NEW MEXICO DEPARTMENT OF TRANSPORTATION

SURVEY AND LANDS ENGINEERING BUREAU

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2000 SURVEY HANDBOOK

Revised January 2010
MAY, 2000


This handbook is intended for the practicing Land Surveyor, both Department staff and consultant, completing New Mexico State Highway and Transportation Department assignments. It is prepared to be used in conjunction with the Minimum Standards for Surveying adopted by the New Mexico Board of Registration for Professional Engineers and Surveyors. *The Handbook establishes the basic principles and practices on how the Department will administer its land surveying assignments.* Equally important, the handbook serves as a reference for all the partners involved in the planning, design and construction of highways and will introduce the land surveyor, engineer, their clientele and associated professions with what is required to complete the Department’s land surveying assignments.

These principles and practices are the cumulative experience of the Department’s staff, the Survey Handbook Committee, and URS Greiner under contract to the New Mexico State Highway and Transportation Department. The handbook has been reviewed and rewritten to incorporate the Department’s current direction. This is one of many “tools” which the Department has developed recently which, like the Compass, “can only show in which direction we should head.” It constitutes a fundamental reference, but *is not intended to be a substitute for sound, professional judgment or legal requirements.*

The Handbook is a dynamic document that must be in a continuous state of improvement. As such you are encouraged to be an active participant and submit your thoughts, ideas and suggestions to allow this document improve with time. We hope that the elements of this Handbook will help us focus our efforts on those things that provide the greatest possible return to the traveling public for the time invested.

Pete K. Rahn, Secretary
New Mexico State Highway and Transportation Department
NMSHTD COMPASS

Our Vision:

The New Mexico State Highway and Transportation Department, through its employees, will be the leader in advancing safe, efficient transportation systems to provide public/commercial mobility, to stimulate economic development and improve the quality of life of our customers. We will be responsible for securing and wisely managing the resources necessary to accomplish our vision. We will be environmentally responsible.

Values:

The New Mexico State Highway and Transportation Department is committed to the following values and believes they establish the boundaries within which all department activities will be conducted:

- Integrity
- Open and honest two-way communications
- Being one team
- High quality work
- Each employee's worth
- Responsiveness to our customers
- Initiative
- Career development
- Courteous and friendly
- Desirable and safe work environment
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The purpose of this handbook is to optimize statewide uniformity in surveying; to establish and maintain the Department's survey standards; and to improve the overall efficiency of the Department's (and the Department's Contractors) survey functions. The handbook provides a reference source for department-wide surveying policies, procedures and information.

The intent is to:

a) Promote uniformity in practice and procedures.
b) To state the Department's policy in areas that change little over time.

In surveying certain fundamental matters, such as the location of boundaries are subject to principles of law, decisions of the courts, and local or regional traditions and customs. There is little policy change that can be made in these matters by individual entities.

The methods and procedures outlined can be used without seriously affecting the progress of the job and should produce results which will be a credit to those performing the work. Good work is demanded and encouraged, valuable time must not be wasted to obtain a degree of accuracy not consistent with the purpose for which the work is being done. The degree to which these methods are adhered to will be reflected throughout the development of a project, from its inception to its completion as a facility turned over to the road user for his/her comfort and convenience. Errors and submission of insufficient data are the source of numerous delays, added construction costs, right-of-way costs, and highway plan changes.

This handbook attempts to establish uniformity but improved methods and technologies will occur and will require changes in methods. For example, equipment such as the automatic total station, Computer Aided Drafting and Design (CADD), Digital Terrain Modeling (DTM), and Global Positioning System (GPS) receivers are revolutionizing note keeping systems and survey data collection procedures. This handbook must be dynamic. Revisions to this handbook will be required as changes occur. This handbook should always be used hand-in-hand with good judgment.

The location survey field crew, following extensive time spent in route proposal studies and public hearings, is the first on the ground starting the initial phase of design. Satisfaction can be taken by assuring that the demands of those who follow (Design, Bridge, Drainage, Right-of-Way, and Construction) have been met by faithfully performing every assignment.
102.02 TYPES OF HIGHWAY SURVEYS

Location Surveys are conducted to locate topography for the use of engineering design and construction of highways. There are two types of Location Surveys:

a) Stand-alone Locations Surveys
b) Location Surveys which support Aerial Mapping

Right-of-Way Surveys are performed to establish the right-of-way of the public roads/highways within the Department’s jurisdiction. Right-of-Way surveys also provide information used in performing road/highway route feasibility studies and for eventual land acquisition.

Monumentation Surveys are conducted to monument existing and newly acquired road/highway right-of-way.

Miscellaneous Surveys include the following categories of surveys:

a) Geodetic Control Surveys: are performed to establish a project wide control network.

b) Photo Control Surveys: are performed to establish horizontal and vertical positions on aerial photography ground control points.

c) Property Surveys: are performed to establish the boundaries of non right-of-way parcels acquired by the Department.
Public relations is one of the more important duties of the surveyor. Often they are the first Department representatives to make contact with the people affected by the Department's highway projects. **Common sense and common courtesy are the best rules in any form of public relations.** It is the responsibility of the Surveyor to be prepared and create a good impression when meeting the public. First impressions, whether good or bad, are often lasting. The survey crew must maintain a pleasant and businesslike attitude at all times, and thereby the impression you create will be a credit to you, your profession, and the Department.

Each employee is a representative of the Department, each responsible for developing and maintaining public goodwill. The Department is a public service organization; it is judged by our behavior as well as by our work. The outdoor nature of surveying keeps surveyors in the "public eye" much of the time. All direct contact with the public should be pleasant, courteous, and businesslike. This includes answering questions, listening to criticism (justified or not), and listening to suggestions. Specific questions regarding the project that are beyond the limits of the survey, should be directed to the Project Development Engineer (PDE). You should be prepared to provide the public with the name and telephone number of the PDE assigned to the project. Crew members, other than the project surveyor (survey party chief), who are approached by the public should be courteous and direct the public to the project surveyor (survey party chief). Questions regarding the survey should be answered by the project surveyor (survey party chief).
102.04  PROPERTY OWNER PERMISSION

The most important phase of public relations is the interaction with the property owner. The property owner is the one who will be directly affected by the survey, construction and possibly the Department's acquisition of property. The property owner will naturally take a close interest in any intrusion onto their property, no matter what the purpose.

The property owner/occupant must be contacted before a survey crew enters the property. The purpose of this contact is to inform the owner/occupant that entry is required, to explain what survey activities are to be performed, to indicate the duration of the survey and any effect it may have on the property, to obtain the owner's name and address and telephone number if the occupant is not the owner, and to obtain permission for entry.

It is the Department's policy to obtain written permission from property owners/occupant to enter their property for all surveys. Geodetic Surveys, photo control surveys and location surveys may be completed on verbal permission from the owner/occupant. Right-of-Way surveys and property surveys must have a signed permission form before beginning the survey. An occupant of the property may give written permission if the owner is not available. In the case of verbal permission, the name and telephone number of the owner/occupant giving verbal permission must be recorded in the field notes. If verbal permission is refused, the survey should not proceed without consultation with the surveyor's supervisor and the project's PDE.

Indian lands, written permission must be obtained prior to any survey activities. A representative from the Department's Right-of-Way section should handle all correspondence between the Department and the Indian Tribe/Nation/Pueblo.

Railroad property's, require written permission prior to any survey activities.

When written permission is required, it should be obtained on the Department's standard Survey Permission Form, see Appendix E. The surveyor should explain the Survey Permission Form to the owner/occupant and ask them to sign it. If the owner/occupant refuses to sign, then the survey cannot proceed. The matter must be referred to the Office of General Counsel. If the owner/occupant cannot be located, then the survey cannot proceed. Instead, the form must be mailed to the owner/occupant by certified mail. If a response is not received within 30 days, the matter must be referred to the Office of General Counsel.

The surveyor is responsible for keeping a record of the owners/occupant from whom permission has been obtained, indicating the date, name and any pertinent notes within the project field notes. A copy of the signed Survey Permission Form must be kept with the field crew for the duration of the survey.
SAFEY

New Mexico State Highway and Transportation Department's Safety Creed:

...Every person bears personal responsibility for keeping out of harm's way.

...The actions of each person are interwoven with the actions of others; a failure on the part of one person could mean a safety and health failure for all.

...Accidents may be action failures resulting from inappropriate staffing; lack of training, procedures, policy or direction; poor supervision or manager non-involvement.

...Accidents will cease only when all employees, with dedicated top management support, are actively involved in correcting all conditions which present a potential for an accident or a personal injury.

The Department’s surveyors and survey crew members, as well as contracted surveyors and survey crews will adhere to the policies and procedures set forth within the New Mexico State Highway and Transportation Department Safety Handbook. A copy of this handbook may be obtained from the Department’s Surveying and Lands Engineering Section.

102.05.1 USE OF TRAFFIC CONTROL DEVICES

It shall be the responsibility of the surveyor to make certain that the proper traffic control devices are in use whenever members of the party are working in the traveled roadway. Traffic control devices used shall conform to the requirements specified in the "Safety Manual for the New Mexico State Highway and Transportation Department," latest edition. All signs, cones, flags, etc., will be clean, bright, and in good repair. Any applicable approved traffic control device may be used as conditions warrant. The number and type of such devices to be used will be a matter of judgment on the part of the survey supervisor. All traffic control devices will be removed when not required, even for short periods of time.

102.05.2 FUNCTION OF TRAFFIC CONTROL PROCEDURES

The primary function of traffic control procedures is to move traffic safely and expeditiously through or around the work area. In the interest of maintaining good public relations, all traffic control procedures must move traffic with maximum safety and minimum inconvenience to the public. All personnel assigned traffic control duties will conduct themselves in a courteous manner at all times.

102.05.3 MISCELLANEOUS SAFETY INSTRUCTIONS

a) Although the overall responsibility for the safety of the survey crew rests with the Party Chief and/or Field Supervisor, each individual has the responsibility for insuring that his work is performed in the safest possible manner. Further, each individual shall
be alert for any unsafe act or condition and shall report such act or condition to his immediate supervisor without delay.

b) Each field crew member shall be issued a safety vest to wear while working in or near the traveled roadway.

c) Each field crew member shall be issued a hard hat and will be required to wear it in accordance with the Department’s safety policy. Hard hats are required when working in construction zones and areas where falling objects and overhanging projections may come in contact with the head.

d) All edged tools shall be kept sharp and in good repair. Employees required to use these tools shall be thoroughly instructed in their proper use.

e) Employees shall not ride on the outside of any motor vehicle at anytime.

f) Each employee riding in a state-owned motor vehicle shall have their seat belt and shoulder harness securely and properly fastened any time that the vehicle is in motion.

g) The number of passengers in any state-owned motor vehicle shall not exceed the number of seat belts in the vehicle.

h) First Aid kits and fire extinguishers shall be kept and properly maintained in all survey vehicles.

i) Pulling measuring tapes across roadways is highly discouraged and shall only be used when other methods cannot be used.

j) When it becomes impossible for a survey crew to safely maintain traffic control and still perform their duties, it shall be the responsibility of the survey supervisor to stop the work and request additional assistance.

k) It shall be the responsibility of the survey supervisor to assure that all accidents involving members of the crew are reported to the Safety Unit at the Department’s General Office or the Department’s District Safety Unit if away from the General Office.

l) When using extended telescoping poles, range poles or high leveling rods, (especially metal ones) extreme caution should be exercised when working around areas where electrical high voltage power lines exist and during electrical storms. Poles and rods should be collapsed before moving from point to point.

m) Party Chiefs and/or Field Supervisors shall not knowingly permit an employee to work when their ability or alertness is impaired by fatigue, or other factors, so they or others are not exposed to injury.

n) Each survey field party shall include at least one person certified in first aid. Each field vehicle shall be equipped with an approved 16-unit, or larger first aid kit.
o) When working on foot and near or on the traveled way, always face oncoming traffic. If unable to face traffic, have a co-worker watch traffic for you. It is advisable to face traffic from any work site within the right-of-way, especially when near, at, or below roadbed level.

p) Assume that all animals are potentially dangerous. Carry a pointed lath or a range pole to ward off an attacking animal. Retreat is usually advisable but do not turn your back and run unless you can reach a haven before the animal reaches you. Do not approach, attempt to capture or kill, or attempt to pet either domesticated or wild creatures.

q) Do not attempt to climb fences, stone walls or other obstructions with instruments held over your shoulders or in your arms. When crossing fences use gates, when practical. When crossing barbed-wire fences, cross at the center of the span and have a co-worker hold the wire(s) for you. If necessary to climb the fence post, make sure that staples are firm and that the post isn’t rotted and weak.

r) Use only clean containers which have been designed and used only for drinking water. Fill only with fresh water. Do not use for cooling or storing canned beverages, juices, etc. Use disposable drinking cups. Do not drink from unfamiliar wells, springs, or other water sources unless approved by a reliable local person who knows the water is safe.
102.06 EQUIPMENT

102.06.1 SURVEYING EQUIPMENT

Each Party Chief and/or Field Supervisor shall insure that his field crew has sufficient equipment, both in type and quantity, so that the work will progress efficiently. A reasonable stock of expendable supplies (wood, flagging, paint, etc.) should be kept on hand to insure uninterrupted work progress.

All surveying equipment is charged out to the Party Chief and/or Field Supervisor of each crew. An accurate record must be kept of this equipment so that inventories may be performed as required by Department regulations. Maintenance and adjustment of all surveying equipment is the responsibility of the Party Chief and/or Field Supervisor.

When State equipment is lost, stolen, or damaged, a report shall be made and proper authorities notified.

ABUSE OF STATE EQUIPMENT WILL NOT BE TOLERATED.

102.06.2 CARE OF INSTRUMENTS

Surveying instruments are precision instruments and must be treated as such. All instruments must be checked periodically to insure that they are in adjustment. Adjustment should be attempted only by competent, experienced personnel. Disassembly should not be performed in the field except in extreme emergency, and then only by competent personnel. It is the responsibility of the Party Chief and/or Field Supervisor to see that the instrument man is responsible for the care and exterior cleaning of the survey instruments and their cases.

Electronic distance measuring equipment should be checked at least once every 12 months by measuring between accurately established points. Calibration baselines have been established for this purpose in Santa Fe and Albuquerque. Data for these baselines can be retrieved from the Surveying and Lands Engineering Section at the Department’s General Office in Santa Fe.

One and two second theodolite instruments shall not be carried while mounted on tripod. Other instruments should be transported according to manufacturer’s specifications.

No instrument shall be transported in a vehicle without first removing it from the tripods and placing it in its case. Instruments in cases shall be placed in padded locations in vehicles, preferably in padded compartments.

Prisms shall not be transported in vehicles without first being placed in their cases.

Tripods and rods shall not be placed under signs, shovels and other equipment in the vehicles which may damage them.
All instruments and equipment used on a survey will be checked for accuracy at the beginning of each major job -- tribrachs for optical plummet and bubble accuracy, tripods for tightness and stability, stake-out rods for bubble accuracy, etc.

Pendulum level instruments (Self leveling-levels) shall be PEG tested prior to every project. PEG level notes should be placed in the field book.

102.06.3 AUTOMOTIVE EQUIPMENT

All state employees are responsible for the safety and proper use of state vehicles placed in their charge. These vehicles are to be used only by authorized state employees in accordance with current Departmental policy. State vehicles shall be operated only by employees who have a valid New Mexico drivers license. Employees operating state vehicles shall scrupulously obey all traffic laws. Survey Supervisors shall insure that vehicles assigned to their parties receive proper maintenance and service, as required, and that these vehicles are properly utilized.

ABUSE OF STATE VEHICLES WILL NOT BE TOLERATED.

A detailed Accident Report Form shall be submitted immediately in the event of an accident involving a state vehicle including a local police report when applicable. The authorized report forms shall be carried in all vehicles at all times. The Survey Supervisor shall be notified as soon as possible.
SURVEY ACCURACY

Accuracy is the degree of conformity with a standard or a measure of closeness with a true value. Accuracy relates to the quality of the result obtained when compared to a standard. It is distinguished from precision, which relates to the quality of the operation used to attain the result.

Precision is the degree of refinement in the performance of an operation (procedure and instrumentation) or in the statement of the result. The term “precise” is also applied, by custom, to methods and equipment used in attaining results of a high order of accuracy, such as precise leveling.

The accuracy of a field survey depends directly upon the precision of the survey. Although surveys with high-order accuracy might be attained through luck and circumstance, without high-order precision, such accuracy are meaningless. All measurements and results should be quoted in terms that are commensurate with the precision used to attain the results.

All surveys must be performed with a precision which ensures that the desired accuracy is attained. Surveys performed to a precision which excessively exceeds the requirements are costly and should be avoided. In other words, "DO NOT OVER SURVEY."

Measurements shall be made to an accuracy consistent with the purpose of the survey.

Project control surveys completed using GPS survey procedures will conform to the Accuracy Standards stated within the Department’s Geodetic Unit Procedural Manual. See Appendix A.

Traverses completed by conventional ground survey procedures must have a closure ratio of 1:20,000. If the traverse does not meet this closure ratio the traverse must be re-run. This closure ratio applies to unadjusted field work.

All traverses must be closed in the field, prior to turning in the field books. The only acceptable unclosed work are topographic side shots which do not affect the control traverse.

Any person who records data not actually measured in the field in order to make the survey appear to close is committing fraud, and will be subject to serious disciplinary action.
102.08 FIELD NOTES

102.08.1 DEFINITION OF FIELD NOTES

Field notes are a written, legal record, arranged in a manner peculiar to surveying, showing pertinent information, measurements, and observations made in the field during the course of a field survey, to be used and interpreted by a person having basic knowledge of surveying.

The part of this definition that usually causes difficulty is the statement that you must keep your notes so that they can be "used and interpreted by a person having basic knowledge of surveying"; that is, someone other than yourself, a person who may have only a limited knowledge of surveying.

If you will make the following assumptions, and bear them in mind whenever you are keeping notes, you will have laid the ground rules for good note keeping.

Assume that the person using your notes,

a) Has poor eyesight.
b) Is not clairvoyant.
c) Will try to place the blame on the field notes, if anything is wrong.
d) Has never been to the survey geographic site.

If this is the situation, your notes must be,

a) Neat, legible, and clear.
b) Complete and self-explanatory.
c) Honest and self-checking.

102.08.2 IMPORTANCE OF FIELD NOTES

Of all the operations accomplished by a survey party, the most important by far is note keeping. It is obvious that no matter how carefully field work is performed or how proficient the party may be, all is rendered valueless if the field notes are not understood by others.

Frequently, surveyors believe they have done an adequate job of note keeping if the field notes, reinforced by their memories, are sufficiently comprehensive to allow them to be used immediately. Obviously, this is not true. Field notes must stand by themselves. They must be interpreted without recourse to questioning the person who prepared them. Field notes often perpetuate a survey when stakes have rotted and monuments are obliterated.

Incomplete and unclear notes result in the following:

a) Lost time and additional costs for trying to decipher them.
b) Necessity of returning to the job to clarify the notes.
c) Erroneous information being placed on maps which can result in costly design errors.
d) Inability to defend the work to others, especially in court.

e) General mistrust of the field party’s work.

f) Repeating the field work.

*Field books are the responsibility of the recorder and shall be thoroughly checked by the party chief and/or field supervisor who is ultimately responsible.* Actually, there is nothing difficult about keeping good field notes if you understand how these notes are to be used and exercise the same amount of care and judgment in their preparation as you do in other survey procedures.

102.08.3 **GENERAL REQUIREMENTS OF GOOD FIELD NOTES**

**NEATNESS**

a) Use a sharp pencil.

b) Make liberal use of enlarged details; avoid crowding descriptions or sketches.

c) Keep lettering parallel with or at right angles to the feature to which it refers.

d) Before starting a sketch, decide what it is to show and organize it. Do not start in one corner of the page and let it grow. Often you will have a map or plat that is to scale; use it as a guide in selecting the size you want. Sketches should be drawn to approximate scale.

e) If you start a sketch that is not the correct size, void it and start over. Do not try to make the best of a bad start.

f) Do not lay the book where it will become dirty. Keep your hands clean.

g) Keep tabulated figures inside column rulings, not in the border. Keep digits and decimal points in vertical line.

h) Use tools like a plastic circle & symbol template, small protractor, small 30/60/90 triangle, 6” plastic scale & straight-edge, bow compass, pencil pointer or emery paper, etc.

i) Do not write one figure over another.

j) Do not overlap figures on each other or on lines of sketches.

**LEGIBILITY**

a) Use Reinhardt’s style of lettering for legibility and speed.

b) Use a pencil of at least 3-h hardness and press down so indentations are made in the paper, but do not use a pencil so hard that notes are only readable in bright sunlight.

c) Use symbols and codes to keep notes compact.

d) Whenever possible, place North to the top or left of the page, and arrange the sketch to read from bottom to top or right to left on the page.

**CLARITY**

a) Whenever possible start each day’s work on a new page. Show the date, weather, party (name and duty,) and type of instrument. Show date on every page.

b) Plan ahead and select a note form that is appropriate for the particular survey.
c) Vary line weight when appropriate. Very often the use of colored pencils increases clarity, although colored pencils should not be used if the notes are to be Photostatted.
d) Vary size of lettering for emphasis.
e) Arrowheads and leader lines should be light and sharp and held to a minimum.
f) Do not make ambiguous statements.
g) Use proper nomenclature.
h) Place a zero in front of numbers less than one. For example, 0.51 instead of .51, and 00° 01' 09" instead of 0° 1' 9".
i) Exaggerate details on sketches for clarity.
j) Line up descriptions and sketches so that it is clear what the descriptions refer to.
k) Show a North Arrow on all sketches so that it is consistent in the way you record data.
l) Be consistent in the way you record data, for example, in one place do not record the curb elevation above the gutter elevation and on subsequent shots reverse the procedure.
m) Use separate books for different types of work or projects. However there are cases where it is practical to use one book, for example, very small projects, additional survey data, etc. If one book is used, keep different types of work or projects separate. Do not jump around; for example, do not enter traverse control notes, then level notes, then traverse control notes then level notes . . . , keep similar types of work or projects together.

COMPLETENESS

a) Show all pertinent measurements and observations.
b) Record complete data, for example, “Mr. John M. Jones, Project Development Engineer, instructed me . . . ,” not just “PDE instructed me . . . ,” be specific.
c) Review your notes before leaving the job site to be sure they are complete.
d) If you are in doubt about the need of recording any information, record it.
e) Do not leave anything to be assumed.
f) If you intentionally leave something out, say so, for example, “Fence lines along north and west property lines not shown.”

SELF-EXPLANATORY

a) Make maximum use of explanatory notes.
b) Place title at the beginning of each type of work stating what the work is.
c) Show closing data with appropriate arithmetic checks and closures.
d) Record sufficient data so field computations can be checked later in the office.
e) Make your statement positive.
f) When a point is established by record, by prorate, or by intersection, etc., state this fact. For example, “Set No. 5 rebar/ 1 1/2” Alum. Cap by proportional measurement . . .
g) Always cross-reference. When work is continued in another book, or continued from another page, note this fact. Do not leave it to someone to guess.
HONESTY

a) Record exactly what you did in the field at the time you did it, not later from memory.
b) Do not record measurements made by others unless you note this fact.
c) Numbers should show degree of precision. For example, rod readings taken to
the nearest 0.1 foot should be recorded 6.3 not 6.30.
d) If you have measured a distance to the nearest 0.01 feet but question the
accuracy, note this, for example, 321.47' ± 0.10'.
e) **Erasures are not permitted** in field books. If an item is recorded in error, draw
a single line through it without destroying its legibility and record the correct
item above.
f) If it is necessary to void an entire page, write “VOID” across the page, draw
diagonal lines to the corners of the page, and cross reference to the page where
the information was recorded.
g) Record field notes directly into bound field books. Notes are not to be kept on
scrap paper and later copied into field books.
h) Avoid copying notes. If it is absolutely necessary, the part copied must be so
marked and the original submitted as a part of the notes. For example, if the
level notes are kept in a PEG book and the elevations are copied into the field
book, the totals must be marked “copied from PEG notes” and the PEG book
must be submitted as a part of the notes.
i) When adding additional data to notes previously prepared, date and initial each
new entry.
j) Record actual measurements, not what they are supposed to be or summations.
k) Never, under any circumstances, falsify notes. This is fraudulent and dishonest,
and will be subject to serious disciplinary action.

SELF-CHECKING

a) Field work and notes should be planned and kept in such a manner that the work
can be checked without a return visit to the field. The office technician should
be able to take the field notes and by calculation, prove the work to be correct.
For example, in leveling, if you start and end on the same bench mark, the office
technician can check that all your turning point rod readings were read correctly,
but he will not know whether the bench mark you used was the one you
described; there may be two spikes in the same telephone pole. Had you started
at one bench mark and ended on a different one, the office technician could
positively prove your work.
b) In boundary work or control work show the closing angles and distance you
measured, not what they are supposed to be. Obviously, every distance you
measure or rod you read cannot be checked, but the main scheme should be
done in a way that is self-checking. It is a matter of judgment as to what part of
the survey warrants checking. For example, to locate trees by one angle and one
distance may be sufficient, but if you feel that their locations are important,
perhaps you should, in addition, draw a sketch showing the distance between
trees with the end trees tied to the property line. This will allow the office to check the correctness of the locations of all the trees.

c) It is of the utmost importance that, on every survey, check measurements are taken to prove the main scheme of the survey.

102.08.4 GENERAL COMMENTS ON NOTE KEEPING

As you study the sample notes shown within Appendix B, you will observe that all the notes, regardless of the type of survey illustrated or the form and format of the page, have seven things in common. They are neat, legible, clear, complete, self-explanatory, honest, and self-checking. These are the attributes surveyors have in mind when they say “These are good, standard notes.”

There is an additional ingredient necessary in note keeping. That is pride. You should always strive to turn in a set of notes you can be proud of. Your field notes, more than anything else you do, create an impression on others of your ability and integrity.

Do not hesitate to put written explanatory notes or supplemental information pertinent to the survey in the field book, even if it takes several pages. For example, if you are asked by an irate property owner to leave, say so in your field notes. If you are told by a neighbor that they saw someone move a stake, note the neighbor’s name and the pertinent part of the conversation. Remember, the notes are a record of pertinent information, measurements, and observations. If you observe something you feel is pertinent evidence, put this in your field notes; it may win a lawsuit for the Department or may be used to clarify doubtful situations. Often, on a large survey, lasting several months, it is advantageous to keep a daily diary in a separate field book. It is permissible to cross-reference a diary if it is submitted as part of the field notes. A source of much difficulty for the party chief is to be given incomplete instructions about the type and amount of information that is to be shown in the notes. For example, the project work order may read “Complete Bridge Survey” and may fail to mention that extended cross-sections are needed to the west of the bridge to design a detour bridge while construction for the new bridge is being done.

A surveyor should request that all instructions be given to him in the Department’s standard Survey Request Form. See Appendix I for the Department’s standard Location Survey Request Form and the ROW Survey Request Form. Be prepared to ask questions, based on past experience, that will define clearly the extent of the work. In the example stated, the surveyor should have asked specifically “Is there going to be a detour or is there a way of re-routing traffic?” Unfortunately, people ordering field work often assume that the surveyor is clairvoyant, and that he will obtain the exact amount of detail to the proper degree of accuracy when he has been given only sketchy instructions. Often the surveyor attempts to overcome the imprecision of his instructions by locating everything in sight with too high a degree of accuracy.

At this point, the whole subject of note keeping may appear to be an insurmountable problem, but the reader should not be discouraged. An experienced surveyor, given adequate instructions and exercising good judgment, can obtain the proper amount of detail to the proper degree of accuracy. By carefully planning field note form, one can present the information so only the correct interpretation can be made.
102.08.5 SETTING UP A FIELD BOOK

When a surveyor receives a new, blank field book, he is obligated to do the following before entering any survey notes.

a) Note the name of the Highway Department, address, and phone number. If the book is lost, the finder will then know whom to contact to return it. The back of the front cover is an appropriate place for this information. This information must be placed inside the book even though it may also appear on the outside. Information on the outside cover of field books often becomes illegible from handling and use. The information should appear in the following form:

If found please contact:

NM STATE HWY. & TRANS. DEPT.
SURVEYING & LANDS ENGINEERING SECTION
P.O. BOX 1149 - 1120 CERRILLOS RD.
SANTA FE, NEW MEXICO  87504-1149
PHONE NO. (505)827-5638

b) All pages in a book must be numbered before field work begins. When the book is open, you see two pages, one to the left and one to the right of the book binding. Only the right-hand pages are numbered. The number is placed in the upper right-hand corner of the right-hand page. Every pair of pages is so numbered. Thus page 1 has ruled lines on the right-hand side only, the left-hand side being a blank fly leaf which is not used. Also, the last ruled page in the book is a left-hand page opposite either a fly or tables, and this page is not used. Once the pages are numbered, no page can be removed without upsetting the numbering systems.

c) The first three or four pages are reserved for future indexing. For example:

- Title page(s)
- Inventory of Books page(s)
- Index page(s)
- General Field Notes page(s).

Comments. Do not use the fly leaf or the inside of the book covers for notes, calculations, additions, etc. To do so immediately raises a question to the person using the notes: "what is this, and why isn't it on the appropriate page in the notes?" Leaving these pages blank and clean also contributes to the general neatness of the book.

102.08.6 TITLE PAGES

Title pages serve two purposes. First, they divide a field book into sections for easy reference and create a definite place of beginning for each new piece of work. Second, they provide a place for recording certain general information necessary to others using the book.

Each survey should be preceded by a title page recording the following information.
a) Control Number. For example CN 1487
b) Project Number. For example P-BRF-047-1(8)
c) Brief generalized geographic location of the project. For example, US56; 6.4 Mi. E. of Jct. 6th St. (Clayton) Br. No. 1830
d) County.
e) Month(s) and year when survey took place. For example, May - July 1988.
f) Type and number of book and exact location. For example:
   Transit Book, 1 of 2, B.O.S. 10+00 to Sta. 150+00
   Property Book, 2 of 4, Sta. 200+00 to Sta. 300+00
   If there is a possibility of confusion in the work description of the exact location, you may clarify with a vicinity sketch or descriptive location, re: all within Sec. 22, T.26N., R.36E., N.M.P.M..
g) Name and title of the persons who performed the survey. For example, Paul Srinel — Surveyor 1, Robert Garcia — Tech. 1, and Jimmie Ryder — Tech. 3.
h) Brief description of the weather conditions at the time of the field survey. For example, Overcast, Temp. 85°, BP 30.5", Windy (20 - 30 mph).
i) Description of the field equipment used for the field survey. For example, Geodimeter 560 Total Station, Wild NA2000 Digital Level, 3-Trimble 4400 GPS Receivers.

After the title page provide an Inventory of Books page. This is a listing of the type of books prepared for a project. For Example 2 - Traverse Books, 3 - Topography Books, 2 - Property Books, 1 - Level Book, etc.

102.08.7 INDEX PAGES

It is the responsibility of the surveyor to index or see that the field book is indexed upon completion of each survey project or each appropriate increment.

ALL FIELD BOOKS MUST BE INDEXED.

An index is a time-saving device to assist the person using the book to locate quickly what he is looking for. Therefore, to index each page defeats the purpose of indexing, for it would be almost as quick to search through the book as it would be to search through an index listing every page. The index is arranged to identify the work briefly by name or description and to refer to the pages where the work may be found.

If the book is properly subdivided by the title pages, the index need only condense the job designation and work description with the proper page number reference. This will alert the user to the pages he/she is looking for, and when he reads the title page, he will know whether this is the work in which he/she is interested.

Indexes are usually arranged chronologically. As each piece of work is completed, it is indexed. The book may not be used again in the field for several weeks, but, when it is, the next completed increment of work is then indexed.
The arrangement of the index and the information required to be shown in the index vary somewhat, depending on the type and volume of work.

102.08.8 GENERAL FIELD NOTES ARRANGEMENT

After the index comes the general notes.

Each survey is required to contain the following information:

a) The basis of bearing.
b) The basis of elevations.
c) The basis of coordinates.
d) The basis of stationing.
e) Plat & Map references

Transit and Topography Books, all for the above information plus:

a) Name of utility owners.
b) Address of utility owners.
c) Any special notations for the utilities.

102.08.9 ELECTRONIC FIELD NOTES (DATA COLLECTORS)

Electronic field notes gathered using data collectors, hand held computers, or total stations should have the same credibility as field notes taken in a standard field book. Electronic field notes will be accompanied with notes recorded in standard field books. The same care and procedure used with field books should be observed with electronic field notes. Electronic field notes must contain all the information specified above for notes kept in field books.

Electronic field notes together with their accompanying field book(s) must be able to stand alone as a representation of the survey.

The ELECTRONIC FIELD NOTES will contain the following basic information:

a) Control Number.
b) Project Number.
c) Brief generalized Geographic location of the Project.
d) County
e) Month(s) and year when survey took place.
f) Brief description of type of survey and exact location of survey.
g) Name and title of persons who performed the survey.
h) Brief description of weather conditions at the time of the field survey.
i) Description of the field equipment used for the field survey.

The accompanying field book will be set up as described within Section 102.08.5, 102.08.6, 102.08.7 and 102.08.8 of this manual and contain the following project specific information.
a) A description of the occupied station and the associated point number. For example, Sta. Occupied, Pnt. No. 523, #5 rebar with cap (stamped N.M.P.L.S. 7482).

b) A description of the back site station and the associated point number. For example, BS, Pnt. No. 518, #5 rebar with cap (stamped N.M.P.L.S. 7482).

c) A listing of the points set or located from the current instrument setup. For example, Set points #675-#800, all point set are #5 rebar with cap (stamped N.M.P.L.S. 7482) or located points #1009-#1350.

d) Clarifying sketches showing point locations and associated point numbers.

e) In cases where the description of a point set or located does not have an associated descriptor code, the descriptor code used and the physical description of the point will be recorded.

Point Codes used in Electronic Field Notes will conform to the Department’s Point Code Tabulation established within the Department’s Computer Aided Design and Drafting Standards. See Appendix C.

At the end of the day or project, which ever is appropriate for the project, the raw data from the collector shall be downloaded in binary format into a computer for processing. At this time a hard copy of the non-edited file will be acquired and signed by the Party Chief. This will help with the legality of the survey if a problem should arise. A copy of the non-edited file should be copied onto a disk, then both disk and hard copy should be archived for future use. The original file should never be edited; it should be kept just like a original field book. If problems or questions arise over the use of Electronic Field Notes, contact the Department’s Survey Coordinator for clarification.
102.09 CONTROL

The establishment of good control is the anchor of all Department projects. The selection of the appropriate horizontal and vertical datum’s, which the survey task is based on is as important as the first step in any engineering project. Horizontal control for all Department projects will be ground coordinates derived from the New Mexico Coordinate System. Vertical control for all Department projects will be National Geodetic Vertical Datum. By maintaining projects on the New Mexico Coordinate System, all projects can be maintained within the Department’s Graphic Information System (GIS).

102.09.1 HORIZONTAL DATUM

All horizontal positions established will be represented by ground coordinates derived from the New Mexico Coordinate System, as defined within Section 47-1-49 NMSA 1978. As stated within Section 47-1-49 NMSA 1978 the term “New Mexico Coordinate System” includes both the New Mexico Coordinate System of 1927, which is based on the North American Datum of 1927 (NAD27) and the New Mexico Coordinate System of 1983, which is based on the North American Datum of 1983 (NAD83).

When the project unit of linear measurement is based on one (1) Meter, the project coordinate system will be NAD83.

When the project unit of linear measurement is based on one (1) US Survey Foot, the project coordinate system will be NAD83.

The linear measurement unit of one (1) foot, as it relates to one (1) meter for all Department work will be the US Survey Foot.

US Survey Foot:

- 1 foot = 1200/3937 meter
- 1 foot = 0.3048006096012 meter
- 3.280833333333 feet = 1 meter
- 39.37 inches = 1 meter
- 1 inch = 2.5400050801 centimeters

102.09.2 VERTICAL DATUM

All vertical positions will be represented by elevations based on the National Geodetic Vertical Datum (NAVD). The acceptable datum’s for Department projects may be either NAVD29 or NAVD88. The determining factor for the selection of the project Datum will be the published Datum of the nearest control monuments. In cases where the availability of control on either Datum is of equal weight, NAVD88 will be used.

102.09.3 CONTROL MONUMENTS

All Control Monuments will be established by the Department’s Geodetic Control Unit following the procedures stated within Department’s Geodetic Unit Procedural Manual and monumented following the procedures stated within Section 102.19 of this Manual.
102.10  HORIZONTAL POSITION

The horizontal position of objects can be established by one of two methods:

a) Conventional ground survey methods.
b) GPS survey methods.

The following Table provides the criteria for establishing the horizontal position using conventional ground survey methods.

The number of horizontal angles required for the location of each of the following is described as number of angle sets. An angle set is made up of two angles, one angle measured with the telescope direct, and one angle measured with the telescope inverted.

<table>
<thead>
<tr>
<th>OBJECT</th>
<th>MAX. SLOPE DISTANCE</th>
<th>MAX. ROD HEIGHT</th>
<th>No. ANGLES SETS</th>
<th>No. DISTANCES</th>
</tr>
</thead>
<tbody>
<tr>
<td>Control Point</td>
<td>300m/1000'</td>
<td>3m/10'</td>
<td>2</td>
<td>4</td>
</tr>
<tr>
<td>Control Point</td>
<td>600m/2000'</td>
<td>3m/10'</td>
<td>4</td>
<td>8</td>
</tr>
<tr>
<td>Picture Center</td>
<td>450m/1500'</td>
<td>3m/10'</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>Wing Point</td>
<td>300m/1000'</td>
<td>3m/10'</td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>Move Up</td>
<td>450m/1500'</td>
<td>3m/10'</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>Property Corner</td>
<td>300m/1000'</td>
<td>3m/10'</td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>R/W Evidence</td>
<td>300m/1000'</td>
<td>3m/10'</td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>Benchmarks</td>
<td>300m/1000'</td>
<td>3m/10'</td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>Topo. Feature</td>
<td>300m/1000'</td>
<td>4.5m/15'</td>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td>Utility Feature</td>
<td>300m/1000'</td>
<td>4.5m/15'</td>
<td>2</td>
<td>1</td>
</tr>
</tbody>
</table>

The maximum slope distances tabulated above are guidelines, if your field distances are within 50m/150', you will be meeting the tolerances required by the Department.

Establishing horizontal positions using GPS survey methods will follow the procedures and criteria stated within the Department’s Geodetic Unit Procedural Manual. See Appendix A.
102.11 VERTICAL POSITION

The vertical position (elevation) of objects can be established by one of two methods:

a) Conventional ground survey methods.
b) GPS survey methods.

All level traverses, without exception, will begin and end (close) on a benchmark with a published elevation on the project datum.

The following criteria for establishing the elevations of objects, using conventional ground survey methods are to be used for all Department projects.

<table>
<thead>
<tr>
<th>Project Benchmarks</th>
<th>Single-wire Leveling</th>
</tr>
</thead>
<tbody>
<tr>
<td>Control Point</td>
<td>Single-wire Leveling</td>
</tr>
<tr>
<td>Picture Centers</td>
<td>Single-wire Leveling</td>
</tr>
<tr>
<td>Inverts</td>
<td>Trigonometric Leveling</td>
</tr>
<tr>
<td>Wing Points</td>
<td>Trigonometric Leveling</td>
</tr>
<tr>
<td>Moveup</td>
<td>Trigonometric Leveling</td>
</tr>
<tr>
<td>Property Corner</td>
<td>Trigonometric Leveling</td>
</tr>
<tr>
<td>Topographical Feature</td>
<td>Trigonometric Leveling</td>
</tr>
<tr>
<td>Ground/Pavement Shot</td>
<td>Trigonometric Leveling</td>
</tr>
<tr>
<td>Utility Feature</td>
<td>Trigonometric Leveling</td>
</tr>
<tr>
<td>Overhead Heights</td>
<td>Trigonometric Leveling</td>
</tr>
</tbody>
</table>
102.12 LOCATION SURVEY

The American Congress on Surveying and Mapping (ACSM) defines topography as “The features of the actual surface of the earth consider collectively as to form. A single feature such as a mountain or valley is termed a topographic feature. Topography is subdivided into hypsography (the relief features), hydrography (the water and drainage features), and culture (man-made features).”

Location surveys are reconnaissance surveys, which are used to gather sufficient topographical data to map the Department’s project corridor. The location of the topography can be accomplished in three ways:

a) Aerial photogrammetry methods
b) Conventional Ground survey methods
c) GPS survey methods

Mapping of projects can be developed from data gathered by conventional ground surveys alone, from data gathered by aerial photogrammetry methods alone and from data gathered by aerial photogrammetry methods supplemented by ground survey data. The criteria for gathering data by ground surveys does not change for stand alone projects or for supplementing aerial mapping.

Location surveys include establishment of horizontal and vertical control, i.e., bench marks and GPS control. The survey centerline should be staked in the field and shown in a drawing file. All survey information will be incorporated into a survey notes sheet that will become a part of the construction plans prepared for the construction phase of NMSHTD roadway projects.

Location surveys establish positions for the following types of topography.

- Terrain, Topography & Planimetry
- Utilities
- Structures
- Turnouts
- Drainage Areas
- Railroads

102.12.1 TERRAIN, TOPOGRAPHY & PLANIMETRY

The party chief must have a complete understanding of the Department’s design project. This knowledge will enable the surveyor to use his/her experience in gathering the most effective data.

When collecting terrain, topography and planimetry data, the criteria of the amount of data required/requested for a project will be described as density of points, not as cross-sections. Point density is described as the distance between shots which are taken to describe terrain, topography and planimetry. Terrain, topography and planimetry data should be gathered in such sufficient quantities, that mapping developed from this data meets the requirements of the National Map Accuracy Standards.
The following Table describes the point density required for Department projects:

<table>
<thead>
<tr>
<th>PROJECT</th>
<th>POINT DENSITY</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Urban</strong></td>
<td></td>
</tr>
<tr>
<td>2m or 1ft contour interval</td>
<td>10m/30ft</td>
</tr>
<tr>
<td>1m or 5ft contour interval</td>
<td>15m/50ft</td>
</tr>
<tr>
<td>topography/planimetry only</td>
<td>15m/50ft</td>
</tr>
<tr>
<td><strong>Rural</strong></td>
<td></td>
</tr>
<tr>
<td>2m or 1ft contour interval</td>
<td>10m/30ft</td>
</tr>
<tr>
<td>1m or 5ft contour interval</td>
<td>15m/50ft</td>
</tr>
<tr>
<td>3m or 10ft contour interval</td>
<td>30m/100ft</td>
</tr>
<tr>
<td>topography/planimetry only</td>
<td>30m/100ft</td>
</tr>
</tbody>
</table>

**Vertical breaks** in the terrain equal to and greater than 3 of the contour interval must be picked up regardless of the point density criteria. All horizontal breaks in the topography and planimetry must be picked up regardless of the point density criteria.

When gathering data to be used in the construction of a Digital Terrain Model (DTM) the definition of the vertical break lines (fault lines) are extremely important. Points shot along a vertical break line must be within the recommended point density.

When establishing the location of breaklines along curves with short radii, the distance between shots must be shortened. The shots on theses types of curves must produce short chords, this will enable the modeling software to create breaklines, which are line segments, that closely represent these curves. Shots along parallel features, i.e. top of curb and gutter lip, must be chosen carefully so the breaklines will not cross within the DTM.

Terrain, topography and planimetry data collected will be coded following the code criteria established within the Department’s Computer Aided Design and Drafting (CADD) Standards. See Appendix C for the Department’s standard Point Code Tabulation.

102.12.2 **UTILITIES**

The utility survey must be completed as a part of the location survey. The utility survey will conform to the criteria within the Department’s Railroad and Utility Section Manual. See Appendix D.

Prior to the beginning of the utility survey, contact must be made with all utility companies. All available record/as-built utility drawings must be obtained prior to the beginning of the utility survey.

Notification of the proper underground utility location agency (Blue Stakes or the subsurface utility contractor) must be given so all underground utilities will be marked prior to the beginning of the location survey.
In addition to locating all paint marks identifying underground utilities (marked by either Blue Stakes or the subsurface utility contractor), all surface evidence of utilities must be located. Evidence of utilities include:

- Manholes
- Valves
- Risers
- Pull Boxes
- Power/Light Poles
- Overhead Lines
- Signs
- Surface Scars
- Pavement Cuts and Patches
- Old paint marks
- Old lath and flagging
- Well Houses
- Pump Jacks
- Water/Oil/Gas Tanks
- Exposed pipes
- Vaults
- Towers

Utility surveys in rural areas must consider the possibility of private (farm/ranch) utilities. Evidence of private (farm/ranch) utilities include:

- Windmills
- Water Tanks
- Stock Tanks
- Surface Scars
- Pavement Cuts
- Irrigation Facilities (pumps, stand pipes, etc.)

All utility evidence must be located both horizontally and vertically. Heights to overhead line(s) must be established at the lowest point where the overhead line(s) cross streets, roads, highways, and alleys. Where multiple lines are on the poles the number of lines will be recorded.

Many times a utility will cross the project corridor. In these cases, evidence of the utilities must be located (horizontally, vertically and with an invert if applicable) on each side of the project corridor.

Utility data collection will be coded following the code criteria established within the Department’s Computer Aided Design and Drafting (CADD) Standards. See Appendix C.
The following "metadata" (data about the data) shall be submitted with each utility survey deliverable, preferably as a separate text file on the submittal media. This information is critical to the Department so as to properly archive the data, as well as to provide follow-up capability in the event problems arise with the data.

- District Utility Permit Number.
- Name, address and phone number of the responsible Party Chief and/or Field Supervisor.
- Date of completion of the survey.
- Equipment used to conduct the survey (e.g. total station, GPS, spirit level).
- Control points used to tie the survey to the NM State Plane Coordinate System, NAD83, and to the North American Vertical Datum 1988 (NAVD88).
- The project ground to grid factor.
- The project ellipsoid/elevation factor.

102.12.3 STRUCTURES

The proper position and detail measurements of existing structures is extremely important to the design of a project.

A detailed field sketch must be completed for all structures. A field sketch must be made and dimensioned for the upstream view, the downstream view, the plan view and if applicable the elevation view of the underside of all structures. Each sketch must show the position and point number of all shots which were taken to establish the location of the structure, measurements taken to dimension the structure, measurements and/or shot positions (and point number) to establish the skew of the structure. The party chief must assume that the designer and/or engineer will not see the structure in the field so the field sketch must contain sufficient detail that the designer will be able to draft the structure and the engineer will be able to design the structure. Structures are to include, but are not limited to, the following:

- Bridges
- Viaducts
- Tunnels
- Headwalls
- Wingwalls
- Junction Boxes
- Culverts

When structures are associated with drainage areas the type and size of the structure must be stated within the field sketch as well as the amount of silt that is adjacent to the upstream and downstream ends of the structure.

Figure 1 identifies the typical components of a bridge which must be located and shown on the field sketch of all bridges.
102.12.4  TURNOUTS

Turnouts include, but are not limited to: driveways to adjacent properties, access roads for crossing utilities, access roads for crossing railroads, and access roads for crossing canals, channels or laterals.

Topographical data must be surveyed for a minimum of 30m/100' outside of the project corridor, or a sufficient distance so as to establish the skew of the turnout. The width of the turnout corridor is defined as the driven path plus 15m/50' on each side.

The density of points should meet the requirements for the project as established within the Point Density Table in Section 102.12.1.

102.12.5  DRAINAGE AREAS

Drainage areas include, but are not limited to: swales, arroyos, channels, river beds, and detention/retention ponds.

Topographical data must be surveyed for a minimum of 60m/200' upstream and downstream of the project corridor for swales, arroyos, channels and riverbeds, or a sufficient distance to establish the skew and slope of these drainage areas. The width of the survey corridor for these types of drainage areas is defined as; from outside toe to outside toe, plus 15m/50' on each side.

For detention/retention ponds, the topographical data must be surveyed within the pond plus a minimum of 30m/100' beyond the outside toe of the pond. If applicable, the depth of the water within the pond will be determined.

The density of points should meet the requirements for the project as established within the Point Density Table in Section 202.12.1.

102.12.6  RAILROADS

Contact with the owner of the railroad must be made prior to surveying within the railroad right-of-way. The Department’s right-of-way is subject to the rights of the railroad right-of-way.

Extreme care must be taken when working within the railroad right-of-way. The following safety precautions are necessary when working within the railroad right-of-way:

- Do not wear red or use red flags. Red will cause the train to stop.
- Do not drive vehicles across tracks except at constructed or designated crossings.
- Always contact the railroad owner before beginning a survey within the railroad right-of-way.
- Always watch for approaching trains. Approaching trains cannot be heard until they blow their whistle.
- Always leave the railroad right-of-way for passing trains. This includes removing equipment from the railroad right-of-way.
• Do not pull a steel chain across the tracks. Bridging the two rails with a steel chain may cause the railroad signal to activate.

The survey corridor for railroads is defined as a minimum of 60m/200’ outside of the project corridor, or a sufficient distance as to establish the skew of the railroad crossing. The width of this corridor is defined as 15m/50’ beyond the toe of slope of the railroad bed.

The topographical data required within the railroad survey corridor include, but not limited to:

• Top of railroad bed.
• Toe of railroad bed.
• Top of rail or rails in cases of multiple tracks.
• Any and all utilities within the railroad right-of-way.
• Drainage structures and facilities within or crossing the railroad right-of-way.
• Railroad station mark and/or mile marker.

The density of points should meet the requirements for the project as established within the Point Density Table in Section 102.12.1.

Before a location survey is considered complete and before the crew leaves the site the project surveyor (survey party chief) must complete the Department’s standard Check List for Location Surveys. See Appendix V.
PHOTOGRAMMETRY

Photogrammetry is the science of obtaining measurements by means of photographs for mapping, cadastral purposes, design, and computation of earthwork and other construction quantities. Photogrammetry will be used by the Department for, but not limited to: drainage studies, corridor studies, and traffic studies. Photogrammetry as performed by the Department or by consultants must meet or exceed National Mapping Standards.

The Department’s flight heights for photogrammetry are 460m/1500’ and 540m/1750’ above terrain. For projects which require a different flight height, the survey criteria will be established by the Department’s Photogrammetry Section and set forth within the survey request for that specific project.

GROUND CONTROL FOR AERIAL PHOTOGRAPHY

Prior to beginning the ground control survey, a Survey Permission Form must be signed by the property owner/occupant. Copies of this form must be kept on file within the Department’s Surveying and Lands Engineering and within the field files. See Appendix E.

Ground control for aerial photography can be established by either conventional ground survey methods or by GPS survey methods. When using GPS survey methods the survey procedures will conform to the Department’s Geodetic Unit Procedural Manual. See Appendix A. When using conventional ground survey methods the survey procedures will conform to Sections 102.10 and 102.11.

PHOTO CONTROL LAYOUT

Photo control will begin 300m/1000’ before the B.O.P. and end 300m/1000’ after the E.O.P. or at the interval spacing of picture centers for the appropriate flight height at either end of the project, unless specified differently within the project’s survey request.

A set of photo control points consist of two (2) control points, one (1) photo center point and one (1) wing point alternating left or right.

All aerial photography projects will begin and end with a set of photo control points. The beginning set of control points will have the photo center paneled as an “Entry” point. The ending set of control points will have the photo center paneled as an “Exit” point.

Wing points be set at 90° (±7°) from the line between consecutive photo center points. Wing points will be set 215m/700’ to 230m/750’, ±15m/50’, left and right of the photo center point for both the 460m/1500’ flight height and the 540m/1750’ flight height.

For photography with 460m/1500’ flight height and the 540m/1750’ flight height a photo center must be set every 300m/1000’.

All photo control picture centers will be monumented with a standard Department monument, unless field conditions make this impractical or warrant otherwise. See Section 102.19.1 for the
standard Department monument.

102.13.3 PHOTO CONTROL POINT PANELS

Care must be taken in the timing of the construction of the photo control panels. Panels should not be constructed so far in advance of the actual flight of the photography that they may be disturbed or destroyed by weather conditions, livestock, traffic and children. Even with good planning weather often delays the photography flight, so a check of all panels prior to the photography flight must be made.

Panels will be constructed from white opaque polyethylene film (Visquine), with a minimum thickness of 5 mils, and a minimum width of 9 inches. Panels may also be painted on pavement using a quality white paint, with a minimum width of 9 inches.

See Typical 1500/ 1750’ Flight Picture Center Layout for panel configuration.

The table below provide the dimensions for the panel configurations shown within Typical 1500/ 1750’ Flight Picture Center Layout.

<table>
<thead>
<tr>
<th>Flight Height</th>
<th>1,500’ (460m)</th>
<th>1,750’ (535m)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Max. Dist. to Picture Centers</td>
<td>1000’ (300m)</td>
<td>1000’ (300m)</td>
</tr>
<tr>
<td>Max. Dist. to Wing Points</td>
<td>700’ (215m)</td>
<td>800’ (250m)</td>
</tr>
<tr>
<td>Entrance and Exit “X”</td>
<td>6’ “X”</td>
<td>6’ “X”</td>
</tr>
<tr>
<td>Wing Points</td>
<td>6’ “T”</td>
<td>6’ “T”</td>
</tr>
<tr>
<td>Panels</td>
<td>10’ legs</td>
<td>10’ legs</td>
</tr>
</tbody>
</table>

For safety reasons and in consideration to the property owner(s)/occupant(s) all panels will be removed after receiving notification from the photogrammetrist that the aerial photos are secured and justifiable.

Project control points which fall within the aerial photography corridor will also be paneled, using the proper configuration shown in Typical 1500/ 1750’ Flight Picture Center Layout.

102.13.4 PHOTOGRAMMETRY SUPPLEMENTAL LOCATION SURVEYS

Even with the advances in Photogrammetry today, the computer model created from aerial photography must be enhanced with topographic ground surveys. Areas that require this supplemental location surveys are:

- Tie in points, e.g. B.O.P., E.O.P., and intersecting streets/roads.
- Railroad crossings.
- Structures
- The centerline of the existing driving surface.
• Obscured areas.
• Drainage areas with minimal slopes.
• Areas below the water surface.
• Longitudinal interfaces for widening, etc.

Supplemental location surveys will be completed following the criteria within Sections 102.10, 102.11, and 102.12.1.
Typical 1500/1750'
Flight Picture Center
Layout

Approx. 1000' (300m)
Approx. 700-800'
(220-250m)
Approx. 1000' (300m)
Approx. 700-800'
(220-250m)
Approx. 1000' (300m)
Approx. 700-800'
(220-250m)
Approx. 1000' (300m)
Approx. 700-800'
(220-250m)

6 ft. cross with 2' taped cross at point in 9 in.
wide plastic film

6 ft. tee with 2' taped tee at point in 9 in.
wide plastic film
The primary responsibility of the New Mexico State Highway & Transportation Department is to design, build, and maintain a safe and efficient transportation system for the traveling public throughout the State of New Mexico. The Department has been performing Right of Way Surveying and Mapping necessary for its highway improvement projects for more than sixty years. It has been a fairly routine and stable process incorporated within funded design, construction, and maintenance improvement programs for the state's highway transportation system. Due to an expanded construction and design program in the late eighties, the Department began to solicit proposals for Right of Way Surveying and Mapping and today consultant services account for a significant portion of the overall project design and right of way related work. Special considerations and requirements to Right of Way surveying were introduced in 1994 by the New Mexico Board of Registration for Professional Engineers and Surveyors. The Board approved the "Minimum Standards for Surveying in New Mexico" effective February 2, 1994. Rule 500.6 and 500.7 of subject standards define the requirements for Right of Way Surveying in our state. The Board requirements and the Department's design development process, of which Right of Way surveying is a part, did not fit well. Since that time the department has refined an internal process that conforms to the minimum standards and reduced impacts on our prime responsibility to efficiently expedite proposed highway improvement projects to construction and beneficial use by industry and the public. Some Right of Way Surveying related projects may be necessitated by District construction or maintenance projects, but they are in general a small percentage of the Department's Right of Way Surveying, Mapping, and Monumentation work being performed at this time. Most Right of Way surveying projects are a result of a need to address the Department's STATE TRANSPORTATION IMPROVEMENT PROGRAM (STIP). Approaches and topics covered are an effort to clarify the process and to assist with design related right of way acquisition considerations and not intended to replace or nullify the use of sound Right of Way surveying practices and procedures.

In addition, the information tendered herein is not intended to substitute for maintaining close communications with appropriate Surveying and Lands Engineering Section staff. On the contrary early and close communications with Department staff are required and should be pursued. Knowledge of the project development/design process is an excellent benefit in expediting a right-of-way project. It's not out of the ordinary for the design development and the right of way acquisition process to extend over a period of eighteen to twenty-four months. Early determination of design-impacted areas or properties is essential to efficient project development. The design development process is complex and scheduled site inspections serve to gauge the percent design completion milestone for a project. Attachment 1 is included herein to facilitate in the overall visualization of the project development and Right of Way surveying, mapping, and monumentation process. However, close coordination with the Project Development Engineer and Surveying and Lands Engineering Section staff cannot be overemphasized. Although most of the following information following is outlined for in-house Right of Way surveying projects most of the information can be used to the benefit of consultant Right of Way Surveyor contractors performing this work for the Department. When in doubt contact with the Survey and Lands Engineer or designee is recommended.
102.14.1  DEFINITIONS AND TERMINOLOGY

Some of the definitions referred to below are a blend of Right of Way related definitions straight from Black’s Law Dictionary tempered with working terms and terminology in use at the Department.

- **Eminent domain** - The power to take private property for public use by the state, municipalities, and private persons or corporations authorized to exercise functions of public character.—. In the United States, the power of eminent domain is founded in both the federal (Fifth Amendment) and state constitutions. However, the Constitution limits the power to taking for a public purpose and prohibits the exercise of the power of eminent domain without just compensation to the owners of the property which is taken. The process of exercising the power of eminent domain is commonly referred to as “condemnation” or “expropriation”.

The right of eminent domain is the right of the state, through its regular organization, to reassert, either temporarily or permanently, its dominion over any portion of the soil of the state on account of public exigency and for the public good.

- **Sovereign Power** - That power in a state to which none other is superior or equal, and which includes all the specific powers necessary to accomplish the legitimate ends and purposes of government.

- **Partial taking** - The taking of a part of an owner’s property under the laws of eminent domain. Compensation must be based on damages or benefits to the remaining property, as well as the part taken.

- **Right of Way parcel** - A parcel of land to be acquired in fee simple for public highway related purposes.

- **Easement** - A right of use over the property of another. An interest which one has in the land of another. A primary characteristic of an easement is that its burden falls upon the possessor of the land from which it issued and that characteristics is expressed in the statement that the land constitutes a servient tenement and the easement a dominant tenement.

- **Right of Way** - Term “right of way” sometimes is used to describe a right belonging to a party to pass over land of another, but it is also used to describe that strip of land upon which railroad companies construct their road bed, and, when so used, the term refers to the land itself, not the right of passage over it.

- **Construction Maintenance Easement. (CME)** – A permanent easement for construction and maintenance of highway project improvements.

- **Temporary Construction Permit (TCP)** - A written permission to temporarily utilize an area outside the highway Right of Way corridor.
• **Non-Right of Way Parcel (NRW)** - A parcel of land acquired in fee simple for purposes not related to or necessary for highway improvement features additionally to reduce the damages the condemnor may be required to pay.

• **Encroachment** - An illegal intrusion in a highway corridor with or without obstruction.

• **Title Report** - A condensed history of the title to land consisting of a summary of the material or operative portion of all the conveyances of whatever kind or nature, which in any manner affect said land or any estate or interest therein together with a statement of all liens, charges, or liabilities to which the same may be subject, and of which it is in any way material for purchases to be appraised. An epitome of the record evidence of title including maps, plats, and other aids. The period of time covered in the chronology of a title report is thirty-three years although a longer period of history may be necessary to substantiate chain of title, property boundaries, or to discover prior public right of way documentation.

• **Memorandum of Understanding (MOU)** - The Department has various and numerous MOU's with Federal agencies, state agencies, and quasi-public agencies. The MOU's layout the procedure and parameters to be considered within the overall process of obtaining highway right of way concurrence for lands under the jurisdiction of affected governmental and quasi-governmental agencies. The Lands Engineering Unit of the Surveying and Lands Engineering Section should be contacted for these applicable documents as well as clarification of the particular surveying and mapping process.
102.15  RIGHT OF WAY ACQUISITION PROJECTS

These types of projects incorporate the entire focus and requirements of Rule 500.7 of the "Minimum Standards for Surveying in New Mexico" and will typically necessitate early dialogue and communications with the Surveys and Lands Engineer. Two major questions to be addressed as early as practicable are: 1.) Does the Department have documented Right of Way for the project corridor proposed to be improved?  2.) Will the proposed design parameters impact the whole length of the project corridor on both sides, only one side, or only isolated or separated locations spaced along the corridor? These two early considerations will dictate the scope of the proposed Right of Way Surveying, Mapping, and Monumentation work for the project and will dictate project development time frame factors as well. At or about the Field Design Inspection (Preliminary Design Inspection) stage of a project, a detailed right of way needs assessment can be made by the Project Development Engineer and a Request for Right of Way Survey and Title Reports can be initiated.

102.15.1  RESEARCH

A Right of Way research package will be prepared by the Surveying and Lands Engineering Section's Research Unit. The Research data project file will be prepared for review and use by the Right of Way surveyor assigned the project. The contents of the Research data file should include all information on existing Right of Way, such as Right of Way maps and documents, county assessor maps copies with correlated current ownership deeds for all impacted properties, copies of plats, easements deeds, monument locations information, etc. Having reviewed all information available, the surveyor will in most cases meet with the Project Development Engineer to discuss the project scope of work as proposed and proceed to schedule the field work necessary.

102.15.2  RIGHT OF WAY FIELD SURVEYING

One of the most important initial responsibilities of the Right of Way Surveyor in the field is to be able to physically locate the existing Right of Way limits. This involves an analysis of both sides of the highway corridor. This is not an easy task primarily due to the fact that most Right of Way acquisition documents in the past was based on a strip conveyance on centerline of construction stationing. It was not monumented in the field. Since the conveyance documents for the Right of Way are what the Department actually acquired, these documents must be considered in the efforts to bring up existing Right of Way limits. Using Right of Way maps alone are not a recommended stand alone step in the efforts to bring up existing Right of Way lines. Further, T rails found throughout our highways are essentially station markers and depending on the field survey evidence and analysis, they can be become Right of Way Markers if accepted by the Department surveyor or they may be project station marker if rejected. The surveyor should be aware that although field crews may have originally staked the proposed locations for these T rails for installation during construction, they were typically set by the construction contractor for the project and paid for "per each". Another historic considerations that the surveyor should be aware of is that the actual Right of Way line could by prior drawings and specifications be located further out than the rail placement.
A second very important responsibility for the surveyor is to determine the direction of intersecting property lines for Right of Way impacted properties. The Department and the Right of Way surveyor are not required to do the boundary surveys or property surveys of Right of Way impacted properties, only to determine the bearing or direction of the intersecting property line in relation to the existing right of way line. In actuality however, the surveyor may need to support his methodology for locating the impacted property line direction and most times will need to examine closely the intersecting leg of the property boundary or he/she may need to survey additional property boundaries in order to be able to defend his/her intersecting boundary location determinations.

The Right of Way surveyor also will need to locate all other features that may reflect on the status and value of the properties. Fence locations, utility poles, walls, structures, septic tanks, wells, orchards, existing easements, etc. need to be located although some of these features may not be ultimately mapped. All land features, improvements, or encumbrance which may effect property values/valuation's need to be shown. On impacted adjacent properties with vague definition or a property line possibly in dispute, the surveyor should address this problem in the field. Executed affidavits by abutting property owners can do much to mitigate a property line. If an area is in dispute or of unknown ownership, that information should be shown if not resolved by the surveyor's best efforts.

All encroachments into public Right of Ways should be shown and described as should all areas which the Department or the public may have established use to or that has been maintained over the years. This information on areas which may be used by public and or claimed by the Department need to be brought to the attention of the Survey and Lands Engineering staff. Upon review of all information including aerial photography, maintenance records reports, etc. with the Department's legal counsel, the Surveys and Lands Engineer will submit written direction to the Right of Way surveyor on how best to treat a particularly difficult situation. The surveyor will finalize all fieldwork including ties to existing monuments or monuments set and submit the Right of Way Field Survey file and data to the Research Unit Surveyor for mapping.

102.15.3 RIGHT OF WAY SURVEY MAPPING

Under the direction of the Right of Way field surveyor the Research Unit will develop and complete the Right of Way Survey Map which will serve as the base map for use by the Lands Engineering Unit in the preparation of the Final Right of Way Maps and documents. Thirty-three year title reports originally requested from the Lands Abstracting Unit of the Right of Way Bureau should be available at this time and should be reviewed by the Right of Way field surveyor in order to try to resolve any chain of title and intersecting property line questions.

Having resolved the Right of Way survey field data, the Research Unit will finalize the Right of Way Survey Map complete with annotation of existing Right of Ways, land ownership's, and impacted parcel property intersections. Although the Right of Way maps may show existing Right of Way documentation as crosshatch on the maps, the actual Right of Way limit lines need
to represent actual and real locations on the ground. Necessary map notes, legend, document and plat references, etc. should also be placed on the map. Most of the plat requirements as called for in Rule 500.7 should be on the map as well as specific prescriptive use and encroachment information as necessary. This document is essentially the base map for the Final Right of Way maps and legal descriptions which may ultimately become a part of a condemnation proceeding. The Right of Way Survey Map should be certifiable by the Right of Way surveyor as an accurate delineation of a field survey at an interim stage of project development. The Right of Way Survey Map file is electronically forwarded to the Lands Engineering Unit for their use in the preparation of the Final Right of Way Maps and documents that will be used for the acquisition of project related Right of Way.

102.15.4 **RIGHT OF WAY MAPPING**

Upon receipt of the completed Right of Way Survey Maps the Lands Engineering Unit will prepare pre-final Right of Way Maps delineating the proposed right of way requirements for review at the Grade & Drain Inspection (Pre-Final Inspection). Immediately following this inspection the Project Development Engineer/Designer will forward in writing the final project Right of Way requirements to the Lands Engineering Unit Supervisor. The Lands Engineering Unit will complete the final Right of Way maps and documents. Upon assignment of a Final Right of Way map date and signature by the Surveys and Lands Engineer, copies of the final Right of Way maps and documents will be forwarded to the Right of Way Bureau for initialization of the Right of Way acquisition process. All revisions, additions, etc. necessary during the Right of Way acquisition process will be addressed by written request to the Lands Engineering Unit Supervisor. Updated maps as necessary will be kept on file at the Lands Engineering Unit repository.

102.15.5 **RIGHT OF WAY CERTIFICATION**

Right of Way certification is an official written notification of the status of the Right of Way acquisition phase and is issued by the Right of Way Bureau staff. Under no circumstances should project site Right of Way monumentation occur prior to the certification notice and then only in accordance with the conditions of the certification letter. Field surveying and mapping for the final monumentation may occur prior to Certification but the setting of monuments delineating new Right of Way acquired under the proposed project will occur only after Certification that in fact Right of Way needed for the project has been acquired by appropriate conveyance document. The Lands Engineering Unit and Monumentation Unit staff both track and file project Certification notices for notification of project surveyors performing the monumentation for the project prior to commencement of construction.

102.15.6 **RIGHT OF WAY MONUMENTATION**

Right of Way monumentation serves to locate the Right of Way limits related to existing and new Right of Way acquisitions obtained for the construction of a project. It also serves to give public notice and is the final step in a long process that is ultimately intended to conform with Rules 500.6 and 500.7 of the “Minimum Standards for Surveying in New Mexico”.

SURVEY HANDBOOK 39 MAY 2000
Following the completion of the Final Right of Way Maps and documents, the Monumentation Unit of the Surveying & Lands Engineering Section begins the preparation of the Pre-Final Monumentation Map. The unit staff works under the direction of the Right of Way Surveyor who will ultimately perform the field monumentation necessary, certify the final Monumentation Map, and provide final certified original mylar’s for official recordation in the County Clerk’s Office of the County where the project is located. The Pre-Final Monumentation Map should be ready by the time the Right of Way Certification letter is issued. The Surveyor can then perform the field monumentation work, provide revisions to the Pre-Final Monumentation Map if applicable and complete the Map. Actual monumentation of Right of Way limits for the project needs to be performed as are the points where new Right of Way lines intersect property lines. When locating and monumenting existing Right of Way limit lines only, monuments at intersecting property lines need not be set. Specifics as to monumentation standards, mapping requirements, etc. can be found herein Article 102.19. Close and early coordination by the surveyor with the Monumentation Unit Supervisor are essential for an efficient work product that is to be completed prior to the award of the project to the construction contractor. Upon recordation of the Final Monumentation Map, the Monumentation Unit Supervisor will distribute mylar reproducible copies to the District office or consultant contract Right of Way Surveyor for their indexing and use.
102.16 EXISTING RIGHT OF WAY SURVEYS

The Department often has to locate existing Right of Way limits on many of our State Roads. For example, presently on proposed improvement projects located in urban areas our first step is to locate existing Right of Way limits for the length of the project. Typically in urban areas, proposed physical improvements include curb and gutter, sidewalks, ADA required access ramps, driveway pads, street lighting pedestals, signalization improvements, etc. and are all usually close to the Right of Way lines. Since very few urban area highways are monumented and because most prior R/W acquisitions resulted from strip conveyances based on an unmonumented centerline of right of way or construction, the need to locate the Right of Way limits for the project and for posterity are necessary. The approach then is to perform an existing Right of Way survey. Following an in-depth analysis of the field evidence and all documents available, an existing Right of Way Map is prepared by the Right of Way surveyor. Notes and data on the map will shed light on the data used to support the mapping. The Right of Way surveyor certifies the existing Right of Way Map and the Monumentation Unit staff will proceed to record same at the County Clerk's office where the project is located. Future Right of Way acquisition mapping needed for a proposed project in the mapped area will utilize the recorded existing Right of Way map as the base map.

102.16.1 RESEARCH

A Right of Way research package similar to that described in 102.15.1 should be prepared. In addition to the research data necessary for a project, a title report for key corridor parcels abutting the existing Right of Way should be requested from the Lands Abstracting Unit of the Right of Way Bureau. The requested title report(s) should date back a minimum of sixty years. A title report to the first recorded document or inception may be necessary. The importance of thoroughly researching our Records Document repository in Room B-17 of the General Office as well as District office records can not be overemphasized. All private survey plats available in the area available should be a part of the research package used by the surveyor.

102.16.2 LOCATING EXISTING RIGHT OF WAY LIMITS WITH DOCUMENTATION

Having obtained all research information necessary the Right of Way surveyor will proceed to perform the Right of Way field survey which will locate all field evidence present to assist with the difficult task of locating existing Right of Way limits. Existing fencing, found monuments, possible encroachments, etc. should be located since all data available will serve to support the final location of the centerline of Existing Right of Way and Existing Right of Way limits. It is important to note that although Surveying and Lands Engineering Section surveyors are performing most of these types of surveys, the District surveyors may be also assigned at times to perform this work. It is recommended that the District surveyor coordinate this type of project with the Survey and Lands Engineering Section staff in order to assure that all available documentation and legal review of the proposed project parameters are addressed fully. For Consultant surveyors working under contract or subcontract with the Department, early contact with the Survey and Lands Engineering Section staff is required. Under no circumstances should a consultant surveyor perform or finalize, or record an existing state road survey location without
first submitting formally same to the Survey and Lands Engineer for review and concurrence. It is also very important to be cognizant of the sovereign power definition in favor of the state in this particular type of Right of Way survey. As noted in this particular case, if the Department has documented Right of Way for a portion of highway then the state’s right to that right of way corridor is absolute over the right of private land ownership’s rights. For example, if the Department has existing Right of Way acquisition documentation for a strip of land one-hundred foot wide along NM 4084 then that is what the public right of way is—one-hundred feet—not 98.5 or 99.5. The public Right of Way is 100.00 feet minimum and possibly more if a case can be made for prescriptive use, acquiescence, or statute. The private land rights are subservient to the public’s interest/right. Once the existing Right of Way is properly located, then an Existing Right of Way/Monumentation Map is prepared, reviewed, certified, and recorded at the County Clerk’s Office where the highway corridor is located. After recordation by the Monumentation Unit staff of the Surveying and Lands Engineering Section appropriate distribution of mylar’s will be carried out.

102.16.3 LOCATING EXISTING RIGHT OF WAY LIMITS WITHOUT DOCUMENTATION

When in-depth research by the Research Unit/ Lands Engineering Unit of the Surveys and Lands Engineering Section and Lands Abstracting Unit of the Right of Way Bureau for a state highway corridor yields no evidence of documented existing Right of Way, the Right of Way Surveyor will gather all information available pertinent to the project limits and proceed to utilize the process described in 102.16.1 and 102.16.2. All available field survey evidence will be obtained and refined to delineate and determine existing roadway features related to the travel surface such as fences, existing bar ditches, road maintenance areas, prescriptive use areas, weed cutting/mowed areas, existing monuments, private property monuments, etc. which can serve to help bring up existing Right of Way limit lines. Aerial photography is also a tool readily available or can be used to substantiate historical public use areas. Again, review and concurrence by the Survey and Lands Engineer/designee is required. If necessary the Survey and Lands Engineer will present possible contentious scenarios to the Department’s legal counsel staff for guidance and direction. When the surveyor has necessary concurrence on the existing Right of Way limit boundaries, the surveyor will map the project for appropriate recordation and public notice at the County Clerk’s Office where the project is located. The Monumentation Unit of the Survey and Lands Engineering Section will do the recordation and appropriately distribution copies of the recorded maps to the District office, Monumentation Unit, etc.
RIGHT OF WAY ACQUISITION PROCESS CONSIDERATIONS

People understand what they see more clearly and easily than what they only hear or read. Demonstration through the use of pictures or drawings is vital in developing, explaining, selling, and spreading ideas, and is of concern to those engaged in the acquisition of rights-of-way. Appraisers must develop reports that will explain the document their opinion of value. Negotiators must be able to explain and sell this opinion to property owners, and attorneys must do the same in condemnation cases to convince the jury. In each of these situations, a right-of-way plan is a valuable tool used as a visual aid. It is the standard procedure to prepare right-of-way plans that are separate and distinct from the highway design plans. These plans contain all of the information necessary for the acquisition of the required right-of-way that is found on the design plans, plus any additional information that will be utilized in the acquisition process.

It is desirable to provide a right-of-way plan containing all of the essential data needed in connection with appraisal and negotiation activities; a plan that shows all of the parcels and ownership’s and their relative locations to one another and to the right-of-way limits and highway centerline; and a plan that will be helpful in establishing efficient and economical land acquisition practices.

A right-of-way plan containing all of the essential data needed in connection with appraisal and negotiation activities should show the right-of-way lines, the widths to be acquired, centerline and stationing with appropriate ties to intersecting property lines, and changes in right-of-way widths. The proposed limit of slope and cross-sections should be shown on the right-of-way plans, except where it has been determined that such information is adequately depicted on the construction plans or other documents available to the appraiser of partial taking. The lines and area of any additional easement areas, either temporary or permanent, that are required to accommodate intersecting roads and streets, land, access and temporary roads, drainage areas, material storage areas, utilities, railroads, and for any other special uses, should also be clearly designated and shown. For each parcel to be acquired, the plans should show:

a. the project identification number, i.e., control number and specific highway project numbers;
b. a parcel identification number;
c. the name of the property owners; and
b. the area of square feet/meters or acres/hectares of the part to be taken and each remainder of a partial taking.

All pertinent data affecting the cost of the right-of-way, such as structures, land service or access roads, improvements, and fences, should be shown. On projects where the access rights have been or are to be acquired, the access control lines and all approved points of entry to or exit from the traffic lanes should also be shown, even where the right-of-way lines and access control lines are coincident. The size, form, and arrangement of right-of-way plans should conform to the applicable requirements for highway plans and contain sufficient dimensional and angular data to permit ready identification and correlation with the legal descriptions of all parcel and easement areas that are required by the associated highway projects.
When Federal funds are used in the right-of-way project, a right-of-way plan may be required by the FHWA Division Administrator showing the rights-of-way authorized and actually acquired including Federal-aid project numbers, parcel identification numbers, area acquired, property lines of the area acquired, and any other pertinent data affecting the cost of right-of-way, such as structures, improvements, fences, etc.
Most of the methodology and data covered under Article 102.15 through 102.17 will apply to consultant contracted work for Right of Way surveying, mapping, and/or monumentation services. However it is important to note that typically on full design development projects awarded to engineering services the contracted firm may or may not have in-house surveying services. If a prime contractor firm under contract to the Department does not have in-house surveying service capabilities a subcontractor is hired by the prime contractor to provide the necessary highway right of way surveying, mapping, and monumentation support. In either case the work should be performed under the direction of a licensed and experienced Right of Way surveyor. Further in the case of where a consultant engineering design firm hires a Right of Way surveyor or surveying firm, the Department must review and approve the licensed surveyor’s qualifications and subcontract prior to the execution of the Contract for services.

Without trying to develop a parallel direction to the topics covered herein for in-house project work it is considered to be a better approach to emphasize to prime contractors and subcontractor firms that early and periodic meetings be held with appropriate Survey and Lands Engineering Section staff. Important communication milestones are noted in Project Development Flow Chart dated 4/12/99 and labeled Attachment 1 herein. Key contacts on Right of Way surveying, mapping, and monumentation projects issues are:

1. Project Development Engineer
2. Survey and Lands Engineer
3. Lands Engineering Unit Supervisor
4. Right of Way Verification Unit Supervisor
5. Monumentation Unit Supervisor
MONUMENTATION

Monumentation Surveys are surveys which set permanent monuments at specific positions within a project. These positions are set along the project right-of-way line(s), along the project control line, along property and section lines as well as along various project centerlines. These monuments are set for horizontal, horizontal and vertical, and vertical control. A Monumentation Map is completed and filed in the office of the appropriate County Clerk to establish public record of the monumentation survey. The monuments set are used to delineate the Department's right-of-way, provide the physical control (horizontal and vertical) for the projects construction, and the expansion of the Department's state-wide control (horizontal and vertical) network. The monumentation survey will be completed following Section 500.7, A through K of the Minimum Standards for Surveying in New Mexico, as adopted by the New Mexico Board of Registration for Professional Engineers and Surveyors.

102.19.1 MONUMENTS

The Department’s standard monument will be a 24" long, #5 (5/8") rebar with a 2 inch Aluminum cap.

The standard 2" Aluminum cap will have stamped along the edge: New Mexico State Highway & Transportation Department. The interior of the cap will be stamped with the New Mexico Registration number of the Land Surveyor responsible for the survey, the Project Control Number, and the Point Number associated to the position of the monument.

Figure 3 shows the standard 2" Aluminum cap.

![Figure 3](image)

If any monument within the construction zone is obliterated, a replacement monument must be set with the standard Department’s aluminum cap. This cap must also be stamped “RESET.” The party responsible for obliterating the monument shall replace the damaged monument at their expense.
Adjacent to all monuments a standard Department guard stake will be set. The standard guard stake will be a 5 foot tall steel fence post with a 12 inch by 5 inch polyethylene or aluminum sign attached to it.

Figure 4 shows the sign to be attached to the standard guard stake.

![WITNESS POST](image)

**FIGURE 4**

102.19.2 **MONUMENT LOCATION**

A standard monument will be set at the following positions for the purpose of monumenting the Department's right-of-way:

- all angle points along the right-of-way lines.
- points left and/or right of points defining the alignment. In most cases the alignment will be the Centerline of Construction. Points defining the alignment are: Angle points, P.O.T.'s, P.C.'s, P.T.'s, P.O.C.'s, P.R.C.'s, and Station Equations.
- intervisible points, and/or points to render a maximum of 1400 feet between monuments.
- points left and/or right of the B.O.P. and E.O.P.
• witness corners and reference points.
• points along sections lines that are also boundary lines for different ownership and sections lines where the existing section corners are in place which intersect the right-of-way lines.
• points along State Lines, County Lines, City Limits, Reservation Boundaries, Grant Boundaries, Forest Boundaries and State Park Lines which intersect the right-of-way lines.
• points along right-of-way line(s) belonging to other agencies re: railroad rights-of-way, major canals and laterals, city streets and boulevards, county roads, utility rights-of-way, federal rights-of-way, which intersect the right-of-way line(s).
• property line points intersecting the right-of-way line(s).
• points defining Construction Maintenance Easements (CME’s).

All points monumented will be shown on the Project Monumentation Map.

Standard monuments will also be set for:

• Project control points.
• Aerial Photography picture centers.

Standard monuments will be set using the criteria established within Section 102.10.

102.19.3 MONUMENTATION MAPS

Monumentation Maps will be completed in accordance with Section 500.7, A through K of the Minimum Standards for Surveying in New Mexico, as adopted by the New Mexico Board of Registration for Professional Engineers and Surveyors.

Monumentation Maps will be prepared as follows:

• Sheet size will be 24” by 36”
• Mapping Scales:
  Imperial Units 1” =100’ and 1”=50’
  Metric Units 1:500 (1cm=5m) and 1:1000 (1cm=10m)
• Show the name, address, phone number and registration number of the Land Surveyor responsible for the survey.
• Show the location and description of all evidence defining the existing Right-of-Way and intersecting boundary lines.
• Show the location and identification number of new monuments to be set.
• Show the name of the apparent owner(s) and the recording data of the most current deed or plat of all adjoining parcels.
• Show parcel numbers of all Standard Takes, Construction Maintenance Easements (CMEs) and Non Right-of-Way Takes (NRWs).
• Show the bearings and distances of all courses of Standard Takes, CMEs and NRWs. Record bearings and distances will be shown within parentheses. For
projects completed in Metric Units, the corresponding Imperial Units will be shown within brackets.

- A Point Identification Table containing the following information: point identification number, station and offset, coordinates, and description. Station and offset will be referenced to the centerline of construction.
- Each sheet shall have a title block which will contain the following information:
  
  New Mexico State Highway & Transportation Department
  Monumentation Map
  Project Number, e.g. SP-0118(201)
  Project Control Number, e.g. CN3332
  The County(s) in which the project is located.
  Scale and sheet number

- Reference to the New Mexico State Plane Coordinate System, including the coordinate system projection (NAD83), the zone (east, central, west) the project ground to grid factor and project convergence angle (delta alpha). All coordinates shown on the Monumentation Maps will be ground coordinates based on the New Mexico State Plane Coordinate System.
- The following Surveyors Certificate will be signed, sealed and dated by the Surveyor responsible for the survey:
  I, (Surveyor’s Name), hereby certify that I am responsible for this survey, which was completed by me or under my direction. This survey is monumented according to the New Mexico State Highway & Transportation Department Right-of-Way Map Project No. xx-xxx(xx)x, the monuments set as shown on this map are true and correct to the best of my knowledge and belief. This survey meets the Minimum Standards for Highway Right-of-Way Surveying in New Mexico, as adopted by the New Mexico Board of Registration for Professional Engineers and Surveyors.
- Labels, symbols, north arrow and graphic scale will adhere to the Department’s Computer Aided Design and Drafting Standards.
- Show a recording block to be used by the County Clerk’s office.
- Label streets, roads, ditches, laterals, State lines, County Lines City Limits, Reservation Boundaries, Grant Boundaries, Forest Boundaries, and State Park Lines which intersect the right-of-way.
- Label surveyed Section lines, Township lines and 3 section lines.
- Do not show cross hatching.
- Do not show Temporary Construction Permits (TCPs).

A sample Monumentation Map is included within Appendix S.

Upon completion of the Monumentation Maps the originals will be turned over to the Surveying and Lands Engineering Section, Monumentation Unit, who will be responsible for filing these maps with the appropriate County Clerk. Copies of the filed Monumentation Maps will be kept within the files of the Department’s Surveying and Lands Engineering Section’s Monumentation Unit. In addition, the Department will return a copy of the filed Monumentation Map to the Land Surveyor responsible for these maps.
102.20 CONSTRUCTION SURVEYS

102.20.1 HORIZONTAL AND VERTICAL CONTROL

The horizontal and vertical control documentation shall be provided to the project surveyor by the Department. It is the responsibility of the project surveyor to make sufficient field checks between the found control monuments to verify their accuracy.

102.20.2 CONSTRUCTION STAKING

It is the Department’s policy to have the construction staking completed by the project’s Construction Contractor. The construction staking must be completed under the direction of a Registered Professional Land Surveyor. The project surveyor must have a complete set of construction plans and a complete tabulation of the project control. The construction plan set will be provided to the project surveyor by the project Construction Contractor; the project control tabulation will be provided to the project surveyor by the Department.

The types of staking that may be required to complete a Department construction project can include, but are not limited to:

- Slope stake reference points for earthwork.
- Subgrade or grading plane stakes for semifinished grading.
- Reference stakes or stringline stakes for final grading or paving of channels, roadways, or other surfaces.
- Reference stakes for the layout of structures, buildings, and equipment.
- Offset reference lines for the construction of pipelines, ditches, and trenches.

At the request of the Department, periodic checks shall be made throughout the duration of a Department construction project by Department personnel on lines and grades established by the project surveyor to verify the work.

102.20.3 EARTHWORK

102.20.3.1 CLEARING LIMITS

The limits of clearing for the project area, in most cases, are set in conjunction with the slope staking operation. Where ground cover is extensive and prior clearing would enhance the slope staking effort, clearing limits can be set by other means. Depending on the type of construction and ground conditions, this can be accomplished by cloth tape and right angle prism, traverse survey, location from photos or maps, or limiting physical features.
SLOPE STAKES

Slope staking is performed to control grading operations in the construction of roadways, canals, plant and pump station sites, berms and drainage ponds. The usual configuration is linear in nature, lending itself to staking from a control line. General parameters for slope staking are as follows:

- The normal spacing of slope stakes is at 15m/50’ intervals, although this can be varied considerably for specific requirements. Where the terrain is level and uniform with light to moderate grading, slope stakes are often set at 30m/100’ intervals.
- Slope stakes are set by various methods such as with hand level and tape, engineers level and tape, theodolite and EDM, and total station instruments, depending on conditions and purpose.
- The slope stake reference point (SSRP) is the physical point set and marked in the field. The actual catch point may or may not be marked by ginity or nail for the convenience of setting the SSRP. The actual catch point is usually lost in clearing or at the start of grading, and it is the contractor’s responsibility to set it from the SSRP.
- Regardless of the method used to establish the SSRP, the cuts and fills, distances, and elevations shall be marked to the nearest 3cm/0.1’.
- The actual SSRP shall consist of a ginity, nail, or where required, a longer stake, driven in flush with the ground. A witness stake is set behind it, facing the work. A 1m/4’ tall lath with flagging shall be set alongside the actual SSRP to mark and protect this point.
- On major earthwork projects, with precalculated slope stake and SSRP listings, a common procedure is to set the SSRP at the precalculated position, establish an elevation on it, and write the stake to the precalculated catch point. When this method is used, a check should be made from the SSRP to the precalculated catch point to confirm the terrain data upon which it was computed. Some deviation in the terrain will likely exist, but will be compensated for by the grade setter when he marks the start of the cut or fill slope. A level of acceptance of the theoretical catch point must be based upon the type and extent of the earthwork, degree of accuracy required, and the economics involved in the time-consuming “trial and error” method of finding the precise catch point to the nearest 3cm/0.1’.
- Where the SSRP is intended to serve as the reference stake from which to construct a subgrade, flow line, building pad, or other finished surface, the actual cut or fill catch point shall be determined exactly by the “trial and error” method.
102.20.3.3 STAKING TO SUBGRADE AND FINAL GRADE

For the purposes of earthwork, final grade stakes are considered to be those stakes from which the earthwork grading is completed, whether it is subgrade for a roadway, building pad, or structure site; or the subgrade of a lined channel. Stakes for this purpose shall be set and marked to the nearest 3cm/0.1’. Where possible, these stakes should also be used to place subsequent levels of structural section and paving materials to final grade, and when this is the case, they shall be set and marked to the nearest 3mm/0.01’.

Examples of finish grade stakes are:

- An offset line consisting of ginnys or hubs on a given station interval along a roadway, channel, or around the perimeter of a structure pad, with references to the grading plane marked on the witness stake.
- The use of “bluetops,” that is, ginnys with the top set to grade in the surface of the grading plane so that grade can be finished directly to it. The use of bluetops often requires them to be reset several times in the course of the work because of their loss to construction equipment. Some kind of offset or remote reference is preferable to bluetops.
- Stringline stakes are an efficient way to stake the surface of a channel or roadway. Stakes are set on offset lines both sides of the subgrade, usually on 15m/50’ intervals. The gradelines are marked on the stakes at an even 0 meter/1 foot interval above finished grade. From a stringline pulled transversely across the grade, each surface of the structural section, from subgrade to finish grade, can be checked with an appropriate measurement. From the same stakes, wires can be set for the use of lining or paving machines.

102.20.3.4 MEASUREMENT OF QUANTITIES

Measurement of quantities by survey methods is usually limited to excavation areas, borrow pits, and stockpiles. Two of the methods commonly employed to accomplish this are:

- Cross sections are taken before and after the work is done, and the volumes are computed by average end area methods.
- A topographic survey is performed with a total station instrument and data collector before and after the work is done. The data from each survey is processed by a computer program, and a terrain surface model is created for each survey. The surfaces are compared by a computer program, and quantities are computed. This is the preferred method as it is usually much quicker in the field and office, as well as being more accurate due to the increased number of data points used.
102.20.4 CHANNELS, PIPELINES, AND ROADWAYS

Alignments of channels, pipelines, and roadways, based on the project coordinate system, should be staked and referenced in a manner that will not require restaking for each stage of construction. Reference points to back of curbs, edge of concrete/asphalt, points on tangent, angle points, and other major alignment points should be set so that centerlines can be readily reestablished.

102.20.4.1 EARTHWORK

Slope stakes and grade stakes shall be set in accordance with the guidelines contained in Section 102.20.3, Earthwork, of this manual.

102.20.4.2 FINAL GRADE STAKES

Final grade stakes, as discussed briefly in Section 102.17.3, are set to:

- Finish the surface of an excavation or embankment to produce a subgrade or grading plane.
- Control the placement of structural section materials, including the final surface as in the case of roadway paving or channel lining.
- Control gradelines for the installation of pipelines.
- Provide a reference from which to set concrete forms and mechanical equipment.

All final grade stakes shall be set and marked to the nearest 3mm/0.01’.

For roadways and channels, final grade stakes are usually set at 15m/50’ intervals. For the control of concrete channel linings and concrete pavement, the interval should be reduced to 7m/25’. along curves. Other special conditions, e.g. transition sections may require staking at irregular intervals.

102.20.4.3 LASER GRADE CONTROL

Where laser grade control is proposed for use by the contractor, the staking interval may be increased. Any increase in the interval of staking proposed for use with laser grade control must be approved by the Department.

102.20.5 “AS-BUILT” PLANS

102.20.5.1 RECORD OF CONSTRUCTION CHANGES

It shall be the policy to record all changes to dimensions, elevations, and locations of design elements shown of the plans that are made during construction. A set of plans shall be maintained at the Department for the purpose of recording “as-built” information only. It shall be the responsibility of the project surveyor to record all changes that are measured or laid out by survey methods. It is recommended that when changes are directed and/or approved by the Department, they are noted in the field book as well as recorded on the “as-built” plans.
102.20.5.2 DISPOSITION OF “AS-BUILT” INFORMATION

At the completion of the project, when all changes have been noted on the “as-built” plans and documented in the field book, the revised plan set shall be forwarded to the Department for permanent recordation and filing in the records.