A COPY OF THE TRANSMITTAL MEMORANDUM FOR NEW MEXICO

AMENDMENT 2

TO THE NATIONAL ENGINEERING MANUAL CANNOT BE LOCATED

NM501.65(a)(1)

§ NM501.65 State Conservationist Responsibilities.

(a) The following is state policy for snow survey and water supply forecasting activities:

(1) Administration (i) The conduct of this program is a part of the assigned duties of all line officers and others where this activity is applicable to their operations. Line officers are to provide leadership and responsibility for the Snow Survey and Water Supply Forecasting Program within their assigned areas and should be recognized as the source of local water supply outlook information.

(ii) The snow survey supervisors are headquartered at Denver, Colorado, and Phoenix, Arizona. When working for New Mexico, they are members of the state office staff. Each supervisor is responsible to the STC for the snow survey activities within their designated areas of the State. They are responsible for the establishment and maintenance of a snow course and soil moisture station network to meet the water supply forecast needs of the state. It is also incumbent upon the snow survey supervisors to ensure the collection and processing of an acceptable quality of measurements and data from all measuring stations. Stream-flow forecasts, water supply outlook, appropriate reports, and publications are to be prepared by the snow survey supervisor for release by the STC. Technical guidance is provided by the Head, Water Supply Forecast Unit, WTSC.

(iii) Since the snow survey supervisors are headquartered at a distance from the state office, technical responsibility for coordination and carrying out certain details in the Snow Survey Program has been assigned to the SCE on the State Programs Staff. This responsibility includes coordinating and directing the routine phases of the Snow Survey and Water Supply Forecasting Program with other activities carried on in the state. In carrying out these responsibilities, the intent is to provide assistance to the snow survey supervisor in keeping the Snow Survey Program coordinated with the activities in the Service and provide support to line officers in carrying out their responsibilities.

(iv) The installation of snow courses, soil moisture stations, air markers, or other data-collecting devices will be done under the direct supervision of the snow survey supervisor. The snow survey supervisor will overview the inspection and maintenance of snow courses and other installations during off-season periods. The foregoing will be accomplished in cooperation with local line officers.

(v) Schedules for measurements of snow courses and soil moisture stations will be prepared by the snow survey supervisor in consultation with line officers involved with the snow survey program as well as with the several cooperating and water-using organizations.

(2) Cooperation Snow activities in the state are closely related and integrated into a cooperative program with state, federal, and private agencies. These cooperative arrangements and agreements will be made by the STC.

(3) Forecasts (i) Forecasts for seasonal flow of streams in terms of acre-feet or other volumetric measurement will be prepared by the snow survey supervisor. Forecasts are used in water management planning for irrigation, reservoir regulation, power, flood control, and municipal purposes. Forecasts are prepared in terms of volume and peak flows depending on available data and the needs of the water users.

(ii) Special forecasts, such as high flow in years of above-normal snow conditions, will be provided for the benefit of landowners in predominantly agricultural valleys subject to flood damage.

(4) Publications (i) A formal snow report will be prepared by the snow survey supervisor reflecting snow conditions on the various courses on February 1, March 1, April 1, and May 1 of each year. These reports will be prepared and issued no later than the tenth day of the respective month. Special snow reports of less formal nature will be published at other times as the need arises. The title page will reflect credit to major cooperating agencies.

(ii) The report will include present and comparative data on snow measurements, reservoir storage, and soil moisture condition. For March 1 and later dates, numerical water-supply forecasts for major streams will be presented, along with past records of streamflow. The report will also contain narrative descriptions of water supply outlook and will also contain narrative descriptions of water supply outlook as of the date of the report. In preparing information on water supply outlook, cooperating agencies will be consulted as far as practicable.

(iii) Snow reports will be sent to any organization or individual requesting the material. Field personnel are requested to advise soil conservation district cooperators in irrigated areas that this information is available upon request. Assistance will be provided in the interpretations of forecasts and their applications to management functions and farm operations. The DC will be responsible for preparing mailing lists for cooperators in his unit. These mailing lists will be forwarded to the area office for review by the AC. The AC will process and transmit these mailing lists directly to the snow survey supervisor. The mailing lists will be revised annually on the basis of information accumulated from purge cards.

(iv) The snow report published for Arizona, Colorado, and New Mexico will include snowfall and related data for major drainage basins in each state.

NM501.65(a)(5)(i)

(5) News Releases (i) The snow survey supervisor will prepare statewide news releases for dissemination by the STC. News releases will be coordinated with other agencies when directed by the STC. General information on the snow survey program of statewide interest will be prepared under the direction of the snow survey supervisor.

(ii) AC's and DC's are encouraged to issue timely local news releases reflecting current and significant historical snow survey data. To avoid the possiblility of being misquoted through the telephone or personal interview, news releases should be submitted in writing. No raw snow measurement data will be made available to the public until the data has been checked for accuracy by the snow survey supervisor.

(iii) When the formal "Water Supply Outlook" or other publications having statewide distribution do not provide adequate local coverage, supplemental news stories should be prepared to amplify local conditions and to provide additional interest to the affected water users. The public information officer will provide such releases to the Albuquerque news media. Where snow survey assistance or information is provided by other agencies or organizations, a joint news release should be considered. To be meaningful, data on snow measurements should be released as soon as possible after the measurements are made.

(6) Equipment (i) The area and district conservationists have line responsibility for the operation and maintenance of all machines and equipment assigned to them. Oversnow vehicles, trucks, and other snow survey equipment will be assigned to a specific member of the snow survey team for active responsibility for operation and maintenance.

(ii) The AC is the accountable property officer for oversnow vehicles and special equipment assigned to Service personnel in his area.

(iii) Measuring equipment, skis, ski poles, snowshoes, varnish, waxes, goggles, and other essential items for oversnow travel will be furnished by the snow survey supervisor as required.

(iv) Authorized personal clothing will be supplied to personnel making snow surveys. These items are covered in General Manual, Part 55 420, Subpart K, Re: Safety and Health Policy. Items supplied to field personnel are based on the degree of hazard encountered and include such items as: ski boots, snow pacs, parkas, pants, mittens or gloves, goggles, or comparable protective clothing, and camping equipment. Special emergency field rations are to be issued to those who travel in remote areas. The degree of hazard will be determined for each snow course by the snow survey supervisor. Personal protective equipment to be furnished snow surveyors will be based upon the degree of hazard determined for the particular snow course.

(v) Protective headgear will be worn while operating or riding on oversnow equipment that does not have an enclosed cab.

(vi) Equipment issued for snow surveys shall not be used for other than official purposes. The snow survey supervisor will coordinate requisitions, determine requirements, and distribute the above-mentioned and special equipment. Requisitions for the procurement of snow survey equipment and supplies not furnished by the snow survey supervisor will be prepared and justified by the DC and approved by the AC. Individuals will be required to do routine maintenance on snowshoes, skis, and other equipment in their possession.

(7) Physical Examinations (i) Physical examinations from private or public facilities are required and are available at government expense to all SCS employees assigned to make snow surveys. Physical examinations will be taken annually, not later than December 1 preceding the snow measurement season. Requests should be made to the state office, and necessary instructions will be provided.

(ii) The physical examinations will consist of having the physician complete Standard Form 78, "Certificate of Medical Examination." If some physical deficiency is noted that will impair the safety of the employee, he will be relieved from snow survey duty.

(iii) Standard Form 78, along with comments concerning it, will be filed with the state office. Electrocardiograms will be authorized by the STC for employees over 40 years of age if the physical examination should indicate the need.

(8) Training As with other activities of the SCS, responsibility for training needs in snow surveys is the responsibility of the line officer. Assistance will be available from the snow survey supervisor. Training of individuals will be conducted through written instructions, personal conferences and domonstrations, area training meetings, and through special area, state, and regional snow survey training schools. Subject matter to be covered includes operation of equipment, safety on oversnow travel, water supply forecast procedures, and related items. Training will necessarily be continuous because of changes in personnel, technology, and methodology.

(9) Time Reporting (i) Time spent on snow surveys will be recorded on Form AD-320 under Financial Project-45 (Fiscal Year precedes 45) and Activity Code 32, with the required class code as shown in Appendix R of NRCH.

(ii) A record of measurements of snow courses, soil moisture stations, and precipitation gauge readings will be recorded on Form SCS-708 as readings are taken. Instructions are given in Field Book under these titles.

PART NM503 - SAFETY

SUBPART A - ENGINEERING ACTIVITIES AFFECTING UTILITIES

§ NM503.02 General considerations.

(e) This establishes Service policy in New Mexico for locating and preventing damage to public and private utilities and also for protecting equipment, operators and other personnel during their investigations or construction operations related to SCS programs. Public and private utilities include such things, either above or below ground, as telephone, telegraph, and electrical transmission lines, missile cables, and pipelines. This policy applies to all SCS programs.

(1) The DC is responsible for all activities relating to public utilities in his field office. He will develop and maintain a record of the names, addresses, phone numbers, and responsible officials of all utility companies having facilities within field office(s) for which he is responsible. The responsible official is one who can provide the necessary protection to avoid disruption or damage to the utility during the investigation or construction operations.

(2) A checklist is to be kept by the responsible SCS employee who records action taken pertaining to work in the vicinity of utilities. This checklist is to be maintained in the SCS job file. Form SCS-ENG-6 is to be used for this purpose.

NM504.03(d)

§ NM504.03 Committee assignments.

(d) For a minor practice or structure (Classes I through IV), the AC is to appoint the investigating committee or the investigating engineer.

§NM510.01 Preliminary studies.

(3) No preliminary study is required if the technical assistance required from the area and state office staffs does not exceed three days.

§NM512.21 Evaluation procedures.

(b) Used materials may be used in installing conservation practices in New Mexico if the following conditions are met:

(1) Expected life of the material equals or exceeds the expected life of the installation.

(2) Used material will perform as satisfactorily as new materials

(3) On classes I through IV jobs, a member of the area engineering staff will accept the material and certify in writing to items 1 and 2 above. This certification will be placed in the case file in lieu of a new material certification.

(4) On class V and above jobs, the material must be accepted by the SCE using the procedure in (3) above.

§ NM512.32 Inspection procedures.

(b) A responsible technician will be designated for each practice. This technician will be responsible for the inspection and documentation on the practice.

SUBCHAPTER C APPLICATIONS

PART NM523 IRRIGATION

§ NM523.00 General.

(a) All Irrigation Water Management shall be evaluated and documented following the procedures outlined on Forms ENG-NM-123-A,B,C, and according to the standards and specifications for Irrigation Water Management (449).

(b) Irrigation Water Management will be reported only if all of the following conditions are met:

(1) Criteria in standards and specifications (449) are met.

(2) All field data is documented on forms (ENG-NM-123-A, B, or C).

(c) Previously reported IWM, reapplied on the same land, may be reported again only when satisfactorily applied with actual additional documented technical assistance on water management.

§ NM530.11 Hydrologic procedures.

This supplement establishes hydrologic policy for planning land and water resource development for all programs of the SCS in New Mexico.

(a) National Engineering Handbook Section 4, Hydrology, shall be used by Service personnel as the basis for all hydrologic determinations on drainage areas of ten square miles or greater.

(b) The procedures outlined in Chapter 2 (Revised for New Mexico), Engineering Field Manual for Conservation Practices, will be used for hydrologic determinations on conservation practices where drainage areas are less than ten square miles.

(c) The watershed hydrology for a structure will be reviewed and approved as part of the design file for a structure according to job class and job approval authority set forth in 501.04. Hydrologic procedures should be approved by the one having job approval authority for the job before final design of the structure is made.

§ NM536.09 State standard detail drawings.

(b) Approved NM standard drawings are to be used whenever site conditions and design requirements permit. Each AC, Engineer, and DC will maintain an assembled file of Standard Drawings with the index placed at the front of the assembly. As additional standard drawings are received, they will be added to the assembly, and the drawing number, date, and title will be added to the index by pen and ink. These drawings will be Appendix 2 to the NMEM.

(1) Structures planned and constructed in conformance with a standard drawing and the specifications thereon are approved for installation providing the individual planning the installation has job approval authority covering the type and size of structure planned or secures necessary design approval by an individual holding the necessary job approval authority.

§ NM540.01 Major projects.

(a) The guidelines contained in Exhibit A are to be utilized in determining the requirements for obtaining complete and accurate surveys. The engineer in charge of the surveys shall make certain that all the needs of the surveys are met. Any questions or doubts should be resolved with the designer or planner prior to starting the surveys.

(b) Planning surveys are needed to enable the planner to plan and estimate the cost of proposed works of improvement. Data required in planning normally includes site topography, representative cross-sections and profiles, drainage areas, site storage data, existing improvements, and other data as necessary.

(c) Design surveys are needed to lay out and design the proposed works of improvement. The surveys are normally more detailed than the planning surveys. The surveys should be referenced to the planning survey's baselines for both horizontal and vertical control.

(d) Construction surveys are needed to ensure that the proposed works of improvement are constructed as planned. They are also used as the basis for measurement of payment quantities. All construction surveys should be referenced to the design survey's baselines for both horizontal and vertical control. The procedures and guidelines as established in the National Engineering Handbook Section 19, "Construction Inspection," shall be followed in making construction surveys.

(e) All field notebooks will contain only the survey notes for one specific site or project. All control points on the baselines are to be referenced. The reference stakes should be set to protect them during construction.

(f) Photogrammetric surveys may be used when it is advantageous due to cost or time. The SCS utilizes professional firms to complete aerial photogrammetric surveys. Contracts for aerial photogrammetric surveys will be developed by the SCE and the SAO.

§ NM540.02 Minor projects.

(a) Technical Release No. 62 shall be complied with in recording, identifying, and filing field survey notes regardless of program, practice size, or recording document.

(1) Bound field notebooks, loose-leaf field notebook sheets, and engineering forms which have been approved for Service use may be used to record surveys and other engineering data. Approved forms are listed in the SCS Forms Catalog.

(2) Should the engineering form have insufficient space to properly record the necessary information, the information will be recorded on loose-leaf sheets (SCS-ENG-28 and SCS-ENG-29).

(b) Field note content. (1) The above mentioned approved engineering forms indicate the basic required information to be obtained. This does not preclude the technician from making additional surveys or investigations and recording these additional data which may be necessary. When properly filled out, these forms will ordinarily contain the minimum required information to support certification for payment under the various soil and water conservation cost-sharing programs and for reporting in-Service progress.

(2) General Manual title 36, PART 402 shall be complied with in obtaining engineering data and supporting information.

(c) Instructions for use of data sheets. (1) Approved New Mexico engineering forms may be used for recording data for various practices. General instructions for use of engineering forms follow, and special instructions, if any, are shown on each approved form.

(2) When data sheets are used, the appropriate engineering form for the practice being designed or checked is to be used. The technician shall take the appropriate engineering form and a field notebook to the field when scheduled to make a site investigation, field design, layout, or perform a completion check of a structural practice. All information will be recorded directly on the data sheet.

(3) It must be remembered that engineering forms and data cards are not SCS standards and specifications. They are tools to expedite the data gathering, design, and certification of practices. SCS standards and specifications and certification policy frequently change without immediate updating of data sheets.

NM540.02(c)(4)

(4) It is the responsibility of the technician to be aware of current policy, standards, and specifications so that data sheets can be supplemented as needed. Engineering forms are to be developed or revised according to AS Forms Management, PART 403, Subpart B - Forms, section 403.22 of the General Manual.

(5) When using engineering forms all blanks shall be completed. A line will be drawn in any blank spaces not applicable. Use sketches or drawings to show needed dimensions, cross-sections, or other related data.

(6) When design data, end areas, volume, capacities, dimensions, etc., are taken from approved charts or tables and inserted in the blanks of a data sheet, the drawing number of the reference from which these data are taken will be shown on the data sheet.

(d) Supplemental data. Reports of concrete tests, certificates by contractors that materials used meet appropriate specifications, batch tickets of concrete mixes used, manufacturer's certificates of quality of material, and other pertinent miscellaneous information shall be attached, by stapling to the data sheet or survey notes. A cross reference shall be made to the location of supporting data when the supporting data applies to more than one project.

(e) Assembling data. (1) All notes, engineering forms, computation sheets, and drawings for a structure shall be assembled and stapled together when the completion check has been made.

(2) Cost-sharing referrals shall have stapled to them the assembled engineering data which supports the certification that a practice meets the practice standards and specifications. Where work is done under GPCP, all notes and designs will be stapled to the GP-4 application for payment.

(f) Filing data. After all data is properly assembled as outlined above, it shall be properly identified and filed as required in the GM.

SUBCHAPTER E - SUPPORT OPERATIONS

PART NM540 FIELD SURVEYS

SUBPART NMB - EXHIBITS

NM540.10-80(a)(1)(iii) EXHIBIT A

§ NM540.10-80 Guidelines for planning surveys.

Guidelines for engineering surveys of proposed channel improvements can be found in Technical Release 25, "Design of Open Channels." Engineering surveys for other types of works of improvement should adhere to the following guidelines and be supplemented by the engineer's experience.

(a) SITE TOPOGRAPHY. In making a survey for a site, the Engineer will make a complete topographic survey of the site. The topographic map will be plotted while the survey is in progress, or in the office from survey notes, depending on the method of survey used. In selecting the method to be used consideration should be given to topography, density of tall cover, amount of detail required and the cost of the survey. The steps normally followed in making site surveys will be:

(1) Establish and reference a permanent base line. (i) A base line will be established with a minimum of two permanent reference points which may also serve as bench marks, depending on local conditions and alignment of the proposed work of improvement, for horizontal and vertical control. This base line may be the initially selected centerline of the proposed work of improvement. If possible, all permanent bench marks will be set at elevations well above the proposed top contour, and located completely outside the construction area. They will be properly referenced in accordance with recognized procedures given in engineering survey handbooks. A minimum of two transit points will be set on the base line and referenced horizontally and vertically to easily identified permanent points. In the event the final centerline differs from the initially selected centerline, new permanent reference points and transit points will be established on the final line as described above.

(ii) For vertical control, mean sea level elevations will be established at the dam site by a closed level circuit from a source of known elevation. A description of the source will be recorded. The error of closure in feet should not be greater than 0.05 times the square root of the distance in miles. After the elevation with reference to mean sea level has been determined at the site a bench mark will be set and referenced to the base line. The bench mark may be a plate set in concrete, a spike in a tree, or other similar means that will give the same degree of permanency; however, manufactured survey markers, consisting of steel stakes with bronze caps, are recommended because they are relatively inexpensive and can be set quickly and easily.

(iii) In some parts of New Mexico it may be too costly and time-consuming to establish vertical control from mean sea level elevations due to the distance and topography between the source of known sea level elevation and the area to be surveyed. In such cases it will be permissible to base all engineering surveys within a watershed on a common assumed datum.

NM540.10-80(a)(1)(iv)

(iv) Horizontal control shall be established and verified using closed traverses. The maximum error of angular closure in minutes shall be 0.5 times the square root of the number of angles turned. The maximum error of horizontal closure shall be 1.0 in 5000.

(2) Locate contours. (i) After the horizontal and vertical controls have been established as set forth above the survey party may begin the development of a topographic map of the site. The topographic map will show the principal drainage channels and contours on 4-foot intervals within the pool area, extending to at least 8 feet above the expected construction area or to the top of the ridge, whichever is the lower. Where the average slope is less than 2 percent, the contours should be located at 2-foot intervals to permit more accurate determination of site topography. In mountainous country, where slopes exceed 50 percent, the contour interval may be increased to 8 to 12 feet. The engineer may ascertain the need for additional intermediate contours, and these should be added to the site topography as required.

(ii) Method 1. Where suitable aerial photographs are available and show sufficient detail to locate and identify baselines and range lines, usually it will not be necessary to run a transit traverse to locate base and range lines. It will be necessary, however, to establish the true scale of the photograph in order to locate properly the intersection of the contours with the range and baselines. Since the scale on an aerial photograph changes near the outside edge of the photograph, it may be necessary to establish more than one scale for each map. This depends on the size of the area and its relative position on the photograph. The center one-third of the aerial photographs have the most nearly uniform scale.

(A) Range lines will be located on the photograph to give adequate coverage of the entire area. Usually it is convenient to use fence lines, power lines, and road rights-of-way for range lines. Normally, these will have to be supplemented with additional lines located on the points of ridges, along slopes, and between points that are identifiable on the photograph.

(B) After the range lines have been selected and located on the ground, temporary bench marks normally should be set at points at or near the upper or both extremities of each line, depending on local conditions. Differential levels then should be run to establish the bench mark elevations, using the same degree of accuracy described in (1) above. The extremities of each range line should be lettered or numbered on the map to facilitate note keeping.

(C) The intersections of range lines and contours are determined next by the use of an engineer's level and chain, or a transit or plane table and stadia. The location of each contour elevation is determined and the distance between contours measured along the range line. These points are plotted on the range lines drawn on the photograph and the contours sketched in between range lines. Level notes for each range line will reflect clearly the direction in which the surveys were made, such as "Range A-B - From B to A". The contours will be identified and located by station numbers on the range line notes, such as Contour 872.0, Station 3 + 62. An alternate method is to survey range lines by taking level reading at 100-foot stations and all breaks in slope and locate the intersection of contours and range lines by interpolation. In many cases a stereoscope is useful as an aid in sketching contours.

(D) More accurately located contours usually will result if the mapper sketches in the contours between ranges while on site where he can see the area being mapped. The top contour, or a key contour, should be located on the ground with a level and sketched on the aerial photograph while establishing the elevations of the ends of the range lines.

(iii) Method 2. If suitable aerial photographs are not available, or if the topography or cover is such that a sufficient number of range lines cannot be accurately located and identified on the photographs, it will be necessary to stake sufficient range lines on the ground and locate the ranges by running a closed transit traverse from the base line. Hubs and tack points should be set on each transit station. The traverse notes should be plotted accurately and checked for error of closure. The error of closure for chained distances should not exceed 1.0 foot per 1,000 feet of traverse length (3.0 feet per 1,000 feet for stadia) and in angular measurement, 1.5 times the square root of the number of angles in the traverse, in minutes. The error for vertical closure in feet should not exceed 0.2 times the square root of the miles of levels run.

(A) Temporary bench marks normally should be set on or near the upper or both extremities of each range line, depending on conditions, and at other convenient points as may be required. Closed differential levels should be run to establish the bench mark elevations. These bench marks should be established with the same degree of accuracy as that required for permanent bench marks in (1) above.

(B) Range lines should be plotted on the same sheet with the transit survey. This sheet may now be used for making a planetable survey and elevations. In either case the top or key contour should be located on the gound and its location plotted accurately on the planetable sheet. It may be necessary to locate other key contours by the same method. Other intermediate contours may be sketched in. This operation should be performed on site. The accuracy with which these contours can be sketched in will be determined by the uniformity of the slopes and the number and location of range lines selected.

NM540.10-80(a)(2)(iv)

(iv) Method 3. Another approved method of obtaining site topography is by a planetable survey, using the telescopic alidade and obtaining distances and elevations by stadia and vertical angles. Prior to the mapping of topographic details, horizontal and vertical control should be established to afford convenient coverage of the area to be mapped.

(A) Horizontal control should be established by selecting stations for a closed traverse and several key points in the area and tying these points to the base line, either by transit or planetable traverse. These points should be strategically located on the ground and plotted accurately on the planetable sheet for use as references in orienting the planetable. They may be actual planetable stations. For transit surveys, the error of closure should not exceed those noted in Method 2. The error of closure for planetable and stadia surveys should not exceed 3.0 feet per 1,000 feet of traverse distance and in angular measurement, 5 times the square root of the number of angles in the traverse, in minutes.

(B) Vertical control should be established by running a closed line of differential levels through the traverse stations and key points throughout the area and setting a sufficient number of temporary bench marks at strategic locations to allow frequent checks by the mapper and for future reference. These bench marks should be set with the same degree of accuracy as outlined in Method 2. In open country, this usually is the most rapid and economical method of obtaining site topography. Care should be used in laying out the traverse stations so that adequate coverage is obtained and errors are not carried forward in succeeding setups. If the site involves physical limitations, several ownerships, or productive lands, key contours should be located on the ground as described under Method 2. To accomplish this it may be found more convenient to use an engineer's level for actual location of these lines on the ground.

(v) Method 4. Topographic information may be obtained in note form by use of the transit as the traverse is being surveyed for horizontal and vertical control. All information for the complete topographic map is recorded while the transit occupies the various stations. Except for vertical control, which is kept current, notes are reduced for plotting later. Vertical angles and distances are used for computing elevations. A minimum of two readings on all turning points is recommended for vertical control. The traverse is computed and balanced before plotting the topographic information to develop a map. Key contours should be located on the ground as described under Method 2.

(vi) Other Methods. Other recognized methods of topographic survey, or combinations of the above methods, may be used if the required degree of accuracy for structural design purposes can be obtained.

NM540.10-80(c)(6) EXHIBIT A

(A) When the economic justification of individual or groups of sites is questionable, it may be advisable for the party to prepare topographic maps in two steps. During the first step sufficient information will be obtained to determine approximate cost and storage data. If the site or group of sites appear to justify economically, additional surveying will be done to meet the accuracy requirement listed above.

(b) REPRESENTATIVE CROSS SECTIONS AND PROFILES. The Engineer shall make representative cross sections and profiles for major features of works of improvement. The accuracy required for surveys is an error of closure in chained distanced of 1.0 feet per 1,000 feet of traverse length and for vertical control, all elevations should be recorded to the nearest 0.1 foot.

(c) DRAINAGE AREA. (1) The drainage areas of works of improvement should be determined carefully and will be used both for planning and design purposes. An overlay map should be made showing the drainage pattern and the watershed boundary of each site.

(2) The drainage area of each site should be outlined on 4-inch aerial photographs using the center 1/3 to 1/2 of each consecutive photograph. The drainage boundary should be delineated by (a) use of accurate quadrangle maps and/or stereoscopic inspection and confirmed by field inspection at key points, or (b) where it cannot be determined readily by stereoscope or from quadrangle maps the delineation will be made by field inspection. Natural divides or man-made diversions which may be considered permanent should be followed. Terrace systems and small diversions which may fail during large storm will be disregarded.

(3) Establish the scale of the photographs on at least one print of each flight line which crosses the drainage area above each site. Two lines approximately perpendicular to each other should be measured. The measured distance should lie between readily identifiable points within the center part of the photograph and along established lines such as a road or fence. During normal surveys, if the scale of the photograph can be adequately determined, it will not be necessary to locate and measure perpendicular distances.

(4) The size of the drainage area in acres normally is determined by planimetering accurately the delineated area on the photographs. For large drainage areas involving several prints it may be advisable to make an overlay of the area in order to obtain a higher degree of accuracy in planimetering.

(5) The drainage area boundary should be established by transit survey where suitable maps are not available.

(6) Drainage areas may be determined from the 7.5 minute series topographic quadrangle, if available.

NM540.10-80(d)(1)

(d) STORAGE DATA TABLE. (1) A storage data table will be developed for each site which impounds water for flood control or other purposes.

(2) The storage data table for each site will record the following information: (i) elevation, (ii) pool area in acres, (iii) cumulative volume in acre-feet at selected elevation points, and (iv) total storage in watershed - inches below each elevation. The pool area for any desired elevation should be obtained by planimetering the area within the selected contour a sufficient number of times to make reasonably certain the area is correct within 2 or 3 percent. The volume increment between elevations should be computed using average areas of adjacent contours. The storage curve will be used to determine intermediate values.

(e) LOCATE OTHER PHYSICAL FEATURES. (1) Public roads within the site should be located accurately and profiles run between points of intersection with the top contour. The elevation of streamflow lines at points of intersection with property lines will be shown.

(2) Any other significant features such as buildings, wells, pipelines, power and telephone lines, churches, cemeteries, fences, etc., will be located on the map and elevations of strategic points located. A vicinity map of the surveyed site is required unless the legal description or physical features clearly indicate the location.

§ NM540.11-80 Guidelines for design surveys.

(a) CHANNEL MODIFICATIONS. Detail design surveys for channel modifications should follow guidelines as set out in Technical Release 25, "Design of Open Channels", and be supplemented by the engineer's experience. Curve data shall be by arc definition, and stationing will be along the curve, not the tangents.

(b) FLOODWATER RETARDING STRUCTURES. In making the final site design survey, the elements to be surveyed, the data to be obtained, and the degree of accuracy involved in obtaining this data should be as follows:

(1) Embankment centerline profile and cross sections. (i) The centerline of the embankment should be established with hub stakes and tack points (can use 5/8-inch rebar with aluminum cap) at all angles in the alignment and at extreme points on each abutment that fall well outside the probable construction area. For convenience in obtaining profiles and cross section temporary bench marks should be set at convenient locations.

(A) Intermediate stakes should be set at intervals not greater than 100 feet and at such other points as necessary to obtain a true profile and accurate cross sections. The zero station of the centerline of the embankment will be located on the left side of the stream looking downstream. Where the spillway is located in the left abutment, the zero station should be located well outside the expected limits of the spillway cut. If the embankment centerline consists of more than one tangent, the curve locations should be staked on chord lengths not greater than 50 feet for curves of 14 degrees or less and 25 feet for curves greater than 14 degrees. Curve data should be based on arc definition.

(ii) Profile levels of the embankment centerline and cross sections of the proposed embankment foundation area should be taken at significant breaks where necessary to reflect a change in ground slopes within the foundation area. For accuracy of the profile, readings should be taken at intervals not greater than 100 feet when the slope is 4 percent or less. This interval should be reduced to 50 feet on slopes from 4 to 8 percent and to 25 feet on all slopes over 8 percent.

(A) All recorded rod readings and elevations for profiles and cross sections should be made to the nearest one-tenth foot. All level circuits should be closed within allowable tolerances.

(2) Emergency Spillway. (i) Criteria for design and layout of earth emergency spillways are contained in Technical Release 2, "Earth Spillways, Tentative"; Technical Release 52, "A Guide for Design and Layout of Earth Emergency Spillways"; and Technical Release 60, "Earth Dams and Reservoirs". If the alignment of the emergency spillway was not finalized in the planning stage extreme care should be exercised in locating the emergency spillway to result in the most economical plan in keeping with current criteria. If a choice of more than one alignment or location of the emergency spillway exists and landrights permit, the engineer responsible for obtaining the detailed survey data will obtain sufficient topographic and other data to be able to fully analyze each alignment or location and arrive at the most desirable plan.

(ii) The centerline of the emergency spillway shall be aligned with a transit, with tack points set at each transit station, points of intersection, and at the ends of the centerline. Intermediate stakes should be set at not more than 50-foot intervals and at such other points as necessary to obtain a true profile and accurate cross sections.

NM540.11-80(b)(2)(A) EXHIBIT A

(A) The alignment of the emergency spillway shall be referenced to the centerline of the embankment and the survey tie fully and accurately described and recorded in the field notes. When the emergency spillway is located adjacent to the end of the earth embankment, the angular divergence, in degrees, between the centerline of the embankment and the centerline of exit channel of the emergency spillway should not be less than 20 degrees plus the average slope (in percent) of the abutment along the centerline of the embankment (not to exceed 90 degrees). Where a curved alignment is necessary in the approach section of the emergency spillway, the radius of curvature of the centerline shall not be less that one-half the base width of the spillway plus 50 feet, and the central angle of the curve should not exceed 130 degrees.

(B) In staking curved sections, the centerline stakes should be set on chord lengths of not greater than 50 feet for curves of 14 degrees or less and 25 feet for curves greater than 14 degrees. Curve data should be based on the arc definition of the curve. The zero station on the centerline of the emergency spillway should be located upstream from the approach section and at least 6 feet vertically below the elevation of the crest section.

(iii) A profile will be developed for the centerline of the emergency spillway, with elevations taken at each stake set in accordance with paragraph (b).

(iv) Emergency spillway cross sections shall be taken normal to the centerline at each profile point. These cross sections shall be extended outside the base width a sufficient distance to include all cut slopes, spillway dikes, waterways for outside water, etc. All ground elevations should be recorded to the nearest one-tenth foot.

(v) When a structural chute emergency spillway is planned, the Engineer shall obtain a centerline profile and cross section in accordance with (b), (c) and (d), except that at the downstream end where the proposed chute will intersect the existing ground, the cross sections shall be made on 20-foot centers for a distance of 60 feet upstream and 100 feet downstream.

(3) Principal Spillway. (i) Location. The foundation conditions may determine the final location of the principal spillway. However, since the foundation has not been investigated at the time the detail surveys are made, alternate locations should be made on the basis of the known general geology of the area and the surface topography. Where foundation conditions will permit, the location should be made so that the problem of downstream release will be minimized. In most cases the location can be made so that the outlet pipe is normal to the centerline of the embankment. However, there will be some locations where setting the axis of the outlet pipe at an angle with the centerline of the embankment may provide better foundation conditions under the structure or better alignment for discharge of the principal spillway.

(ii) When the location and alignment of the principal spillway and possible alternates have been made, the centerline should be staked with a transit, setting tack points at all angles in the alignment and at the intersection with the centerline of the embankment. The station of this point on each line should be recorded in the field notes, as well as the angle formed by the two lines. Intermediate stakes should be set at 50-foot intervals and at breaks in surface grade which will be significant in profiling and cross sectioning. Additional stakes should be set at the approximate location of the riser inlet and at the anticipated point of the outlet and at the anticipated location of the center of the energy dissipator. The zero station of the centerline of the principal spillway should be set not less than 100 feet outside the upstream toe of the embankment.

(iii) Profile levels shall be run along the centerline, starting at the zero station and extending past the discharge end of the principal spillway along the stream bed a sufficient distance to determine the stream gradient and any high or control points in the channel.

(A) In no case should this distance be less than 800 feet from the end of the principal spillway conduit unless it is obvious that control points, such as culverts, rock ledges, etc., will control the gradient to be used. The profile should extend downstream until the channel gradient is 0.3 percent or less. However, if the surveys will extend downstream more than 3000 feet, the State Conservation Engineer should be asked to provide guidance on how far downstream the channel surveys should extend beyond 3000 feet. The profile shall accurately describe the ground line along the proposed alignment. The junction of the centerline of the principal spillway outlet channel and the centerline of the stream channel should be established by a definite station. Beyond this point the profile should follow the meander of the stream.

(iv) Cross sections of the principal spillway shall be taken normal to its centerline at each profile station. The distance out from the centerline to which the cross sections should be taken will be governed by the depth of excavation necessary for the installation of the conduit and appurtenances, and should extend past any probable excavations. The minimum section should not be less than 50 feet on each side of the centerline. To better define the area of installation of an energy dissipator, cross sections shall be taken at no greater intervals than 20 feet from the anticipated location of the pipe outlet to a minimum distance of 100 feet downstream. Downstream from this point, cross sections of the principal spillway outlet channel should be made at intervals not exceeding 50 feet until the junction of the principal spillway outlet channel and the stream channel is reached. Below this junction, the maximum spacing of cross sections along the profile shall be 200 feet. If the end of a profile reach is a control section (i.e., bridge, culvert, rock ledge, etc.), sufficient cross sections, grade lines and hydraulic head control lines shall be obtained to permit the designer to determine the hydraulic capacity of the control section.

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(4) Other Survey Data Required. (i) To assist the design engineer in detailing other installations that may be required, such as foundation drains, relief wells, etc., it will be necessary to locate the flow lines and banks of the old stream channel, and any other drainage channels that may be within the embankment foundation area. This information may be obtained by running a base line at right angles to the centerline of the embankment and marking the location of streams and banks by perpendicular offsets. The established centerline of the principal spillway may be used for this purpose.

(ii) It is also necessary to obtain cross sections of all stream channels within the embankment foundation area in order that the volume of required stream channel excavation may be estimated. The number of cross sections required will be dictated by the uniformity of the channel sections. The minimum number of sections required shall be controlled by one of the following:

(A) The maximum meandering distance of the stream channel between adjacent sections shall not exceed 40 feet.

(B) A minimum of 7 sections shall be taken of each stream channel: (1) One near the anticipated upstream toe; (2) one near the anticipated downstream toe; (3) one at the centerline of the embankment; and (4) one at each of the third points between the centerline and the anticipated upstream and downstream toes.

(iii) All sections should be taken normal to the direction of flow in the channel, with sufficient elevations on each to plot each section accurately. The distance between sections, as measured along the centerline of the channel, also should be recorded.

(5) Layout and Staking Borrow Areas. (i) The area below the principal spillway crest elevation normally is a principal source of borrow material for the construction of the embankment. In order to sample this area and properly record the laboratory data, it is necessary to establish and plot a reference system prior to the geologic investigation of the site. This reference system consists of a series of staked lines parallel to the centerline of the embankment or a tangent section and stationed corresponding to the full station numbers on the embankment.

(ii) These parallel lines are called grid lines and are lettered for reference purposes, beginning with grid line "A" at 300 feet upstream from the centerline of the embankment and progressing upstream at 200-foot intervals.

(iii) Each grid line within the approximate limits of the principal spillway crest elevation is staked at 100-foot intervals and stations numbered corresponding to the stations on the centerline of the embankment. The number of such grid lines set and staked will be governed by the volume of borrow material required and the area within the limits of the principal spillway crest. Usually six grid lines will cover a sufficient area of material. If additional area is needed, the grid system is easily expanded. After the grid lines have been staked, each grid line should be profiled, and elevations recorded to the nearest one-tenth foot, at each station and at significant breaks to reflect the surface profile. In some instances there will not be a sufficient quantity of suitable material within the principal spillway crest elevation area and other sources will have to be investigated. When this occurs, a similar system of grid lines should be laid out for areas selected by the engineer and the geologist for investigation. These areas must be referenced to the centerline of the dam. Sufficient reference points (5/8-inch rebar with aluminum caps) should be placed in each borrow grid system so that the grid system can be easily reestablished.

(c) OTHER WORKS OF IMPROVEMENT. The engineer in charge of the design surveys shall ascertain the extent of detailed surveys required for other works of improvement. The extent and accuracy of such surveys should be similar to those established by the guidelines for Floodwater Retarding Structures.

(d) PLOTTING OF DETAIL DESIGN DATA. The engineer in charge of the detailed surveys shall have all detailed design surveys plotted on 21" X 30" sheets of 10 X 10 red line cross section tracing paper before forwarding the survey data to design. The following guidelines shall be used for plotting the survey data:

(1) Embankment Cross Sections. All embankment cross sections should be plotted. The scale to be used will depend on the maximum height of the dam. For maximum fill heights up to 60' the sections should be plotted on 1" = 10' vertical and 1" = 20' horizontal. For fill heights greater than 60' these scales may be reduced to 1" = 20' vertical and 1" = 50' horizontal.

(i) In any case the scales used should be clearly indicated on the plotted sections, and all sections for any one embankment should be plotted to the same scale. The vertical spacing of the plotted sections should be such as to allow the design engineer to plot the embankment section and cutoff on each cross section without extending into the cross section above or below.

(2) Emergency Spillway Cross Sections. All emergency spillway cross sections should be plotted. The vertical scale should be 1" = 10'. The horizontal scale will be determined by the width of the sections taken. For sections less than 300 feet in width the horizontal scale should be 1' = 20'. For sections from 300' to 700' wide the scale would be 1' = 50'. For sections more than 700' in width the scale may be reduced to 1' = 100'. By observing the above scales, two columns of cross sections can be plotted within the width of a standard 21" X 30" sheet. The vertical spacing of the plotted sections should be such as to allow the design engineer to plot the final spillway grade on each cross section without extending into the cross section above or below.

(3) Principal Spillway Cross Sections. All principal spillway and stream channel cross sections should be plotted using a scale of 1" = 20' horizontal and 1" = 10' vertical. The vertical spacing of the plotted sections should be as to allow the design engineer to plot the grades on each section without extending into the cross section above or below.

(4) Profiles. The centerline of dam, centerline of emergency spillway, centerline of principal spillway and borrow grid profiles shall be plotted using a scale of 1" = 10' vertical. The horizontal scale should normally be 1" = 100'. However, the horizontal scale used can be 1" = 50' or 1" = 200' if needed to adequately display the profile.

§ NM540.12-80 Guidelines for photogrammetric surveys.

Photogrammetry is the science of making measurements on photographs. Aerial photogrammetry applies to the measurement of photographs taken from the air. As the science of aerial photogrammetry has developed, it has come to include all operations, processes and products involving the use of aerial photographs. Among these are included the measurement of horizontal distances, the determination of elevations, the compilation of planimetric and topographic maps, the preparation of mosaics and orthophotos, and the interpretation and analysis of aerial photographs for geological, agricultural and engineering investigations.

NM540.12-80(b)(4) EXHIBIT A

(a) ADVANTAGES AND DISADVANTAGES OF USING AERIAL PHOTOGRAMMETRY. The main advantages of the compilation of topographic maps by using aerial photographs over ground methods are as follows:

(1) The speed of compilation.

(2) The reduction in the amount of control surveying required to control the mapping.

(3) The high accuracy of the locations of planimetric features.

(4) The faithful reproduction of the configuration of the ground by continuously traced contour lines.

(5) The freedom from interference by adverse weather and inaccessible terrain.

(6) By proper selection of flying heights, focal lengths, and plotting instruments, and by proper placement of ground control, photogrammetric mapping can be designed for any map scale ranging from 1 inch = 20 feet down to 1 inch = 20,000 feet, and smaller; and for a contour interval as small as 1/2 foot.

(7) Because of the wealth of detail that can be seen in a spatial model, the resultant photogrammetric map will be more complete than will a comparable map produced by ground methods.

(b) AMONG THE DISADVANTAGES OF MAPPING BY USING AERIAL PHOTOGRAPHS ARE:

(1) The difficulty of plotting in areas containing heavy ground cover such as high grass, timber, and underbrush.

(2) The high cost per acre of mapping small areas.

(3) The difficulty of locating positions of contour lines in flat terrain.

(4) The necessity for field editing and field completion. Field completion is required where the ground cannot be seen in the spatial model because of ground cover, where spot elevations must be measured in flat terrain, and where such planimetric features as overhead and underground utility lines must be located on the map. Editing is necessary to include road classification, boundary lines not shown on the photography, drainage classification, and names of places, roads, and other map features.

NM540.12-80(b)(4)(c) EXHIBIT A

(c) TECHNICAL GUIDES FOR PHOTOGRAMMETRY. (1) Control Surveys. Control panels should be established prior to the aerial photography. The error in closure for vertical control surveys in feet should not be greater than 0.05 times the square root of the distance in miles. The error in closure for horizontal control should not exceed 1 in 20,000.

(d) TOPOGRAPHIC MAPS. The elevation of 90 percent of all readily identifiable points shall be in error not more than one-half contour interval. No point shall be in error more than a full contour interval.

(e) CROSS SECTION AND PROFILE DATA. Cross section and profile data shall consist of defining break point elevations along each cross section and profile. The elevation shots should be read at a spacing not to exceed 100 feet, plus intermediate break points as necessary to accurately depict the profile. Elevations shall be read and recorded to the nearest 0.1 foot. The vertical accuracy of all spot elevations shall be that 90 percent shall be within $\pm$ 0.5 foot and 95 percent shall be within $\pm$ 1.0 foot. Horizontal distances shown on cross sections or profiles shall be accurate to within 1-foot ground distance measured from the base line.

§ NM544.05 State procedures.

This supplement applies to any precision engineering instruments, particularly to levels, transits, alidades, and planimeters that are used in our work.

(a) The obtaining of engineering survey data is dependent upon the accuracy of our instruments; therefore, the following shall apply:

(1) When any of the above types of instruments are used only occasionally, the user shall, prior to using it, make a check of the instrument and determine whether or not it is in adjustment. The items to check for determining whether or not the instrument is in adjustment are listed in Chapter 1 of the Engineering Field Manual.

(2) If the instrument is out of adjustment, it shall not be used until necessary adjusting is done.

(3) Each level, alidade, and transit in use shall be checked for adjustment at least once a month. Instruments that are used daily shall be checked for adjustment at least once a week. The first thing on Monday morning is a good time to do it. Everyone using a level should know how to make the necessary adjustments correctly. If they do not, they shall ask for training in making the adjustments normally required. Taking apart and cleaning engineering survey instruments should generally be by or under the direction of the engineering specialist serving the field office.

(4) Form NM-122, "Checking and Adjustment Record of Engineering Instruments," is to be utilized for maintaining the checking and adjustment record outlined above. It is the responsibility of the DC to see that a record of each instrument (level, alidade, transit, etc.) is maintained in accordance with the preceding paragraph.

(5) The applicable checking and adjustment record (NM-122) shall be affixed to the instrument box.