas like NR 06-03, Block 423 in the Beaufort Sea Planning Area. Between the computations for the SOBD's dated 6/4/82 and 2/2/88, the State revised their straight baseline contentions, eliminating the baseline contention which affected this block, and a new hydrographic survey was completed, leading to a landward movement of the computational baseline and associated seaward projected boundaries. As there were State leases adjoining the 6/4/82 SSB, the Federal Government did not re-lease any of the former State areas that were within the Federal '8(g) Zone' after the 2/2/82 computations. Prior to Sale 124 in 1991, leases adjoining the 6/4/82 SSB were relinquished. A SOCBD depicting the 1982 and 1988 projected seaward boundaries defined areas (of less than 12 hectares) within the Federal '8(g) Zone' which could potentially be developed into a bidding unit.

[12] Graphic portrayal must be on only one datum, i.e., either NAD 27 or NAD 83. SOCBD's can depict boundaries from both datums if transformed coordinates are used for one of them.

3.4.1. OCS Regions. The OCS regions must specifically request SOCBD production, provide the MSS with all relevant source materials needed to develop the SOCBD's, and identify a point of contact with whom the MSS can work directly. SOCBD depiction of lease or land status information is an OCS regional responsibility. Blocks depicting lease or land status information must be approved (signed and dated) by the appropriate OCS Regional Director.

3.4.2. Office of International Activities and Marine Minerals (INTERMAR). INTERMAR must specifically request SOCBD production, provide the MSS with all relevant source materials needed to develop the SOCBD's, and identify a point of contact with whom the MSS can work directly. SOCBD depiction of lease or land status information is an OCS regional responsibility. Blocks depicting lease or land status information must be approved (signed and dated) by the appropriate OCS Regional Director.

3.4.3. Mapping & Survey Staff (MSS). Upon formal request of an OCS region or INTERMAR, the MSS will develop SOCBD's. They will depict the coordinates of the intersection(s) of the ambulatory boundaries, areal measurements for the resulting parcels of land, and approval signature and date. SOCBD's are intended for use with SOBD's and will not show coordinates for the projected boundary arc and tangent segment intersections, contributing baseline point coordinates, nor projected boundary intersections with the block boundary as depicted on the "parent" SOBD's. SOCBD's, as developed by the MSS, will not depict lease or land status information; this information may be added by the OCS regions as indicated in Part II, sections 3.4.1. and 3.4.2.

3.5. Supplemental Official Lease Diagram(s) (SOLD)

SOLD's are specialized computational products which supplement OPD's and SOBD's. MSS will use PLUD's annotated by OCS regional leasing specialists to develop SOLD's. Like SOBD's, SOLD's are intended to be used as stand-alone lease descriptions in the lease instrument. They reflect official NAD 83 coordinates and areal measurements of bidding units. NAD 27 lease instruments reflect a NAD 27 leasehold's official description (see Part II, section 4.3.); SOLD's will reflect the NAD 83 coordinate equivalents of appropriate portions of NAD 27 leaseholds lying within an NAD 83 cadastre block. (See Part II, section 10.) Until a NAD 27 leasehold is terminated, relinquished or expires, the official description of the boundary between adjoining NAD 27 and NAD 83 leaseholds will be the NAD 27 lease description. (See Part II, section 4.3.6.)

3.5.1. OCS Regions. OCS Regions must specifically request SOLD production and work with MSS to develop PLUD's as outlined in Part II, section 3.6.1. Prior to the Chief, MSS signing completed SOLD's for the Director, MMS, the appropriate OCS region will review, verify, and approve the portrayed NAD 27 leasehold information.

3.5.2. Office of International Activities and Marine Minerals (INTERMAR). INTERMAR must specifically request SOLD production and work with MSS to develop PLUD's (as outlined in Part II, section 3.6.2.). Prior to the Chief, MSS signing completed SOLD's for the Director, MMS, INTERMAR and the appropriate OCS region must review, verify, and approve the portrayed NAD 27 leasehold information.

3.5.3. Offshore Systems Center (OSC). OSC will modify the B&B, TIMS computational system to incorporate needed output requirements for SOLD's.

3.5.4. Mapping & Survey Staff (MSS). MSS will use PLUD's annotated by an OCS regional leasing specialist to develop the SOLD's. MSS will use B&B, TIMS to compute coordinates and areal measurements to SOBD accuracy. SOLD's will be signed for the Director, MMS, by the Chief, MSS, after OCS regional (and, if necessary, INTERMAR) approval/verification of portrayed NAD 27 leasehold information.

3.6. Plot Unit Diagram(s) (PLUD)

PLUD's are internal working documents used to develop SOLD's. Using the NAD 83 B&B, TIMS database and NAD 27 leasing information from the Outer Continental Shelf Information System (OCSIS)[13], an OCS regional leasing specialist detailed to the MSS will produce print screens through the B&B, TIMS production process. (See Part I, section 2.3.4.) The OCS regional leasing specialist will annotate the PLUD's to indicate how irregular portions resulting from NAD 27 leaseholds adjoining unleased areas on the NAD 83 cadastre are to be combined to form bidding units.

3.6.1. OCS Regions. OCS Regions must specifically request PLUD production and work with MSS to develop them. The OCS regions will:

- Detail an OCS regional leasing specialist to MSS to develop the PLUD portrayal of bidding units.
- Update and maintain the TIMS(O) database to reflect the most current leasehold information prior to PLUD production.

3.6.2. Office of International Activities and Marine Minerals (INTERMAR). INTERMAR must specifically request PLUD production and work with MSS to develop them. In addition, INTERMAR will:

- Arrange for an OCS regional leasing specialist from the appropriate OCS region to be detailed to MSS to develop the PLUD portrayal of bidding units.

[13] When this document was written, OCSIS was being converted into several major components of TIMS. Rather than cite each component, throughout the remainder of this document, OCSIS and the TIMS components being derived from OCSIS, will be referred to as "TIMS(O)."

- Arrange for the appropriate OCS region to update the TIMS(O) database to reflect the most current leasehold information prior to PLUD production.

3.6.3. Mapping & Survey Staff (MSS). MSS will:

- Coordinate PLUD production with the OCS regions and INTERMAR.

- Provide B&B, TIMS/PLUD training to OCS regional leasing specialists prior to PLUD production.

3.7. Summary of MMS NAD 83 Cadastre-related Products

3.7.1. Standard Computational Products. The Mapping & Survey Staff (MSS) will depict the NAD 83 cadastre on two standard computational products--OPD's and SOBD's:

- OPD's (Official Protraction Diagrams) are the base documents which are supplemented by all other MMS cadastre-related products. They depict a metric grid, with full grid blocks being 4800-by-4800 meters throughout the OCS and areal measurements for partial blocks along UTM zone boundaries.

- SOBD's (Supplemental Official OCS Block Diagrams) are individual cadastre block diagrams which identify the OPD name and number, block number, datum, previous computation date, planning area, radius and types of boundaries intersecting the block, coordinates for arc and tangent segment offshore intersections, contributing baseline point coordinates, UTM "X" and "Y" coordinates of the block, areal measurements within the block, and ("for the Director, MMS") approval signature and date.

3.7.2. Specialized Computational Products. Upon OCS regional or INTERMAR request, the MSS will depict the NAD 83 cadastre on two specialized computational products--SOCBD's and SOLD's:

- SOCBD's (Supplemental Official Composite Block Diagrams) are supplements to SOBD's. These SOBD-like diagrams portray ambulatory boundary changes through time, within a single block, and usually on the same datum and identify boundary intersections and resultant areal measurements.

- SOLD's (Supplemental Official Lease Diagrams), a SOBD-like diagram, are developed from PLUD's, and are intended for use as stand-alone lease instrument descriptions when a NAD 83 cadastre block contains a NAD 27 leasehold's. (PLUD's--Plot Unit Diagrams are internal working documents which have been annotated by an

OCS regional leasing specialist to indicate how irregular portions resulting from NAD 27 leaseholds adjoining unleased areas on the NAD 83 cadastre are to be combined to form bidding units.)

3.8. Historical Record

The MSS will:

- Maintain a historical record of each NAD 83 OPD in hardcopy, archival quality, format.
- Maintain a historical record of each NAD 83 SOBD, SOCBD, and SOLD in both digital (B&B, TIMS) and hardcopy formats.
- Maintain a historical record of the final NAD 27 OPD's prior to conversion of planning areas to NAD 83 in hardcopy, archival quality, format.
- Maintain a historical record of each pre-B&B, TIMS computed NAD 27 SOBD and SOCBD in hardcopy format.
- Maintain a historical record of each B&B, TIMS computed NAD 27 SOBD and SOCBD in both digital and hardcopy formats.

4. DATUM TRANSFORMATIONS

The MMS will use the FGCS approved procedures for obtaining NAD 83 coordinates for NAD 27 positions. In descending order of accuracy, these three methods are:

- Survey the NAD 27 positions on NAD 83.
- Perform a simultaneous adjustment for all NAD 27 positions utilizing original survey observations.
- Transform NAD 27 coordinate values using the North American Datum Conversion (NADCON) transformation software.

4.1. Transformation Software

For most purposes, the MMS will use the third option to obtain NAD 83 equivalents for NAD 27 coordinates/positions. Through 55 FR 3493, February 1, 1990, the MMS advised the public that the Agency would use the NGS developed software for this purpose. In 56 FR 20020, May 1, 1991, the MMS specifically advised the public that the federally-endorsed datum transformation computer software known as NADCON would

be used to convert existing NAD 27-based cadastre coordinates into NAD 83 equivalents.

The first version of NADCON to fully satisfy MMS OCS requirements offshore of Alaska and the conterminous U.S. is NADCON v2.00. The NGS officially released NADCON v2.00 in July 1991, and was adopted as the Agency's standard NAD 27/83 datum transformation software. With the introduction of the HARN's, this policy is being modified to accommodate later versions of NADCON. (See Part II, section 3.1.5.)

The current version of NADCON (v2.10) and NADCON v2.00 produce identical NAD 27/NAD 83 (1986) transformation output from the same input. However, NADCON v2.00 and the previous NADCON versions (e.g., v1.01 and v1.02) do not always develop identical transformation output from identical input coordinates. It is, therefore, the Agency's policy that:

- The NADCON version used must be identified on all transformed coordinates, both hardcopy and digital data formats.
- Transformed coordinates developed by using earlier NADCON versions may be used for planning purposes, if the NADCON version is known.
- NADCON v2.00 or later will be used for transformed coordinates and computations released to the public or other agencies.

4.1.1. OCS Regions. Each OCS Regional Director will designate an OCS regional NADCON liaison. The liaison will serve as the point of contact for the MSS geodesist for the dissemination of NADCON and NADCON-related information within the OCS region.

4.1.2. Mapping & Survey Staff (MSS). The MSS geodesist will be responsible for:

- Identifying and coordinating NADCON revisions with the NGS.
- Distributing and maintaining the PC executable version of NADCON within the Agency.
- Distributing and maintaining the NADCON source code within the Agency.
- Ensuring OSC receives revisions to the NADCON code.

4.1.3. Offshore Systems Center (OSC). OSC will be responsible for the incorporation of NADCON into the Agency's national computer systems. When requested, OSC will assist the OCS regions with incorporating NADCON into OCS regional computer systems.

4.1.4. OPDC Supervisory Program Analyst. Through Federal Register notices, the OPDC Supervisory Program Analyst will advise the public of MMS adoption of new NADCON versions.

4.2. NAD 83 Coordinate Equivalent Values for Non-NAD 83 International Maritime Boundaries

The conversion of non-NAD 83 international maritime boundaries (e.g. U.S.-Canada Maritime Boundary in the Gulf of Maine) to NAD 83 will be determined on a boundary by boundary basis. The MSS geodesist will determine the most appropriate method (transformation, recomputation, both, etc.) for calculating the NAD 83 coordinate equivalents, and the Chief, MSS will coordinate with DOS to ensure acceptability of the procedures and coordinates. (See Part II, sections 4.3.4. and 6.)

4.3. Leasehold and Boundary Integrity When Transforming

The MMS affirms that an OCS lessee's rights issued under a NAD 27 legal descriptions will continue to be protected as warranted under that description (55 FR 3493, February 1, 1990). However, the procedure for portraying NAD 27 leases on the NAD 83 cadastre and developing NAD 83 coordinate equivalents and areal measurements for the leases can be complex:

- "There is no rigorous mathematical method for transformation between such systems as NAD 27 and NAD 83... The most that we can achieve ... is to make sure that the fixed coordinates in the new system remain the same as published and that the shapes of geometric figures within the network are preserved as much as possible. Beyond that all efforts are fruitless."[14]

- "[NAD 27 and NAD 83] differ systematically because of a change in the reference ellipsoid and randomly because of imperfections in either system, known distortions in NAD 27, and the inclusion of many new measurements in the NAD 83 adjustment."[15]

- Both straight lines and arcs in NAD 27 become non-mathematically definable curves when transformed and portrayed in NAD 83. (See Part II, Appendix B.)

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[14] Vincenty, T. (1988) "A Note on Approximate Transformations of Coordinates." *Surveying and Mapping,* 48, No. 3, pp. 207-211.

[15] Graff, D.R. (1988). "Coordinate Conversion from NAD 27 to NAD 83." *Journal of Surveying Engineering,* 114, No.3, pp. 125-130.

- The original NAD 27 radius between projected boundary intersections and the baseline is not maintained during the transformation process. (For example, a NAD 27 radius of 5556 meters will be 5556 meters plus or minus a small amount.)

In addition, there are two major concerns. First, the procedure should be straightforward and simple, requiring neither special knowledge nor a significant amount of training for understanding and use. Second, industry, coastal States, and other Federal agencies must be able to replicate MMS computations without specialized software and/or equipment.

As discussed in Part II, Appendix B, to simplify the transformation process for NAD 27 leaseholds and to ensure that industry, the coastal States, and others can replicate the MMS computations, the MMS will consider:

- Straight lines on NAD 27 leaseholds and boundaries to be straight lines on NAD 83.

- Arcs on NAD 27 leaseholds to be arcs of the same radius on NAD 83.

The procedures outlined in Part II, sections 4.3.1. through 4.3.6. are specific conditions which further explain the process to be used by MMS to maintain NAD 27 leasehold and boundary integrity.

4.3.1. Case 1: Blocks Leased Under NAD 27. On the exterior block boundary, the maximum distance over which a straight line may be considered to connect transformed coordinate pairs is between the block's corners (e.g., 4800 meters on the metric UTM grid system in the Alaska OCS Region and 15,840 feet on the corrupted English UTM system in the Gulf of Mexico OCS Region). However, if there are other intersections with the block boundary (SSB, Limit of "8(g) Zone" Boundary, adjacent block corners, etc.), then they become the limiting factor for assuming straight lines.

> Example: On Figure 4, assume that Block 78, LM 9A is a NAD 27 leasehold. It is described by block corners D, E, H, and K. On the NAD 83 cadastre, a straight line may be assumed between transformed corners D-E. However, between corners D-K there are two intersections--intersection C with an adjacent block corner and intersection n with the Limit of "8(g) Zone" Boundary. These two intersections become the limiting factors for assuming straight lines between block corners D-K. Straight lines may be assumed only between transformed intersections D-n, n-C, and C-K.

On the interior of the block, all boundaries will be transformed. Straight lines on NAD 27 will be maintained as straight lines on NAD 83; and circular curves on NAD 27 will be maintained as circular curves of the appropriate radius on NAD 83.

> Example: On Figure 4, assume that Block 77, LM 9A is a NAD 27 leasehold.

It is described by block corners E, F, G, and H and contains the Limit of "8(g) Zone" Boundary with intersections o, p, q, and r. On the NAD 83 cadastre, these intersections would be transformed and the intersections connected with either a straight line for a tangent segment or a circular curve of the appropriate radius for an arc segment.

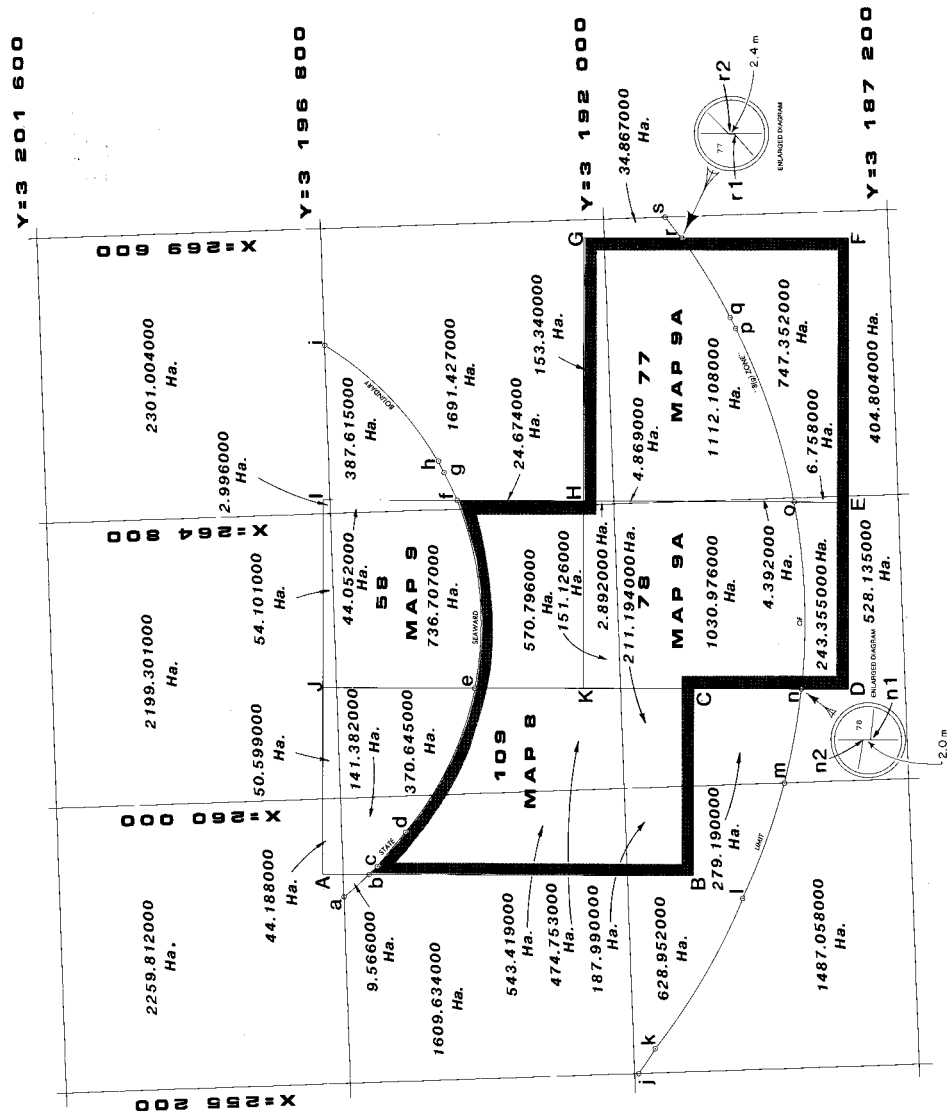
4.3.2. Case 2: Ambulatory Boundaries. Ambulatory NAD 27 projected offshore boundaries will be recomputed on NAD 83 after the projected boundary's baseline has been transformed or redefined on NAD 83. When these boundaries intersect a NAD 27 leasehold, the recomputed projected boundary will intersect and terminate on the exterior block boundary of the leasehold. When the lease is terminated, relinquished or expires, the block will be redefined on NAD 83 and the recomputed projected boundary used.

Example: On Figure 4, assume that Block 77 and Block 78, LM 9A are NAD 27 leaseholds. The blocks are described respectively by block corners E-F-G-H and D-E-H-K. As the blocks are leaseholds, Case 1 applies within the block boundaries. However, outside of the leaseholds the recomputed Limit of "8(g) Zone" Boundary terminates on the exterior of the leaseholds, causing a temporary offset of the projected boundary as illustrated in the enlargements for intersections n and r.

4.3.3. Case 3: U.S. Supreme Court Decreed Boundaries. If a boundary projected offshore from a U.S. Supreme Court decreed NAD 27 baseline (e.g., the court-decreed baseline for the State of Mississippi) is not contained within a leased block, the baseline from which the boundary is projected will be transformed and the projected boundary recomputed on NAD 83.

Example: On Figure 4, assume that the Limit of "8(g) Zone" Boundary has been projected from a U.S. Supreme Court decreed NAD 27 baseline. The decreed baseline coordinates would be transformed and the projected boundary recomputed. Inside the leasehold, Case 1 applies. Outside of the leasehold the results would be the same as for Case 2--the recomputed Limit of "8(g) Zone" Boundary terminates on the exterior of the leaseholds, causing a temporary offset of the projected boundary.

Both the baseline and the SSB for the State of Louisiana have been decreed by the U.S. Supreme Court. Transformation of the decreed NAD 27-based coordinates for these two lines will negate the three Admiralty/Imperial mile relationship between them. Thus, conversion of Louisiana's baseline and SSB will require special considerations/procedures to be developed later. Development of these procedures may require the MSS to work with the Department of Justice and the issuance of a Supplemental Decree.



X=, Y= NAD 83 Cadastre Coordinates

a – s Assumed Projected Boundary Intersections

K H D E Assumed NAD 27 Leasehold

Figure 4. Assumed NAD 27 Leaseholds in the Gulf of Mexico OCS Region (from a portion of LA-Map Nos. 8, 9, and 9A) Depicted on the NAD 83 Cadastre.

4.3.4. Case 4: International Maritime Boundaries. NAD 27-referenced international maritime boundaries which have been established by international agreement, treaty, decisions of the World Court, etc., normally will be converted to NAD 83 as outlined in Part II, sections 4.2. and 6. The resulting NAD 83 boundary coordinate equivalents will be connected using the method (geodesic lines, rhumb lines, etc.) indicated in the original document establishing the boundary.

> Example: The NAD 27 coordinates for the U.S.-Canada boundary in the Gulf of Maine will be transformed to NAD 83 equivalents. The NAD 83 coordinate equivalent intersections would be connected using the method described in the original document establishing the boundary.

4.3.5. Case 5: Subdividing Irregular Portions to Create Bidding Units. Irregular portions result from NAD 27 leaseholds adjoining unleased areas on the NAD 83 cadastre. As used by the MMS, an irregular portion is the unleased area in a NAD 83 cadastre block lying between a transformed NAD 27 lease boundary and a NAD 83 block boundary.

> Example: On Figure 4, the area outside the NAD 27 leasehold in the NAD 83 block bounded by the following coordinates is an irregular portion:
>
> | | | |
> |---|---|---|
> | NW corner | X=264 800, | Y=3 192 000 |
> | NE corner | X=269 600, | Y=3 192 000 |
> | SE corner | X=269 600, | Y=3 187 200 |
> | SW corner | X=264 800, | Y=3 187 200 |

At the Regional Director's discretion, these irregular portions may be added to other adjoining unleased cadastre blocks to create a bidding unit. (See Part II, sections 3.5. and 3.6.) When the subdivision of an irregular portion into two or more fractional parts is necessary, the MMS will use established surveying procedures for the subdivision of fractional sections.

> Example: On Figure 4, assume it is necessary to subdivide the 404.804000 hectare irregular portion into two fractional parts at corner F. Three main options are:
>
> - A line from corner F to the southeast corner of the block.
> - An extension of transformed line E-F (or F-G).
> - A line running grid north-south (or grid east-west) from corner F.
>
> The MMS will use option three to subdivide irregular portions into fractional parts. This option simplifies the computational and replication procedures.

4.3.6. Form MMS-2005. When NAD 83 irregular portions adjoining NAD 27 leaseholds are leased, Form MMS-2005 ("Oil and Gas Lease of Submerged Lands Under the Outer Continental Shelf Lands Act") must reflect: (1) that the boundary description between the NAD 27 and NAD 83 leaseholds is the NAD 27 lease description until such time as the NAD 27 leasehold is terminated, relinquished or expires; and (2) the NADCON version used to determine NAD 83 coordinate equivalents. (See Part II, section 3.5.)

4.4. Orphan Datum Transformations

NADCON v2.00 and v2.10 (see Part II, section 3.1.5.) perform most NAD 27 to NAD 83 coordinate transformations using the CONUS.LAS & CONUS.LOS data files in the Atlantic, Gulf of Mexico, and Pacific OCS Regions and the ALASKA.LAS & ALASKA.LOS data files in the Alaska OCS Region. The latitude and longitude limits for these data files are:

Data File	Latitude	Longitude
CONUS	20°N-50°N	063°W-131°W
ALASKA	46°N-77°N	128°W-194°W

Within all OCS regions except the Gulf of Mexico, orphan datums--local datums, exclusively covering relatively small areas--existed when the U.S. adopted NAD 83. For a variety of reasons, these datums, such as the St. Lawrence Datum in Bering Sea, the Puerto Rico and Virgin Islands Datum in the Caribbean Sea, and the Old Hawaiian Datum in the Pacific Ocean were never tied to, nor incorporated into, NAD 27.

Historically, the U.S. has had many orphan datums (e.g., the Valdez Datum), most of which were incorporated into NAD 27 long before the U.S. adoption of NAD 83. When the U.S. adopted NAD 83, the parameters necessary to transform most remaining orphan datum coordinates directly to NAD 83 were determined, thus by-passing their incorporation into NAD 27[16].

The following orphan datums co-existed with NAD 27 at the time the U.S. adopted NAD 83. The latitude and longitude limits below define the areas where NADCON, in standard configuration for an OCS region, considers any input coordinate to be on the orphan datum[17] when transforming from NAD 27 to NAD 83:

[16] The orphan datum for St. Matthew, Hall, and Pinnacle Islands has not been incorporated into either NAD 27 or NAD 83. Also see Part II, Section 6.

[17] NADCON does not differentiate between NAD 27 and orphan datum coordinates in the input. Output Format 1, identifies the datum name used by NADCON; output Format 2 does not.

Alaska OCS Region

Datum	Latitude	Longitude
St. George	56°N-57°N	169°W-170°W
St. Lawrence	62°N-64°N	168°W-172°W
St. Matthew	See Part II, Section 6	
St. Paul	57°N-58°N	169°W-171°W

Atlantic OCS Region

Datum	Latitude	Longitude
Puerto Rico/V.I.	17°N-19°N	064°W-068°W

Pacific OCS Region

Datum	Latitude	Longitude
Old Hawaiian	18°N-23°N	154°W-161°W

As currently defined, NADCON's CONUS data files do not overlap the Caribbean Sea and Pacific Ocean orphan datums. This means that although orphan datum to NAD 83 and NAD 83 to orphan datum coordinate transformations can be performed, NAD 83 to NAD 27 and NAD 27 to NAD 83 transformations cannot. If actual NAD 27 coordinates are to be transformed, or are needed, NADCON will have to be revised or another transformation procedure used.

In the Alaska OCS Region, however, the Alaska data files do overlap the area of the orphan datums. Thus special, standardized transformation procedures within the orphan datum limits **must** be used.

4.4.1. Orphan Datum Transformation Procedure 1--To Obtain NAD 27 Coordinates From Orphan Datum Coordinates.

1. With NADCON in "standard configuration" for the MMS Alaska OCS Region (i.e., STGEORGE.LAS & STGEORGE.LOS, STPAUL.LAS & STPAUL.LOS, and STLRNC.LAS & STLRNC.LOS data files in the NADCON program directory), enter the orphan datum coordinates into the program and transform them into their NAD 83 coordinate equivalents. (See Figure 5.)

2. Temporarily remove the appropriate data files (STGEORGE.LAS & STGEORGE.LOS, STPAUL.LAS & STPAUL.LOS, or STLRNC.LAS & STLRNC.LOS) from the NADCON program directory. This can be done by (1) deleting the appropriate data files, (2) moving the appropriate data files to another directory, or (3) renaming the data files (e.g., change STGEORGE.LAS and STGEORGE.LOS to STGEORGE.LA and STGEORGE.LO, respectively.)

3. Enter the NAD 83 coordinate equivalents into NADCON and transform them into NAD 27 coordinate equivalents. (NADCON will perform the transformations using the ALASKA.LAS & ALASKA.LOS data files.)

4. Return the NADCON program directory to its original configuration. (How this is done depends upon how step 2 was performed.)

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╔══════════════════════════════════════════════════════════════════════════════╗
║ .       Current    <Dir>                    | ..    Parent     <Dir>                  ║
║ ALASKA   .LAS  530,000  04-12-91 01:30p | ALASKA   .LOS  530.000  04-12-91 01:33p ║
║ AREA     .PAR       26  03-04-91 02:07p | NADCON   .EXE   91,618  06-24-91 09:44a ║
║ NADGRD   .EXE   73,164  08-29-90 08:32a | NADGRD   .FOR   55,141  09-04-90 01:17p ║
║ README   .200   13,594  07-03-91 10:31a | README   .GRD   12,208  09-04-90 03:14p ║
║ STGEORGE.LAS   30,256  01-02-90 01:19p | STGEORGE.LOS   30,256  01-02-90 01:19p ║
║ STLRNC   .LAS   13,776  01-02-90 02:19p | STLRNC   .LOS   13,776  01-02-90 02:20p ║
║ STPAUL   .LAS    3,696  01-02-90 02:21p | STPAUL   .LOS    3,696  01-02-90 02:21p ║
╚══════════════════════════════════════════════════════════════════════════════╝
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Figure 5. Standard NADCON v2.00 directory configuration for the MMS Alaska OCS Region.

4.4.2. Orphan Datum Transformation Procedure 2--To Obtain NAD 83 Coordinates From Actual NAD 27 Coordinates.

1. Temporarily remove the appropriate data files (STGEORGE.LAS & STGEORGE.LOS, STPAUL.LAS & STPAUL.LOS, or STLRNC.LAS & STLRNC.LOS) from the NADCON program directory. This can be done by (1) deleting the appropriate data files, (2) moving the appropriate data files to another directory, or (3) renaming the data files (e.g., change STGEORGE.LAS and STGEORGE.LOS to STGEORGE.LA and STGEORGE.LO, respectively.)

2. Enter the NAD 27 coordinates into NADCON and transform them into their NAD 83 coordinate equivalents.

3. Return the NADCON program directory to its original configuration. (How this is done depends upon how step 1 was performed.)

5. MMS/GEOLOGICAL SURVEY (USGS) AGREEMENT

For NAD 83-based OPD's adjoining the shoreline, the MSS will utilize selective thematic map layers from the USGS National Mapping Program 1:100,000- and 1:250,000-scale

maps. OPD's which do not adjoin or contain landmass do not necessitate a cooperative production effort. The main points of the ten year MMS/USGS Agreement, signed April 5, 1991, follow.

5.1. MMS/MSS Responsibilities

The MSS will:

- Provide the USGS, Rocky Mountain Mapping Center (RMMC) with a list of OPD's and corresponding USGS, Defense Mapping Agency, and/or adjacent country 1:250,000-scale maps in order of priority and proposed completion dates.

- Provide the USGS, RMMC with edited copies of the appropriate USGS maps depicting features to be shown and/or deleted from the deliverable USGS product.

- Arrange periodic meetings among technical staffs to discuss work status, resolve technical issues related to NAD 83 conversion, and the mapping products.

- Provide the USGS, RMMC with a stable base film positive or negative of the finalized OPD's which depict the shoreline, as they are completed.

5.2. USGS Responsibilities

The USGS, RMMC will:

- Provide the MMS with copies of the appropriate USGS maps to be used to depict features to be shown and/or deleted from on the deliverable USGS product.

- Provide the MMS with one (1) emulsion up, 7 mil film positive for each map. The composite film positive will consist of the following: drainage plate showing shoreline areas, rivers, and other hydrographic features; hydrographic feature place names from both the "blue" and "black" separation plates; and NAD 83 latitude and longitude grid ticks depicted at 15-minute intervals.

Usually, the composite plates will follow the standard 1:250,000-scale USGS map format. When a map does not follow the standard format (includes insets, e.g., Trinity Islands; depicts areas beyond the neatlines, e.g., Teller; or the map uses a non-standard neatline format, e.g., Unalaska), the features will be cast on a separate cell in their correct locations.

5.3. MMS/USGS, RMMC Joint Responsibilities

The exceptions noted above will be identified in a jointly developed MMS/USGS Annual Work Plan (AWP). The MMS and the USGS, RMMC will begin preparing the AWP early in the third quarter of the fiscal year (FY) so that it can be executed by the start of the next FY. The AWP's may include, but are not limited to: definition of financial arrangements; definition of cartographic products to be delivered or supplied; definition of product standards and technical specifications; agency responsibilities; production and delivery schedules; and the duration of the AWP.

6. DEPARTMENT OF STATE (DOS) COORDINATION

The DOS will be provided an opportunity to review MMS NAD 83 OPD's adjoining international maritime boundaries. In addition to the graphic product review, DOS will be afforded the opportunity to review transformed SOBD coordinates for the international maritime boundaries. The Chief, MSS will coordinate DOS review and ensure that the OPD's and SOBD's are available to the OCS regions by the established dates.

7. ST. MATTHEW ISLAND

Although NAD 83 is the official horizontal datum for the U.S., several orphan datums are still in use. Most are in the U.S. Pacific Dependencies (e.g., Guam); however, in Alaska, St. Matthew Island along with neighboring Hall and Pinnacle Islands remain on an orphan datum.

The NGS has indicated that they do not have sufficient horizontal control data to place the island on either NAD 27 or NAD 83. This situation precludes:

- The accurate projection of the SSB and the Limit of "8(g) Zone" Boundary seaward from the islands.

- The transformation of orphan datum coordinates to or from either NAD 27 or NAD 83.

The MSS geodesist will continually evaluate potential cooperative agreements and emerging technologies (e.g., kinematic aerial photography/Global Positioning System (GPS) surveying) to find a cost effective method of placing the islands on NAD 83.

8. COMPUTATION OF PROJECTED MARITIME BOUNDARIES BEYOND 12 NAUTICAL MILES

The computational programs currently used by the MSS to project boundaries seaward from a baseline (e.g., the SSB), are based on planar geometry. These programs were specifically designed for nearshore computations (3 to 6 nautical miles offshore), and at 12 nautical miles[18] offshore, they have reached the limit of their computational accuracy.

For several years a need to compute maritime boundaries projected more than 12 nautical miles from a baseline (e.g., the 200 nautical mile EEZ Boundary and moratorium and impact assistance lines) has been emerging.[19] However, accurately projecting boundaries beyond 12 nautical miles seaward from a baseline requires a fundamental change in the computational algorithms--projections will have to be based on the principles of ellipsoidal rather than planar geometry.

The MSS geodesist will provide the OSC with the ellipsoidal geometry algorithms and technical documentation after the programs have been tested. The OSC and the MSS should have the equidistant and ellipsoidal geometry-based programs completed, tested, documented, and incorporated into B&B, TIMS six months later.

[18] Texas and the Gulf of Mexico side of Florida have a composite (historic and current) State Seaward Boundary of three marine leagues (i.e., nine nautical or geographic miles). The Limit of "8(g) Zone" Boundary is three nautical or geographic miles seaward of the State Seaward Boundary.

[19] This is not a need unique to NAD 83. There may also be a need to depict these maritime boundaries on NAD 27 OPD's in planning areas that are not scheduled for conversion to NAD 83 until late in the process.

9. APPENDIX A--NAD 83 OPD FORMAT

9.1. NAD 27 OPD/LM Formats

As discussed in Part I, Appendix A, there are five NAD 27 cadastres used on the OCS offshore of the conterminous U.S. and Alaska. The uniqueness of each SPCS-referencing LM cadastre is illustrated in Figures 6 through 8 (followed by additional cadastre attributes):

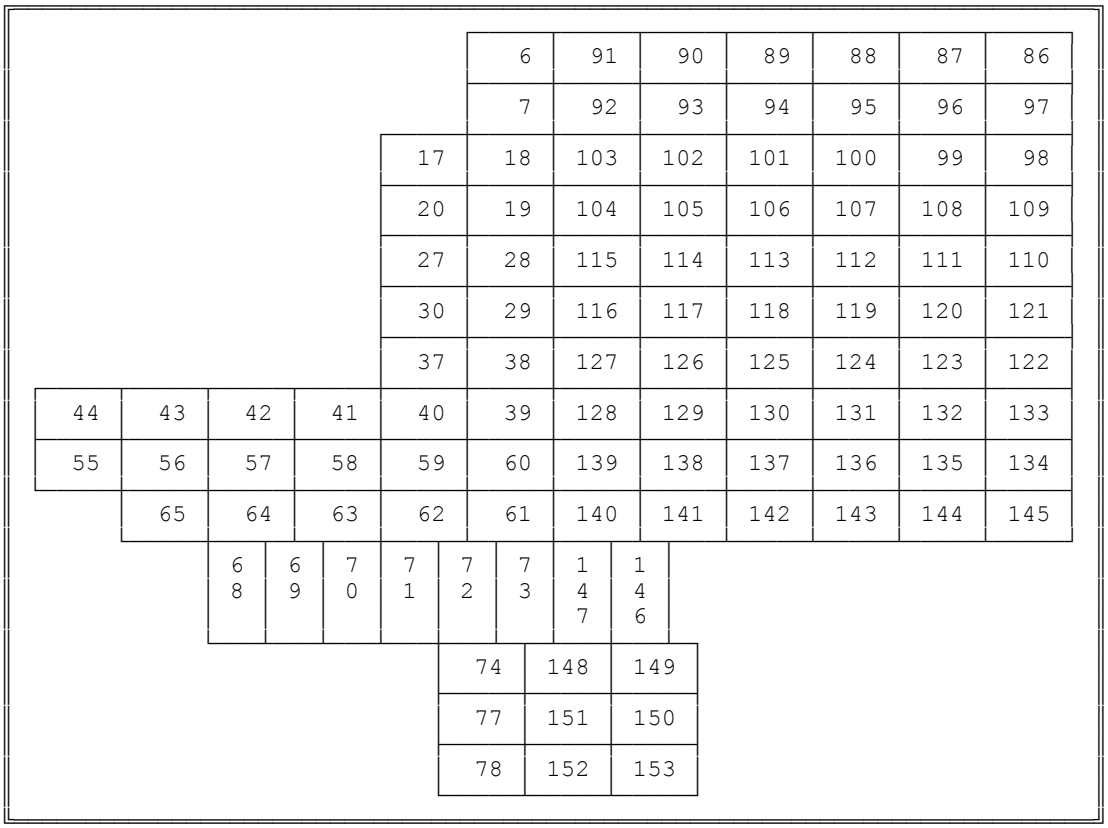
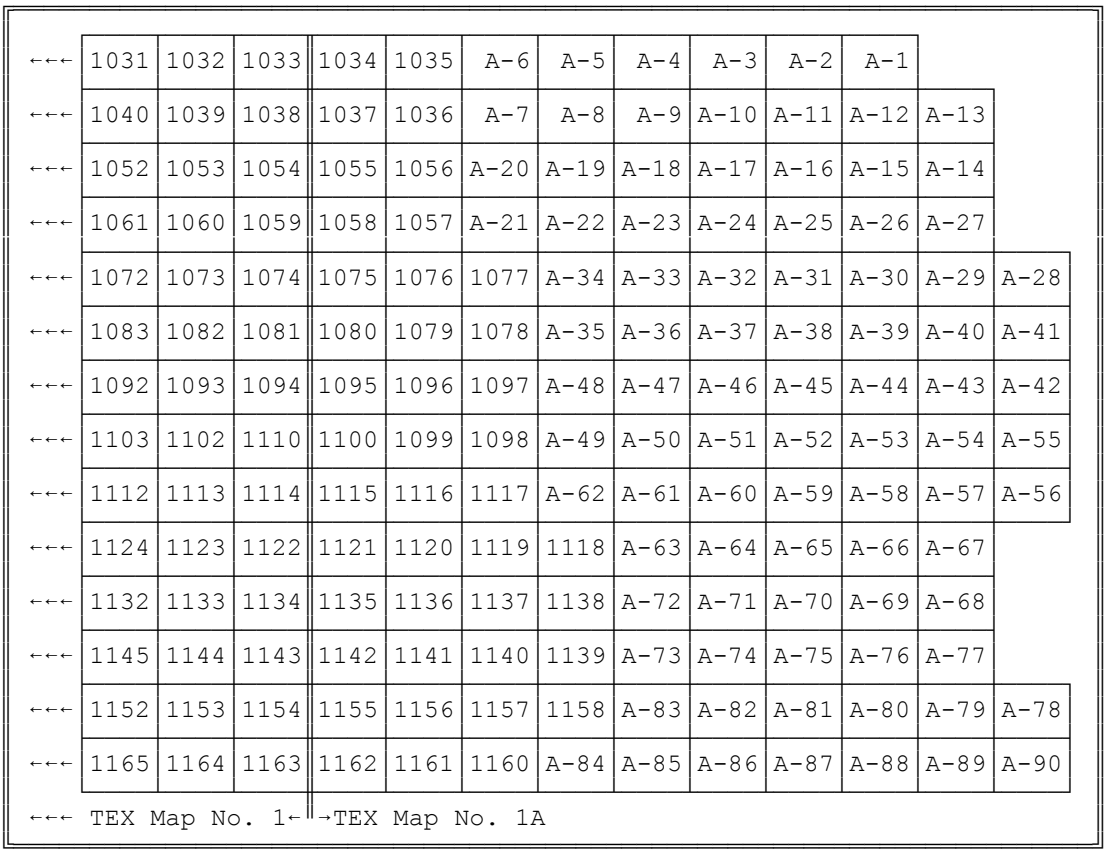


Figure 6. Cadastre 1: Typical numbering scheme for Leasing Maps referencing the Louisiana SPCS--LA Map No. 10 (Main Pass Area).

- Dimensions of LM's: unique to each LM.
- Number of columns of blocks: unique to each LM.
- Number of rows of blocks: unique to each LM.
- Area of full cadastre grid blocks: varies; usually between 4,999.967 and 5,760 acres.
- Starting LM cadastre block number: unique to each LM.

- Block numbering scheme: generally boustrophedonic[a].



←←←	1031	1032	1033	1034	1035	A-6	A-5	A-4	A-3	A-2	A-1		
←←←	1040	1039	1038	1037	1036	A-7	A-8	A-9	A-10	A-11	A-12	A-13	
←←←	1052	1053	1054	1055	1056	A-20	A-19	A-18	A-17	A-16	A-15	A-14	
←←←	1061	1060	1059	1058	1057	A-21	A-22	A-23	A-24	A-25	A-26	A-27	
←←←	1072	1073	1074	1075	1076	1077	A-34	A-33	A-32	A-31	A-30	A-29	A-28
←←←	1083	1082	1081	1080	1079	1078	A-35	A-36	A-37	A-38	A-39	A-40	A-41
←←←	1092	1093	1094	1095	1096	1097	A-48	A-47	A-46	A-45	A-44	A-43	A-42
←←←	1103	1102	1110	1100	1099	1098	A-49	A-50	A-51	A-52	A-53	A-54	A-55
←←←	1112	1113	1114	1115	1116	1117	A-62	A-61	A-60	A-59	A-58	A-57	A-56
←←←	1124	1123	1122	1121	1120	1119	1118	A-63	A-64	A-65	A-66	A-67	
←←←	1132	1133	1134	1135	1136	1137	1138	A-72	A-71	A-70	A-69	A-68	
←←←	1145	1144	1143	1142	1141	1140	1139	A-73	A-74	A-75	A-76	A-77	
←←←	1152	1153	1154	1155	1156	1157	1158	A-83	A-82	A-81	A-80	A-79	A-78
←←←	1165	1164	1163	1162	1161	1160	A-84	A-85	A-86	A-87	A-88	A-89	A-90

←←← TEX Map No. 1← →TEX Map No. 1A

Figure 7. Cadastre 2: Typical numbering scheme for Leasing Maps referencing the Texas SPCS--(portion) TEX Map No.1 (South Padre Island Area) and TEX Map No. 1A (South Padre Island Area East Addition).

- Dimensions of LM's: unique to each LM.
- Number of columns of blocks: unique to each LM.
- Number of rows of blocks: unique to each LM.
- Area of full cadastre grid blocks: 5,760 acres.
- Starting LM cadastre block number: unique to each LM.
- Block numbering scheme: generally boustrophedonic.

[a]Literally, “turning like an ox while plowing;” the numbering of successive rows of blocks on a cadastre from right to left then left to right, etc.

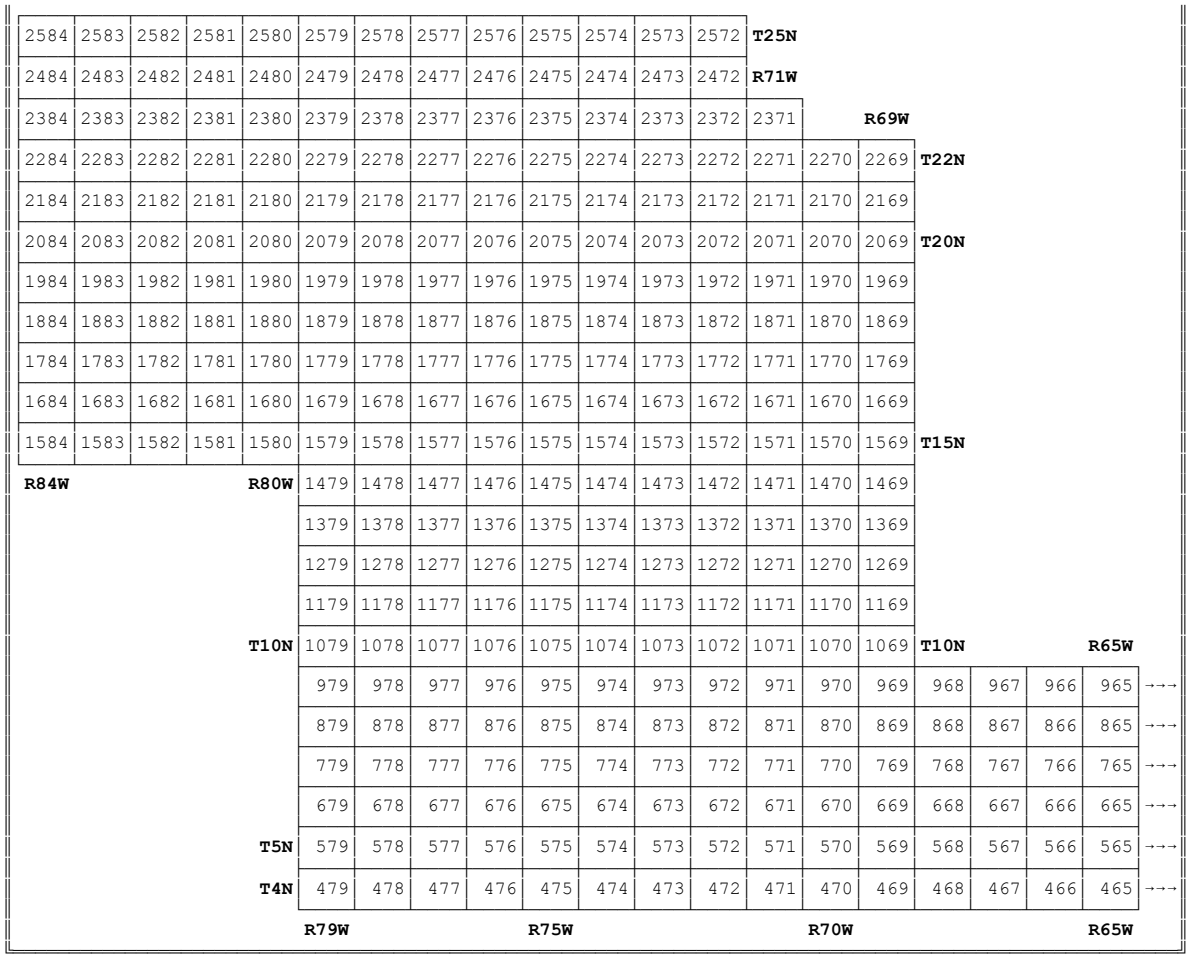


Figure 8. Cadastre 3: Typical numbering scheme for Leasing Maps referencing the California SPCS--(portion) CAL Map No. 6E (Channel Islands Area).

- Dimensions of LM's: unique to each LM.
- Number of columns of blocks: unique to each LM.
- Number of rows of blocks: unique to each LM.
- Area of full cadastre grid blocks: 5,760 acres.
- Starting LM cadastre block number: unique to each LM.
- Block numbering scheme: township and range.Although each LM is unique relative to the SPCS cadastre grid, depiction of the cadastre grids, information portrayed on the cadastre grids, and information contained in the LM collar is standardized:

- LM's use the Lambert projection referencing the Clarke 1866 spheroid.

- The SSB (generally three geographical miles or three marine leagues, as appropriate for the particular coastal State) and the "Limit of '8(g) Zone'" (generally three geographical miles beyond the SSB) are depicted from computations based on principles outlined in the Law of the Sea Convention.

- Non-projected maritime boundaries are depicted as stipulated in the treaty, international agreement, court decree, etc. which established the boundary.

- Areal measurements and distances for partial cadastre grid blocks adjoining OPD/LM interfaces are depicted, usually to two decimal places.

- Collar notes and diagrams identify a SPCS's point of origin, the LM's Federal approval date, dates of previous LM editions, scale, adjoining LM's and OPD's, latitude and longitude, caveats, and other relevant information.

- Areal measurements for Federal and State land ownership, projected boundary coordinates, and computational baseline coordinates for cadastre blocks adjoining the SSB and the Limit of "8(g) Zone" are portrayed on SOBD's.

Two additional cadastres, Cadastres 4 and 5, both based on the UTM grid and projection system, are portrayed on OPD's. Cadastre 4, using a corrupted UTM grid and English coordinates and areal measurements (feet and acres, respectively) is utilized in those portions of the Gulf of Mexico OCS Region not covered by LM's. (See Part I, Appendix A.) Cadastre 5, a completely metric UTM cadastre, is used in areas of the Pacific OCS Region not covered by LM's and throughout the entire Alaska and Atlantic OCS Regions.

The format for Cadastre 4 OPD's is:

- Dimensions of OPD's: 1° (of latitude) x 2° (of longitude).

- Number of columns of blocks: 44 columns of 15,840-by-15,840 feet blocks.

- Number of rows of blocks: 23 (or as necessary 24) rows of 15,840-by-15,840 feet blocks.

- Area of full cadastre grid blocks: 5,760 acres.

- Starting OPD block number: Block number 1 in column 1, row 1 (usually).

- Block numbering scheme: See Figure 9.

Column	1	2 →→→ 5 →→→ 10 →→→ 15 →→→ 20 →→→ 25 →→→ 30 →→→ 35 →→→ 40 →→→ 44									
Row 1	1	2	5	10	15	20	25	30	35	40	44
2	45	46	49	54	59	64	69	74	79	84	88
3	89	90	93	98	103	108	113	118	123	128	132
4	133	134	137	142	147	152	157	162	167	172	176
5	177	178	181	186	191	196	201	206	211	216	220
6	221	222	225	230	235	240	245	250	255	260	264
7	265	266	269	274	279	284	289	294	299	304	308
8	309	310	313	318	323	328	333	338	343	348	352
9	353	354	357	362	367	372	377	382	387	392	396
10	397	398	401	406	411	416	421	426	431	436	440
11	441	442	445	450	455	460	465	470	475	480	484
12	485	486	489	494	499	504	509	514	519	524	528
13	529	530	533	538	543	548	553	558	563	568	572
14	573	574	577	582	587	592	597	602	607	612	616
15	617	618	621	626	631	636	641	646	651	656	660
16	661	662	665	670	675	680	685	690	695	700	704
17	705	706	709	714	719	724	729	734	739	744	748
18	749	750	753	758	763	768	773	778	783	788	792
19	793	794	797	802	807	812	817	822	827	832	836
20	837	838	841	846	851	856	861	866	871	876	880
21	881	882	885	890	895	900	905	910	915	920	924
22	925	926	929	934	939	944	949	954	959	964	968
23	969	970	973	978	983	988	993	998	1003	1008	1012
24	1013	1014	1017	1022	1027	1032	1037	1042	1047	1052	1056

Figure 9. Cadastres 4 and 5: Typical numbering scheme for NAD 27 Official Protraction Diagrams 44 cadastre grid blocks wide.

Column	1	2 →→→	5 →→→	10 →→→	15 →→→	20 →→→	25 →→→	30 →→→	35 →→→	40 →→→	45 →→→	47
Row 1	1	2	5	10	15	20	25	30	35	40	45	47
2	48	49	52	57	62	67	72	77	82	87	92	94
3	95	96	99	104	109	114	119	124	129	134	139	141
4	142	143	146	151	156	161	166	171	176	181	186	188
5	189	190	193	198	203	208	213	218	223	228	233	235
6	236	237	240	245	250	255	260	265	270	275	280	282
7	283	284	287	292	297	302	307	312	317	322	327	329
8	330	331	334	339	344	349	354	359	364	369	374	376
9	377	378	381	386	391	396	401	406	411	416	421	423
10	424	425	428	433	438	443	448	453	458	463	468	470
11	471	472	475	480	485	490	495	500	505	510	515	517
12	518	519	522	527	532	537	542	547	552	557	562	564
13	565	566	569	574	579	584	589	594	599	604	609	611
14	612	613	616	621	626	631	636	641	646	651	656	658
15	659	660	663	668	673	678	683	688	693	698	703	705
16	706	707	710	715	720	725	730	735	740	745	750	752
17	753	754	757	762	767	772	777	782	787	792	797	799
18	800	801	804	809	814	819	824	829	834	839	844	846
19	847	848	851	856	861	866	871	876	881	886	891	893
20	894	895	898	903	908	913	918	923	928	933	938	940
21	941	942	945	950	955	960	965	970	975	980	985	987
22	988	989	992	997	1002	1007	1012	1017	1022	1027	1032	1034
23	1035	1036	1039	1044	1049	1054	1059	1064	1069	1074	1079	1081
24	1082	1083	1086	1091	1096	1101	1106	1111	1116	1121	1126	1128

Figure 10. Cadastre 5: Typical numbering scheme for NAD 27 Official Protraction Diagrams 47 cadastre blocks wide in the Alaska OCS Region.

The format for Cadastre 5 OPD's is:

- Dimensions of OPD's: 1°x2° between latitudes 23°N and 48°N and 1°x3° poleward of 48°N.
- Number of columns of blocks: varies from 44 to 47 columns of 4800-by-4800 meter blocks depending upon latitude.
- Number of rows of blocks: 23 (or as necessary 24) rows of 4800-by-4800 meter blocks.
- Area of full cadastre grid blocks: 2304 hectares.
- Starting OPD block number: Block number 1 in column 1, row 1 (usually).
- Block numbering scheme: See Figures 9 & 10.

As currently implemented, none of the aforementioned cadastres is totally adequate for use throughout the entire OCS offshore of the conterminous U.S. and Alaska. Although Cadastre 5 comes close to meeting MMS-wide needs, even it requires modification. Its main format weaknesses are:

- OPD block configuration varies from 44 up to 47 columns of blocks.
- OPD's were not developed/planned for use in a "worst case scenario." In order to be applicable MMS-wide (used anywhere on the OCS without modification or corruption), the cadastre and OPD format needed to be developed for use at the equator.
- As the MMS develops/updates its computerized databases, the need for a standardized cadastre has increased.

9.2. NAD 83 OPD Format Considerations

To develop an OPD format that can be used anywhere on the OCS, the following factors were considered:

1. At the equator:
    - One degree of latitude ≈ 111,321 meters.
    - A 6° wide UTM zone ≈ 667,926 meters.
    - The number of 4800-by-4800 meter blocks per row (or columns of blocks) in a UTM zone = 140.
    - The number of 1°x2° OPD's across a UTM zone = 3.
    - The minimum number of 4800-by-4800 meter blocks per row (or the number of columns of blocks) on an OPD = 47.
2. Between the equator and 1°N/S:
    - One degree of longitude ≈ 110,567.3 meters.
    - The number of rows of 4800-by-4800 meter blocks on an OPD = 23 or 24. (MMS OPD's do not necessarily terminate the cadastre on standard latitude/longitude graticule increments. The cadastre terminates on a full row of blocks **close** to the OPD latitudinal limits. To completely cover the area between the equator and one degree north (or south) requires slightly more than 23 rows of blocks. Therefore, depending on the final NAD 83 OPD parameters, 24 rows may be

necessary.)

3. Lines of longitude converge towards the poles:

   - The distance between lines of longitude approximates a cosine function. For example, at 60°N/S, the distance between lines of longitude is approximately 1/2 of equatorial distance for the same pair of lines. (The cosine of 60° is .5; but since the earth is not a perfect sphere, at 60°N/S, the distance between a pair of meridians is **approximately** half the distance between the same pair of meridians at the equator.)

   - At 48°N/S the convergence of the lines of longitude has become significant enough to warrant changing the size of the OPD's to 1°x3°.

9.3. Industry NAD 83 OPD Recommendations

Through a Federal Register notice, the MMS requested comments on the Agency's draft NAD 83 Implementation Plan. In relation to OPD's and the proposed NAD 83 offshore cadastre one company operating on the OCS made two recommendations which have the potential of minimizing the confusion/mixing of NAD 27 and NAD 83 datum-dependent data:

- NAD 83 OPD's use 50 blocks per row rather than 47. They felt this would not create any new problems, but would facilitate the manual use of OPD's. (See Part II, Appendix A, section 9.4.1. concerning OPD's actually needing to be 48 blocks wide.)

- NAD 83 OPD's should begin with a four digit number (e.g., 2001) in the block in the northwest corner instead of beginning with the number 1. They felt the use of a numbering scheme not previously used on OPD's would eliminate, or at least reduce, the possibility of confusing NAD 83 cadastre blocks with NAD 27 cadastre blocks. (See Part II, Appendix A, section 9.4.1. for a discussion of why a different block numbering scheme was adopted.)

Further discussion of these two proposals with industry, the coastal States, and within MMS found that although the concept of a new numbering scheme and cadastre was not wholeheartedly endorsed, it was not rejected.

9.4. NAD 83 OPD Format

After evaluating the five NAD 27 offshore cadastres and receiving input from the public, and MMS offices, the MSS developed an NAD 83 OPD and cadastre format that can be used worldwide, without modification:

- Dimensions of OPD's: 1°x2° between the equator and 48°N/S. (Three OPD's are needed to cover 1° of latitude across a UTM zone. The actual western and eastern limits of each of the three OPD's, from west to east, is: (1) the UTM zone western boundary and X=404,000; (2) X=404,000 and X=596,000; and (3) X=596,000 and the UTM eastern zone boundary.)

  1°x3° between 48°N/S and the limit of the UTM grid system at 80°N/S. (Two OPD's are needed to cover 1° of latitude across a UTM zone. The actual western and eastern limits of each of these OPD's, from west to east, is: (1) the UTM zone western boundary and X=500,000; and (2) X=500,000 and the UTM eastern zone boundary.)

  If OPD's would ever be required poleward of 80°N/S, the metric Universal Polar Stereographic (UPS) Projection/Grid would be used.

- Number of columns of blocks: 50 columns of 4800-by-4800 meter blocks. (See Part II, Appendix A, section 9.4.1.)

- Number of rows of blocks: 23 (or as necessary 24) rows of 4800-by-4800 meter blocks.

- Area of full cadastre grid blocks: 2304 hectares.

- Starting OPD block number: Block 6001 in column 1, row 1 (northwest corner of the OPD). (See Part II, Appendix A, section 9.4.1.) Note: Due to meridian convergence, on OPD's adjoining a western UTM zone boundary, even if the full cadastre grid is depicted, Block 6001 may not be; it and others may lie entirely west of the UTM zone boundary.

- Block numbering scheme: See Figure 11. (See Part II, Appendix A, section 9.4.1.)

9.4.1. Block Numbering Scheme Rationale. First, between the equator and 48°N/S, a UTM zone is three OPD's wide. Half of the cadastre blocks should lie west of the central meridian and half should lie east ("mirror images"). This necessitates the center of the three OPD's containing an even number of 4800-by-4800 meter blocks per row. Therefore, at the equator a minimum of 48 blocks per row becomes the required minimum, rather than the mathematically computed minimum of 47. Further increasing the number of blocks per row to 50 does not adversely affect database storage requirements, and appears to facilitate use of OPD's since the block numbering scheme is more readily apparent.

Second, NAD 83 block and boundary coordinates and areal measurements will be metric. For portrayal on OPD's, SOBD's, SOCBD's, etc. coordinates will be computed to three (3) significant decimal digits and areal measurements to six (6) significant

decimal digits. The following **NAD 27** comparison for block 818, OPD NH 16-04 (Mobile), illustrates the differences between computations performed using an IBM mainframe computer and the B&B, TIMS platform[a]:

Intersection 1	X=1 203 840.00'	Y=10 949 032.28'	IBM
	X=1 203 840.000'	Y=10 949 032.284'	B&B, TIMS[b]
NW Block Corner	X=1 188 000.00'	Y=10 961 280.00'	IBM
	X=1 188 000.000'	Y=10 961 280.000'	B&B, TIMS
State Area "A"	4947.03 Acres		IBM
	4947.030898 Acres		B&B, TIMS

With these differences, a **datum conscious user** familiar with the NAD 27 and NAD 83 cadastres and their portrayal on OPD's and LM's **should not** confuse NAD 27 coordinates and areal measurements with NAD 83 coordinates and areal measurements, even during the transition period prior to full NAD 83 implementation.

It must be noted that even when working with just one datum (e.g., NAD 27), one cannot cite just a block number without also citing the appropriate OPD or LM. For example, Block 737 is portrayed on 41 of the 66 NAD 27 OPD's and LM's in the Pacific OCS Region. Unless one knows the specific OPD or LM, this block could be located near the shore or near the EEZ. If one knew that the block was on CAL Map No. 6C, it would immediately be recognized that the block number should be read as "7N-37W."[c] Datum and cadastre education/awareness is the best method for ensuring that NAD 27 and NAD 83 data are not mixed.

Third, the occasional OPD/SOBD user, or a user unfamiliar with the MMS OCS cadastres, may have problems recognizing datum-referenced data well beyond the transition period to NAD 83. To reduce the potential for mixing NAD 27 and NAD 83 data, the block numbering scheme could be further modified. With the exception of the LM's in the Pacific OCS Region, block numbering schemes for the NAD 27 cadastres used numbers smaller than 2000. By using 2001, for example, as the first block on an OPD, the chance of confusing a NAD 27 block with a NAD 83 block is reduced even further. In the Pacific OCS Region, the use of 2001 as the initial block number on NAD 83 OPD's would duplicate cadastre block numbers in only a small portion of that OCS

[a] If there were to be a NAD 83 Block 818, OPD NH 16-04 (Mobile), the differences would be even more pronounced in that the coordinates would be in meters and the areal measurements in hectares.

[b] No increased accuracy is implied between computational systems. Increased significant decimal digits are used to facilitate the numerous coordinate conversions and datum transformations necessary to implement the metric NAD 83.

[c] An explanatory note to users concerning the interpretation of block numbers is found on all California LM's. On CAL Map No. 6C the note reads: "The identification of the blocks is based on the numerical sequence N (North) starting at the Y origin, and the numerical sequence W (West) starting at the central meridian. Example: Block 10N-39W is depicted and referred to as 1039."

Region. Theoretically, because of the unique interpretation of the Pacific OCS Region's LM block numbers there should be no confusion with any duplicated block numbers on NAD 83 OPD's.

Finally, to fully minimize confusing NAD 27 and NAD 83 cadastre blocks/data, and to have a standardized block numbering scheme throughout the entire OCS, NAD 83 cadastre block numbers should be unique, not duplicate any NAD 27 cadastre block numbers. Block 55N-90W (5590) on CAL Map No. 6A is the largest block number appearing on any NAD 27 OPD or LM. To avoid duplicating any NAD 27 cadastre block numbers, on NAD 83 OPD's the most logical starting block number after 2001 is 6001 as illustrated in Figure 11.

Column	1	2	3	4	5 →→→ 10 →→→ 15 →→→ 20 →→→ 25 →→→ 30 →→→ 35 →→→ 40 →→→ 45 →→→ 50									
Row 1	6001	6002	6003	6004	6005	6010	6015	6020	6025	6030	6035	6040	6045	6050
2	6051	6052	6053	6054	6055	6060	6065	6070	6075	6080	6085	6090	6095	6100
3	6101	6102	6103	6104	6105	6110	6115	6120	6125	6130	6135	6140	6145	6150
4	6151	6152	6153	6154	6155	6160	6165	6170	6175	6180	6185	6190	6195	6200
5	6201	6202	6203	6204	6205	6210	6215	6220	6225	6230	6235	6240	6245	6250
6	6251	6252	6253	6254	6255	6260	6265	6270	6275	6280	6285	6290	6295	6300
7	6301	6302	6303	6304	6305	6310	6315	6320	6325	6330	6335	6340	6345	6350
8	6351	6352	6353	6354	6355	6360	6365	6370	6375	6380	6385	6390	6395	6400
9	6401	6402	6403	6404	6405	6410	6415	6420	6425	6430	6435	6440	6445	6450
10	6451	6452	6453	6454	6455	6460	6465	6470	6475	6480	6485	6490	6495	6500
11	6501	6502	6503	6504	6505	6510	6515	6520	6525	6530	6535	6540	6545	6550
12	6551	6552	6553	6554	6555	6560	6565	6570	6575	6580	6585	6590	6595	6600
13	6601	6602	6603	6604	6605	6610	6615	6620	6625	6630	6635	6640	6645	6650
14	6651	6652	6653	6654	6655	6660	6665	6670	6675	6680	6685	6690	6695	6700
15	6701	6702	6703	6704	6705	6710	6715	6720	6725	6730	6735	6740	6745	6750
16	6751	6752	6753	6754	6755	6760	6765	6770	6775	6780	6785	6790	6795	6800
17	6801	6802	6803	6804	6805	6810	6815	6820	6825	6830	6835	6840	6845	6850
18	6851	6852	6853	6854	6855	6860	6865	6870	6875	6880	6885	6890	6895	6900
19	6901	6902	6903	6904	6905	6910	6915	6920	6925	6930	6935	6940	6945	6950
20	6951	6952	6953	6954	6955	6960	6965	6970	6975	6980	6985	6990	6995	7000
21	7001	7002	7003	7004	7005	7010	7015	7020	7025	7030	7035	7040	7045	7050
22	7051	7052	7053	7054	7055	7060	7065	7070	7075	7080	7085	7090	7095	7100
23	7101	7102	7103	7104	7105	7110	7115	7120	7125	7130	7135	7140	7145	7150
24	7151	7152	7153	7154	7155	7160	7165	7170	7175	7180	7185	7190	7195	7200

Figure 11. NAD 83 OPD numbering scheme.

10. APPENDIX B--NON-MATHEMATICALLY DEFINABLE CURVES RESULTING FROM DATUM TRANSFORMATIONS

NAD 27/83 coordinate transformations are non-linear, with the amount of "coordinate shift" varying with positional location on the earth. Technically, non-mathematically definable curves result from the transformation of both straight lines and arcs transformed from NAD 27 to NAD 83, as illustrated by the transformations in Part II, Appendix B, section 10.2.

> Example: On Figure 4, Block 78, LA Map 9A encompasses an area of 14,758 feet (north-south) by 10,450.07 feet (east-west). On NAD 27 a straight line connects block corners D and E. In the transformation process, the two block corners do not shift by the same magnitude. NADCON output shows that corner D has a total shift magnitude of 27.220 meters while corner E has a total shift magnitude of 27.149 meters, a difference of .071 meters. Breaking the line into smaller segments (of approximately 2,500 feet for this illustration (points D1-D4)) before transforming results in a better definition of the line, and show that it is now a complex curve rather than a straight line. Transformation of the north-south line between block corners E and H produces similar results. The same is true for arc n-o. **All transformations result in complex curves.**

The best definition of a transformed line or arc would be achieved by breaking the line or arc into smaller segments, and the smaller the segments, the better the resulting line or arc definition after transformation. Three question arise, however. First, into how many segments should a line or arc be broken? Second, what distance interval should be used for line and arc segments? Third, for arcs, what radius should be used?

This situation is somewhat akin to the Bureau of Land Management (BLM)/MMS decision to use a scale factor of "1" for NAD 27 boundary and areal measurement computations on the UTM grid system. Technically, a scale factor of "1" is applicable only in specific portions of a UTM zone. However, to simplify the computational process and to ensure that industry, coastal States, and others could replicate MMS (and previous BLM) computations, it was decided to use this scale factor throughout a UTM zone.

To simplify the transformation process, especially for NAD 27 leaseholds, and to ensure that industry, coastal States, and others can replicate MMS computations, MMS will consider:

- Straight lines on and within NAD 27 cadastre blocks and boundaries to be straight lines on NAD 83.
- Geodesic lines on and within NAD 27 cadastre blocks and on boundaries to be geodesic lines on NAD 83.
- Rhumb lines within NAD 27 cadastre blocks and on boundaries to be rhumb

lines on NAD 83.

- Arcs within NAD 27 cadastre blocks and on boundaries to be arcs of the same radius on NAD 83.

As with using of a scale factor of "1" for UTM grid system computations, slight discrepancies in the second or third decimal place can be found by not using some sort of complex curve definitions. This would not appear to be a problem for two reasons. First, the lease instrument, Form MMS-2005 ("Oil and Gas Lease of Submerged Lands Under the Outer Continental Shelf Lands Act"), does not indicate the type of acres or hectares being leased (i.e., surface, bottom, grid, etc.). Second, Form MMS-2005, Section 2, indicates that the areal measurements for the acres or hectares being leased are **approximate**.

10.1. Conversion of SPCS Coordinates to Geodetic Coordinates, South Pass Area, South Addition, LA Map 9A, Block 78, Lambert Projection, Louisiana South Zone

POINT[a]	NAD 27 SPCS EASTING	NAD 27 SPCS NORTHING	NAD 27 LATITUDE	NAD 27 LONGITUDE
C	2605477.93000	61307.90000	28 49 17.45358	89 26 33.98015
D	2605477.93000	52634.00000	28 47 51.59934	89 26 35.58826
D1	2605928.00000	52634.00000	28 47 51.52582	89 26 30.53126
D2	2608428.00000	52634.00000	28 47 51.11648	89 26 02.44119
D3	2610928.00000	52634.00000	28 47 50.70545	89 25 34.35118
D4	2613428.00000	52634.00000	28 47 50.29273	89 25 06.26124
E	2615928.00000	52634.00000	28 47 49.87833	89 24 38.17136
E1	2615928.00000	54892.00000	28 48 12.22786	89 24 37.74558
E2	2615928.00000	57392.00000	28 48 36.97273	89 24 37.27412
E3	2615928.00000	59892.00000	28 49 01.71763	89 24 36.80259
E4	2615928.00000	62392.00000	28 49 26.46256	89 24 36.33099
E5	2615928.00000	64892.00000	28 49 51.20753	89 24 35.85934
H	2615928.00000	67392.00000	28 50 15.95253	89 24 35.38761
K	2605477.93000	67392.00000	28 50 17.67424	89 26 32.85173
n	2605477.93000	55164.48000	28 48 16.64598	89 26 35.11920
n1	2605928.00000	55121.37000	28 48 16.14576	89 26 30.06984
n2	2608428.00000	54983.84000	28 48 14.37512	89 26 02.00349
n3	2610928.00000	55018.01000	28 48 14.30227	89 25 33.90529
n4	2613428.00000	55224.34000	28 48 15.93177	89 25 05.77477
o	2615928.00000	55605.83000	28 48 19.29331	89 24 37.61097

[a] Points reference Figure 4. Points D1-D4 are generated points lying between block corners D and E. Points E1-E5 are generated points lying between block corners E and H. Points n1-n4 are generated points lying between arc intersections n and o.

10.2. NAD 27 to NAD 83 Latitude and Longitude Transformations Using NADCON Version 2.00, South Pass Area, South Addition, LA Map 9A, Block 78

	NAD 27		NAD 83 (1986)		Shift NAD 27 - NAD 83 (1986) (meters)		
POINT[a]	LATITUDE	LONGITUDE	LATITUDE	LONGITUDE	LAT.	LONG.	TOTAL
C	28 49 17.45358	89 26 33.98015	28 49 18.32283	89 26 34.14873	26.761	4.571	27.149
D	28 47 51.59934	89 26 35.58826	28 47 52.47108	89 26 35.75573	26.838	4.542	27.220
D1	28 47 51.52582	89 26 30.53126	28 47 52.39747	89 26 30.69867	26.835	4.540	27.217
D2	28 47 51.11648	89 26 02.44119	28 47 51.98762	89 26 02.60827	26.820	4.531	27.200
D3	28 47 50.70545	89 25 34.35118	28 47 51.57609	89 25 34.51793	26.804	4.522	27.183
D4	28 47 50.29273	89 25 06.26124	28 47 51.16286	89 25 06.42766	26.788	4.513	27.166
E	28 47 49.87833	89 24 38.17136	28 47 50.74795	89 24 38.33745	26.773	4.504	27.149
E1	28 48 12.22786	89 24 37.74558	28 48 13.09680	89 24 37.91202	26.752	4.513	27.130
E2	28 48 36.97273	89 24 37.27412	28 48 37.84091	89 24 37.44094	26.729	4.523	27.109
E3	28 49 01.71763	89 24 36.80259	28 49 02.58506	89 24 36.96979	26.705	4.533	27.087
E4	28 49 26.46256	89 24 36.33099	28 49 27.32923	89 24 36.49857	26.682	4.543	27.066
E5	28 49 51.20753	89 24 35.85934	28 49 52.07345	89 24 36.02730	26.659	4.554	27.045
H	28 50 15.95253	89 24 35.38761	28 50 16.81769	89 24 35.55596	26.636	4.564	27.024
K	28 50 17.67424	89 26 32.85173	28 50 18.54174	89 26 33.02110	26.708	4.591	27.099
n	28 48 16.64598	89 26 35.11920	28 48 17.51700	89 26 35.28699	26.816	4.550	27.199
n1	28 48 16.14576	89 26 30.06984	28 48 17.01670	89 26 30.23757	26.813	4.548	27.196
n2	28 48 14.37512	89 26 02.00349	28 48 15.24558	89 26 02.17089	26.799	4.539	27.180
n3	28 48 14.30227	89 25 33.90529	28 48 15.17220	89 25 34.07238	26.782	4.531	27.163
n4	28 48 15.93177	89 25 05.77477	28 48 16.80112	89 25 05.94157	26.765	4.523	27.144
o	28 48 19.29331	89 24 37.61097	28 48 20.16203	89 24 37.77752	26.745	4.516	27.124

[a] Points reference Figure 4. Points D1-D4 are generated points lying between block corners D and E. Points E1-E4 are generated points lying between block corners E and H. Points n1-n4 are generated points lying between arc intersections n and o.

11. APPENDIX C--North American Datum Conversion NAD 83 (1986) to NAD 83 (199x) Using Selected OCS Preliminary Baseline Points for the States of Florida, Oregon, and Washington in NADCON V2.10

Point	NAD 83 (1986) Latitude	NAD 83 (1986) Longitude	NAD 83 (1990) Latitude	NAD 83 (1990) Longitude	Shift NAD 83 (1986) - NAD 83 (1990) (meters) Lat.	Long.	Total
FL 01	30 16 22.86552	87 33 08.57696	30 16 22.86729	87 33 08.57769	.055	.019	.058
FL 02	30 19 27.17631	87 17 49.05712	30 19 27.16859	87 17 49.05897	-.238	.049	.243
FL 03	30 20 07.75563	87 06 48.25350	30 20 07.74212	87 06 48.25568	-.416	.058	.420
FL 04	30 23 46.53870	86 37 46.01714	30 23 46.52044	86 37 46.01453	-.562	-.070	.567
FL 05	30 22 58.53360	86 27 03.64765	30 22 58.51666	86 27 03.64405	-.522	-.096	.530
FL 06	30 20 08.55347	86 11 45.71170	30 20 08.53939	86 11 45.70390	-.433	-.208	.481
FL 07	30 15 03.85516	85 57 06.71000	30 15 03.84304	85 57 06.70053	-.373	-.253	.451
FL 08	30 05 32.39663	85 41 16.43569	30 05 32.38480	85 41 16.42452	-.364	-.299	.471
FL 09	29 59 07.62504	85 31 39.23293	29 59 07.61298	85 31 39.21918	-.371	-.369	.523
FL 10	29 51 36.38371	85 24 42.34829	29 51 36.37240	85 24 42.33297	-.348	-.411	.539
FL 11	29 40 57.67303	85 18 46.23987	29 40 57.66238	85 18 46.22368	-.328	-.435	.545
FL 12	29 37 53.16842	85 06 12.37306	29 37 53.15865	85 06 12.35838	-.301	-.395	.497
FL 13	29 40 17.77657	84 49 53.08910	29 40 17.76743	84 49 53.07772	-.281	-.306	.416
FL 14	29 47 18.47020	84 37 27.17104	29 47 18.46134	84 37 27.16248	-.273	-.230	.357
FL 15	29 53 49.85909	84 23 32.41499	29 53 49.85073	84 23 32.40813	-.257	-.184	.316
FL 16	30 05 07.99560	84 14 12.61406	30 05 07.98748	84 14 12.60824	-.250	-.156	.295
FL 17	30 02 05.27575	83 55 34.04252	30 02 05.26760	83 55 34.03774	-.251	-.128	.282
FL 18	29 53 54.05507	83 39 39.83801	29 53 54.04562	83 39 39.83158	-.291	-.173	.338
FL 19	29 41 51.76616	83 29 23.09125	29 41 51.75469	83 29 23.08219	-.353	-.244	.429
FL 20	29 28 44.62026	83 20 06.65509	29 28 44.61026	83 20 06.64398	-.308	-.299	.430
FL 21	29 19 43.11082	83 10 44.17998	29 19 43.10326	83 10 44.16781	-.233	-.328	.402
FL 22	29 08 53.47072	83 04 38.83440	29 08 53.46483	83 04 38.82257	-.181	-.320	.368
FL 23	29 08 51.96904	82 48 33.01510	29 08 51.96467	82 48 33.00618	-.135	-.241	.276
FL 24	28 52 14.53397	82 43 43.76925	28 52 14.52943	82 43 43.76289	-.140	-.172	.222
FL 25	28 35 29.02372	82 39 41.84857	28 35 29.01958	82 39 41.84184	-.128	-.183	.223
FL 26	28 16 56.84938	82 44 24.68435	28 16 56.84528	82 44 24.67645	-.126	-.215	.250
FL 27	28 03 38.34263	82 49 48.25147	28 03 38.33534	82 49 48.24075	-.225	-.293	.369
FL 28	27 48 34.49967	82 48 53.47049	27 48 34.49295	82 48 53.45790	-.207	-.345	.402
FL 29	27 39 48.31638	82 44 51.06227	27 39 48.31141	82 44 51.04928	-.153	-.356	.387
FL 30	27 31 28.81920	82 44 12.16581	27 31 28.81582	82 44 12.15279	-.104	-.357	.372
FL 31	27 26 30.44570	82 41 28.47944	27 26 30.44314	82 41 28.46666	-.079	-.351	.360
FL 32	27 21 54.83079	82 37 32.72510	27 21 54.82926	82 37 32.71284	-.047	-.337	.340
FL 33	27 17 51.78224	82 34 1.30616	27 17 51.78194	82 34 01.29458	-.009	-.319	.319
FL 34	27 14 54.89891	82 32 12.60112	27 14 54.89959	82 32 12.59011	.021	-.303	.304
FL 35	27 11 57.01621	82 30 24.18141	27 11 57.01690	82 30 24.17044	.021	-.302	.303
FL 36	27 06 20.84408	82 27 45.40970	27 06 20.84442	82 27 45.39861	.010	-.305	.306
FL 37	26 53 54.61317	82 20 41.05928	26 53 54.61280	82 20 41.04616	-.012	-.362	.362
FL 38	26 44 41.29932	82 15 52.24148	26 44 41.29836	82 15 52.22662	-.030	-.411	.412
FL 39	26 35 37.31569	82 13 27.15508	26 35 37.31578	82 13 27.14039	.003	-.406	.406
FL 40	26 27 19.38162	82 08 59.91760	26 27 19.38238	82 08 59.90352	.023	-.390	.391
FL 41	26 27 00.83267	81 57 02.68810	26 27 00.83384	81 57 02.67445	.036	-.378	.380
FL 42	26 19 48.21453	81 50 45.24694	26 19 48.21576	81 50 45.23379	.038	-.365	.367
FL 43	26 07 51.94283	81 48 22.86580	26 07 51.94469	81 48 22.85290	.057	-.358	.363
FL 44	25 58 37.71117	81 44 50.61019	25 58 37.71433	81 44 50.59720	.097	-.361	.374
FL 45	25 52 20.26860	81 42 00.53390	25 52 20.27273	81 42 00.52097	.127	-.360	.382
FL 46	25 49 57.49948	81 30 42.18931	25 49 57.50515	81 30 42.17637	.175	-.360	.400
FL 47	25 45 02.05985	81 22 57.22254	25 45 02.06589	81 22 57.21184	.186	-.298	.351
OR 01	41 59 36.92189	124 13 56.53843	41 59 36.92958	124 13 56.53416	.237	-.098	.257
OR 02	42 08 16.70419	124 21 48.36595	42 08 16.71828	124 21 48.36001	.435	-.136	.456
OR 03	42 18 02.20443	124 25 00.09229	42 18 02.22421	124 25 00.08248	.610	-.225	.650
OR 04	42 21 18.30298	124 25 35.29142	42 21 18.32384	124 25 35.27898	.644	-.285	.704
OR 05	42 32 59.19448	124 23 48.37308	42 32 59.21724	124 23 48.35052	.702	-.515	.871
OR 06	42 42 03.49363	124 28 46.77796	42 42 03.51733	124 28 46.74767	.731	-.689	1.005
OR 07	42 54 17.48973	124 30 34.19965	42 54 17.51071	124 30 34.15709	.647	-.965	1.162
OR 08	43 04 51.49076	124 26 20.51304	43 04 51.50646	124 26 20.46528	.484	-1.080	1.184
OR 09	43 10 25.19306	124 24 24.71763	43 10 25.20555	124 24 24.66922	.385	-1.093	1.159
OR 10	43 20 37.49898	124 22 54.22773	43 20 37.50631	124 22 54.17738	.226	-1.134	1.156
OR 11	43 24 26.80295	124 18 21.32138	43 24 26.80754	124 18 21.27263	.142	-1.097	1.106
OR 12	43 26 06.10441	124 17 22.12109	43 26 06.10796	124 17 22.07254	.110	-1.092	1.097
OR 13	43 31 39.30975	124 14 49.42040	43 31 39.31025	124 14 49.37220	.016	-1.082	1.082
OR 14	43 40 15.21899	124 13 04.12029	43 40 15.21668	124 13 04.07201	-.071	-1.082	1.084
OR 15	43 49 04.62669	124 10 09.32148	43 49 04.62171	124 10 09.27252	-.154	-1.094	1.105
OR 16	43 56 56.23410	124 08 46.63067	43 56 56.22763	124 08 46.57711	-.200	-1.194	1.211

	NAD 83 (1986)		NAD 83 (1991)		Shift NAD 83 (1986) - NAD 83 (1991) (meters)		
Point	Latitude	Longitude	Latitude	Longitude	Lat.	Long.	Total
OR 17	44 04 03.13640	124 07 50.33303	44 04 03.12598	124 07 50.27800	-.322	-1.225	1.266
OR 18	44 17 17.33272	124 06 59.83166	44 17 17.31150	124 06 59.77913	-.655	-1.165	1.336
OR 19	44 22 45.32976	124 07 18.13416	44 22 45.30528	124 07 18.08386	-.756	-1.114	1.346
OR 20	44 30 06.02646	124 05 38.23301	44 30 05.99672	124 05 38.18718	-.918	-1.012	1.367
OR 21	44 36 43.92181	124 04 21.62524	44 36 43.88960	124 04 21.58512	-.994	-.885	1.331
OR 22	44 46 23.71167	124 04 32.71852	44 46 23.67654	124 04 32.68555	-1.085	-.725	1.304
OR 23	44 54 28.09773	124 01 52.31167	44 54 28.05916	124 01 52.28655	-1.191	-.551	1.312
OR 24	44 59 31.48785	124 00 57.00817	44 59 31.44720	124 00 56.98747	-1.255	-.453	1.334
OR 25	45 07 58.87887	123 58 25.21594	45 07 58.84252	123 58 25.20362	-1.122	-.269	1.154
OR 26	45 14 03.27108	123 58 27.02336	45 14 03.23746	123 58 27.01654	-1.038	-.149	1.049
OR 27	45 25 13.96960	123 57 46.05938	45 25 13.93771	123 57 46.06147	-.985	.046	.986
OR 28	45 37 28.77720	123 56 44.68211	45 37 28.74785	123 56 44.69276	-.906	.231	.935
OR 29	45 42 29.58254	123 56 25.98763	45 42 29.55444	123 56 26.00150	-.867	.300	.918
OR 30	45 58 00.48624	123 58 21.70260	45 58 00.45943	123 58 21.72770	-.828	.540	.989
OR 31	46 11 21.57049	123 59 31.03149	46 11 21.55773	123 59 31.06339	-.394	.684	.789
OR 32	46 18 04.45899	124 04 40.85841	46 18 04.45165	124 04 40.88869	-.227	.648	.686
OR 33	46 19 37.15889	124 04 11.16165	46 19 37.15246	124 04 11.19069	-.199	.621	.652
WA 01	46 13 58.16316	124 03 27.44596	46 13 58.15316	124 03 27.47873	-.309	.702	.767
WA 02	46 18 04.55905	124 04 40.65843	46 18 04.55171	124 04 40.68871	-.227	.648	.686
WA 03	46 21 45.55802	124 03 39.16625	46 21 45.55281	124 03 39.19352	-.161	.583	.605
WA 04	46 26 20.35603	124 03 27.97807	46 26 20.35325	124 03 28.00137	-.086	.497	.505
WA 05	46 33 20.95085	124 03 49.29435	46 33 20.95103	124 03 49.31248	.006	.386	.386
WA 06	46 39 07.64510	124 04 36.00551	46 39 07.64714	124 04 36.02020	.063	.312	.319
WA 07	46 46 46.83544	124 06 00.11814	46 46 46.83996	124 06 00.12794	.140	.208	.250
WA 08	46 56 20.71703	124 10 39.82774	46 56 20.72475	124 10 39.83034	.238	.055	.245
WA 09	46 58 51.41358	124 10 22.12854	46 58 51.42201	124 10 22.12926	.260	.015	.261
WA 10	47 00 53.31159	124 10 14.92971	47 00 53.32041	124 10 14.92920	.272	-.011	.273
WA 11	47 04 23.40943	124 10 28.03361	47 04 23.41858	124 10 28.03160	.283	-.042	.286
WA 12	47 11 10.30470	124 12 04.04353	47 11 10.31473	124 12 04.03849	.310	-.106	.328
WA 13	47 26 57.28917	124 24 19.88469	47 26 57.29960	124 24 19.86884	.322	-.332	.463
WA 14	47 35 26.38774	124 22 14.49726	47 35 26.39717	124 22 14.48383	.291	-.281	.404
WA 15	47 40 47.77843	124 29 21.21918	47 40 47.78647	124 29 21.20331	.248	-.331	.414
WA 16	47 49 16.66963	124 33 26.74759	47 49 16.67519	124 33 26.73317	.172	-.300	.346
WA 17	47 54 21.95878	124 39 17.17654	47 54 21.96178	124 39 17.16325	.093	-.276	.291
WA 18	48 09 13.32374	124 45 28.35662	48 09 13.32414	124 45 28.35005	.012	-.136	.136
WA 19	48 24 28.22071	124 44 32.08615	48 24 28.22103	124 44 32.08386	.010	-.047	.048

12. APPENDIX D--ACRONYMS & ABBREVIATIONS

AWP - Annual Work Plan

B&B, TIMS - The Block and Boundary component of TIMS; See OB2MIS; See TIMS

BLM - (U.S. Department of the Interior,) Bureau of Land Management

CONUS - The conterminous United States

DOI - Department of the Interior

DOS - Department of State

EEZ - Exclusive Economic Zone

FGCS - Federal Geodetic Control Subcommittee

FGDC - Federal Geographic Data Committee

FIPS - Federal Information Processing Standards

FR - Federal Register

FY - Fiscal Year

GIS Geographic Information System

GPS - Global Positioning System

GRS 80 - Geodetic Reference System of 1980

HARN - High Accuracy Reference Network (formerly HPGN)

HPGN - High Precision GPS Network (former name of HARN)

IGDC - Interior Geographic Data Committee

INTERMAR - Office of International Activities and Marine Minerals

LM - Leasing Map

MMS - (U.S. Department of the Interior,) Minerals Management Service

MMS/USGS Agreement - April 5, 1991, MMS/Geological Survey (USGS) Agreement

MSS - MMS, OPDC, Mapping & Survey Staff, formerly the Mapping & Survey Group (MSG)

NAD 27 - North American Datum of 1927

NAD 83 - North American Datum of 1983

NADCON - North American Datum Conversion transformation software

NGS - (U.S. Department of Commerce, National Oceanic and Atmospheric Administration, National Ocean Service,) National Geodetic Survey

OB2MIS - Offshore Block, Boundary, and MAP/OPD Information System; See B&B, TIMS

OCS - Outer Continental Shelf

OCSIS - Outer Continental Shelf Information System; See TIMS(O)

OMB - Office of Management and Budget

OPD - Official Protraction Diagram

OPDC - Office of Program Development and Coordination

OSC - Offshore Systems Center

Part I - "Project Plan for Implementing NAD 83 in the Minerals Management Service, Part I: Responsibilities and Timeframes"

PLUD - Plot Unit Diagram

RMMC - Rocky Mountain Mapping Center

SOBD - Supplemental Official OCS Block Diagram (also referred to as a "Split Block")

SOCBD - Supplemental Official Composite Block Diagram

SOLD - Supplemental Official Lease Diagram

SPCS - State Plane Coordinate System

SSB - State Seaward Boundary

TAG - Technical Advisory Group

TBD - To Be Determined

TIMS - Technical Information Management System

TIMS(O) - An all-inclusive reference to the several TIMS components into which OCSIS is evolving; See OCSIS

U.S. - United States

USGS - (U.S. Department of the Interior,) Geological Survey

UPS - Universal Polar Stereographic

UTM - Universal Transverse Mercator

WGS 84 - World Geodetic System of 1984