



SURVEY STANDARDS

TYPES OF SURVEYS

The Nevada Department of Transportation Location Division has identified the following as typical **types of surveys** that may be released to an “On Call” consultant. Please note the use of hierarchical survey methods used at NDOT. This method of surveying prevents the buildup of systematic errors over large regions by imposing restraints and allows the surveyor to determine the maximum computed uncertainty of a position, with respect to controlling Monumentation, and in terms of local relative positional accuracy. Because the published High Accuracy Reference Network (HARN*) has negligible systematic errors, it serves as the current reference frame considered to be absolutely accurate at NDOT. The survey type or types required in a given task order shall be referred to and have a meaning as described below:

Control Surveys

BASIC CONTROL SURVEY: The basic control survey or control densification, based directly upon fixed HARN control, provides control for all other project surveys and is a connected series of independent vectors, properly weighted, constrained, and adjusted least squares network.

CONSTRUCTION CONTROL SURVEY: This survey, based directly upon previously adjusted and fixed **Basic** control, includes reference monuments placed every 1450 feet (+/-) along the project length, and being inter-visible between adjacent monuments, at or near right-of-way limits in secure locations.

AERIAL CONTROL SURVEY: This survey, based directly upon, as a minimum, previously adjusted and fixed higher order **Construction** control, provides for the placement of aerial panels.

Cadastral Boundary Surveys

CADASTRAL BOUNDARY SURVEY: This survey, based directly upon and as a minimum, previously adjusted and fixed **Construction** control, providing for positions of Highway Reference monuments, R/W monuments, property monuments, and section corners that would typically, in addition to construction control, be used to identify properties and boundary locations.

Engineering Surveys

TOPOGRAPHIC SURVEY: This survey, based directly upon and as a minimum, previously adjusted and fixed **Construction** control, provides for the location of topographic features, including utilities, surfaces, and other detail that may be found within or along NDOT right-of-way.

CONSTRUCTION SURVEYS: This survey, based directly upon and as a minimum, previously adjusted and fixed **Construction** control, marks the horizontal location (line) as well as the vertical location, or elevation (grade) for proposed fixed works.

* HARN: refers to the NAD83/94 adjusted NAD83 datum.

MINIMUM ENGINEERING SURVEY STANDARDS

Topographic Surveys

NDOT has determined that dependent upon various needs, topographic surveys will be collected with a precision defined by these levels:

- Level 1 Details that can be precisely defined, usually consisting of points.
Example: sewer/culverts inverts, white pavement, and bridge beams.
Positional accuracy:
Horizontal class = **IV** vertical class = **II**
- Level 2 Details that require a location at moderate precision, consisting of points or
polylines.
Example: manhole cover, edges of oil, walkway.
Positional accuracy:
Horizontal class = **VII** vertical class = **VII**
- Level 3 Natural features not precisely defined, consisting of polylines.
Example: stream banks, rock outcrops, edges of gravel road.
Positional accuracy:
Horizontal class = **VIII** vertical class = **VIII**

Plotting of topographic features requires a positional accuracy dependent upon the final map scale and a plotting accuracy assumed to be 0.002ft.

Contract Stakeout Survey

Positional Tolerances

	Horizontal (+/-)		Vertical (+/-)	
Rough Grade Stakes	0.15m	0.50ft	0.05m	0.16ft
Sub grade Red Head Stakes	0.05	0.16	0.01	0.03
Finish Grade Blue Top Stakes	0.05	0.16	0.01	0.03
Building Offset Stakes	0.005	0.03	0.01	0.03
Sewer Offset Stakes	0.05	0.16	0.01	0.03
Waterline Offset stakes	0.05	0.16	0.02	0.07
Hydrant Offset stakes	0.05	0.16	0.01	0.03
Street Lights	0.05	0.16	0.03	0.10
Curb Offsets	0.01	0.03	0.01	0.03
Structural Concrete	0.01	0.03	0.01	0.03

MINIMUM CONTROL AND LAND SURVEY STANDARDS

The Nevada Department of Transportation Location Division has determined that the following minimum standards must be met by all “On Call” consultants. These standards are given in terms of relative position accuracies and exceed those minimums as required by NAC 625.780, NAC 625.790, and NAC 625.860. Further, we have correlated these tables to match NDOT classifications, thus assuring that everyone understands the minimum accuracies required at 95% probability. These standards are independent of measurement equipment and technology but do reflect the objectives required by NDOT. While the classification chart used by NDOT is the FGCS accuracy classification chart, products prepared for NDOT must only meet NDOT specifications. NDOT does not intend to “Blue Book” tied monuments, therefore specifications, but not accuracy standards, are significantly different.

NDOT Minimum Positional Accuracies

	Basic Control	Construction Control	Cadastral Control	Aerial Control
Horizontal	IV	V	VI	VI
Vertical	VI	III	VI	VI
NAC 625	State	County	High Urban	Photogrammetric

Note:

- Positional tolerances required use the next highest, or greater, classification of control for their relative frame of reference.
- Basic control points set in concrete and having a greater likely permanence, are commonly referred to as “X” points or HARN densification points. These typically include establishing basic control points on existing NGS benchmarks.
- Control Extension only occurs from monuments with semi-permanent character.

NDOT Classification Chart at 95%

Classes	Range	Typical uses
I	< 0.001 m (. 003ft.)	Precise measurement studies
II	< 0.002 m (. 007ft.)	Precise measurement studies
III	< 0.005 m (. 020ft.)	Precise measurement studies
IV	< 0.010 m (. 030ft.)	Basic control or HARN densification
V	< 0.020 m (. 070ft.)	Construction control
VI	< 0.040 m (. 152ft.)	Aerial control, cadastral corner
VII	< 0.100 m (. 330ft.)	Utilities location
VIII	< 0.500 m (1.64ft.)	Features mapping
IX	< 2.000 m (6.65ft.)	Resource mapping
X	< 5.000 m (16.40ft.)	Resource mapping
XI	< 10.00 m (32.81ft.)	Resource mapping
XII	> 10.00 m (32.81ft.)	Resource mapping

MINIMUM GPS ACQUISITION SPECIFICATIONS

NDOT has established these rules as to how the minimum positional tolerances (standards) can best be met. As new technology becomes available, it is expected these specifications may require modification or additions.

GPS Specifications by Survey Type

Specifications	Basic	Construction	Cadastral	Aerial	Topographic
Minimum number of connections to higher order fixed known horizontal/vertical control per network	3	3	2	2	2
Minimum number of independent vectors to individual control points	2	2 vectors 1 scalar	2	2	1
Max number of network traverse legs without 3 independent vectors	2	4	4	4	N/A
Dual frequency	Y	N	N	N	N
Minimum satellite mask angle above horizon	13	13	13	13	13
Minimum number of satellites tracking/GDOP	5/7	5/6	5/6	5/6	5/6
Epoch recording Rate Seconds	15	15/5	15/5/1	15/5/1	15/5/1
Field data log required	Y	Y	Y	Y	N
Point description with unique name required	Y	Y	Y	Y	N
Recommended min/max station spacing (miles)	6/31 max	.3/.35	0/6	0/.3	0/.3
<u>Survey Method:</u>					
Static	_____				
Fast Static	_____				
Stop & Go	_____				
RTK(post processing)	_____				
RTK(calibration)	_____				
Conventional	_____				

NDOT Minimum GPS Occupation Times

Dual Frequency

	< 5 Km	≥ 5km to <15Km	≥ 15 to <50Km
Static	20 minutes	20 to 50(2x60 Basic)	50-130*(2x120 Basic)
Fast Static	8 to 10 minutes*	10 to 20 minutes *	N.A.
Stop & Go	10 epoch's minimum		N.A.
RTK (post processing)	Reoccupation > than 45 minutes apart		N.A.

Single Frequency

	< 5 Km	≥ 5 to <10Km	≥ 10 to <15km
Static	20 minutes	20 to 50 minutes *	50 to 75 minutes*
Fast Static	15 minutes	15 to 20 minutes	N.A.
Stop & Go	10 epochs		

Observation times and accuracy are functions of GDOP, number of satellites, ionospheric disturbances but mainly distance. It is highly recommended that baselines be kept to a minimum while also recognizing the NDOT has minimum monument distances assuring a relative line accuracy (RLA). RLA is the allowed positional tolerance / distance between station.

* Indicates a range of time proportional to the vector distance.

Observation times are determined avoiding both the worst “observing window” and optimum “observing window” while traditionally assuring a fixed ambiguity integer solution.

Below are some industry standard occupation times that are not reflective of NDOT standards, but that are acceptable.

Static (95%)

Double Frequency: 20 min + 2min per km

Single Frequency (15km max): 30 min + 2 min per km

Fast Static (95%)

Single Frequency: 10 min + 2min per km

Double Frequency: 5 min + 1 min per km

NDOT Minimum GPS Network Adjustment Procedures

1. Vector Processing

- Basic control will use Precise ephemeris & others Broadcast
- Process using best independent baselines
- Ratio >2 , variance <2 , fixed solutions with dual frequency
- Ratio >4 , variance <4 , fixed solution with single frequency
- Check loop closures

2. Free - Network Adjustment

- Fix one coordinate for adjustment
- Tribrach error = .002m and HI error = .003m
- Evaluate all vectors eliminating those failing
- Process monuments in hierarchical method.

3. Constrained Network Adjustment

- Constrain all control
- Use geoid 03, or latest, for orthometric elevations
- Compare constrained adjustments to free adjustment
- Calculate ground coordinates

CONVENTIONAL SURVEYS

While we expect to use conventional surveys only in unusual circumstances, they will be with us for a number of years. Traditional survey equipment may be used to collect all types of surveys, except “Basic Control Surveys.” If used, traverses and networks must be adjusted using least squares and positional tolerances evaluated verifying they meet NDOT standards. Further, they may be included into GPS data sets and thus must be properly weighted. Below are standard NDOT weights used in adjustments.

Angle Weighting (95%)

	Instrument/Distance Shot					
	1 sec <100m	1sec >100m	6 sec <100m	6 sec >100m	20 sec <100m	20 sec >100m
1 set	5.1	3.1	5.9	4.1	7.7	6.5
2 set	4.6	2.3	5.1	3.0	6.2	4.7
4 set	4.4	1.8	4.7	2.3	5.3	3.4
8 set	4.3	1.5	4.5	1.8	4.8	6.2

Distance Weighting Using Manufacturer’s Specifications

	Constant	PPM
Trimble 5600	2mm	2
Geodimeter 112	9mm	1
Engineer chain	0mm	200

Centering Errors

Horizontal Centering =	0.003 m
Vertical Centering =	0.006 m

Precise Elevations

Procedure Used	
2 nd order class 1	$6\text{mm} \times \sqrt{\text{km}}$
2 nd order class 2	$8\text{mm} \times \sqrt{\text{km}}$
3 rd order class 1	$12\text{mm} \times \sqrt{\text{km}}$

FINAL SURVEY REPORTS

At the end of a project a final survey report will be delivered to the Geodesy Section at NDOT, where they will be archived. The final reports, paper and digital, may include:

- Network diagram
- Raw data files
- Minimally constrained report (grid or geographic)
- Constrained report (grid or geographic)
- Point ellipse diagram
- Project combination factor
- Final coordinate list (gnd)
- Point descriptions
- ASCII utilities file
- Supplemental roadway profiles
- Contract control list
- “Best Fit” alignment report
- Drafted project plat showing best-fit alignment, necessary jurats, monument offsets, PLSS offsets, and a coordinate table. Created PLSS corner perpetuation document.

A general report or narrative shall be written describing the project in general thus documenting any found concerns or problems with the survey or problems that the survey brought to light. When this report is stamped and delivered with the surveyor’s seal, the final product can be considered delivered.

INSTRUCTIONS FOR SETTING AND STAMPING OF CONTROL MONUMENTS

Monuments Character

Monuments may include both horizontal station markers and benchmarks. All points shall be placed before the point is occupied by an instrument, signal, or rod. NDOT requires a specific type of monument to be used on all projects dependent upon the type of control. Stamping will reflect the monument and name.

	Basic	Construction	Cadastral*	Aerial
Wooden Hub				x
Washer Disc				x
Rebar Marker			x	
Feno Monument		x	x	
Concrete Marker	x			

*Cadastral monuments will be set in accordance with state and local laws and stamped by the PLS in responsible charge. Corner records will be filed if needed using NAC 625.810 as a guide.

NDOT Naming Convention

After a preliminary project review (reconnaissance) has been completed by the consultant and reviewed by NDOT, caps shall be provided to the consultant by NDOT. The station name shall be assigned using a unique number as assigned by NDOT, and the consulting surveyor shall complete field setting and stamping.

EX: LPN1012, first station point number, section corner
Designation = **1012001L**

- Letters 1, 2, 3&4 designate the Location Project Number (LPN) assigned by NDOT
- Letters 5,6, &7 designate the sequential station number assigned and stamped by consultant
- Letter 8 indicates the point type assigned and stamped by consultant

Point types

A =	Traverse point
X =	Permanent basic control point
M =	Construction control point
K =	Construction control point / no spirit level elevations
L =	Section corner (PLSS)
H =	Highway reference monument
S =	Local street monument
P =	Property corner
Z =	Fixed NGS control (X, Y, & Z)
B =	Boundary Control Point
R =	Railroad or Reset

CONSTRUCTION CONTROL MONUMENTATION

Construction control monuments shall be used as reference monuments on all projects. Construction monuments (reference monuments) shall be constructed and surveyed prior to project design on all projects requiring preliminary surveying.

1. Monuments will be stamped Nevada Dept. of Transportation Control Monument and designated by the present Location Division's point naming convention. A minimum of three (3) Construction Monuments will be inter-visible and placed in NDOT's right-of-way in areas most likely not to be disturbed using conventional survey methods.
2. All monuments will be of a semi-permanent character.
3. Construction Monuments will be established and surveyed to construction control standards set forth in this manual. For monument character and NDOT naming conventions, see page 30.
4. Spacing between the Construction Monuments will not be greater than 1650 feet nor less than 1300 feet and will be inter-visible.
5. The distance error between inter-visible "Location" construction control monuments must exceed a ground relative line accuracy of $RLA = 1:20,000$ horizontally and $.008m$ times the square root of the distance in kilometers vertically, or a positional tolerance at the 95% confidence level of <0.070 feet horizontally and <0.020 feet vertically.
6. All Construction Monuments will have horizontal and vertical positions constrained to NAD83/94 HARN adjusted coordinates and NAVD88 or NGVD29 vertical control or the most recent datum set forth by Nevada Revised Statutes. Horizontal grid positions should be corrected to ground using page 33 as a guide, or contact Geodesy Section directly.

The Consultant will generate a Control Schedule for inclusion into each design contract.

1. The Control Schedule will have a listing of Reference Monuments used in establishing the best fit alignment, its relationship to Public Land Survey Corners, Property Corners or Property Controlling Corner Monuments, property corners adjacent to the right-of-way corridor, construction control monuments, and any previously existing alignment reference monumentation. Examples will be provided upon request, through the Geodesy Section
2. The Stamped Control Schedule shall be sent to the Location Division for review and will be included in the contract plans.

MONUMENT DESCRIPTIONS

As experienced surveyors know, there is no perfect measurement. Therefore coordinate values used to pinpoint a monuments true location is a close approximation at best. The uncertainty of this position at some known confidence level (95%) is why two boundary surveys never precisely agree with one another. Monument descriptions, on the other hand, can precisely agree, and so while both coordinates and actual monument descriptions are both evidence of true location, the monuments actual position is best identified by a good description, a found monument, and a precise coordinate value.

NDOT has developed these description instructions to facilitate description writing and to further perpetuate a description with its automatic insertion into the Location Information System (LoIS) database.

Several rules must be adhered to:

Limit the total monument description length to 600 characters including spaces.

Use any word processor (text editor) to export out an ASCII text file (.TXT).

Pipe symbols (|) must separate the fields.

An NDOT description consists of six fields: point name| point type| northing| easting| ortho elevation| and description body. These six fields are divided by the pipe symbol (|) with a carat symbol (^) at the end.

Description Example

Field #1	Point name: "205204"
Field #2	Point type: "H"
Field #3	Northing: "123456.78"
Field #4	Easting: "987654.32"
Field #5	Elevation: "1234.56"
Field #6	Monument description at monument: "Station is a found standard NHD brass disc in concrete, stamped "205204," 2.46' below ground with a witness post set 3' south." To Reach: "To reach station proceed from the intersection of Pyramid Way and Emerson Road proceed NE'ly along Pyramid Way 0.60 of a mile and station is 34.45' left of C/L" Special Information: "Station is 34.45' lt of "E" 10+00.00PC, and is the NE S4 T15N R30E. See county recorder File #125-263 BK125."

Final LoIS Import File with Description Example

205204|H|123456.78|987654.32|1234.56|Station is a found standard NHD brass disc in concrete 2.46' below ground with a witness post set 3' south. To reach station proceed from the intersection of Pyramid Way and Emerson Road proceed NE'ly along Pyramid Way 0.60 of a mile and station is 34.45' left of the C/L. Station is 34.45' lt of "E" 10+00.00PC and is the NE S4 T15N R30E. See county recorder file #125-263 BK125.

RESOLVING GROUND AND GRID DISTANCES

NDOT survey projects, while on the NAD83/94 state plane datum, must reflect contract distances and R/W descriptions as though horizontally measured on the ground. The effects of ignoring differences between distances on the ground and distances on the grid can lead to one thinking incorrectly that the initial survey work was poorly done, or they may fully recognize the cause but do nothing to resolve it. NDOT resolves ground to grid discrepancies by applying these rules:

1. All NDOT projects shall have as a Basis of Bearings the Nevada Coordinate System (NAD83-1994) with the control monuments used to establish the basis clearly indicated. Further, survey adjustments shall be accomplished and these adjustment data sets are given an appropriate positional tolerance rating based upon this grid and fixed higher order control monuments used.
2. All plan and R/W ground distance corrections, shall place an adjusted datum parallel with the initial state plane datum, by using a single combination grid factor and at a near enough ground level for any inherent distance differences to be lost in normal (acceptable) methods of surveying. A ground coordinate system is generated by dividing state plane coordinates by the project combination ground-to-grid factor. The normal error between true ground distances and grid distances has been determined to not exceed 50 ppm (1:20,000) over the length of a project. If this error is exceeded, then the project shall use multiple combination grid factors with coordinate equations.
3. R/W plans and contract plans shall reflect a mean combination ground-to-grid factor, be printed upon any calculation sheets any time ground (modified) state plane coordinates are used, and be noted in the bearing source statement.
4. R/W calculations, “best-fit” alignment retracements, and areas may be adjusted and calculated on the project ground (modified) coordinate system.

Combination Grid Factors Already Chosen for Specific Geographic Areas

AREA	NAD 83/94	NAD 27
Battle Mountain	0.99969109545	0.9996910955
Boulder City	0.99984402433	0.9998290292
Carson City	0.99980003999	0.9997992943
Elko	0.99964312740	0.9996427280
Ely	0.99963813100	0.9996390000
Lake Tahoe Basin	0.99973706915	0.9997107400
Las Vegas	0.99982303132	0.9998236040
Lovelock/Fallon	0.99973062500	0.9997101703
Minden/Gardnerville	0.99980003999	0.9997992943
Reno	0.99981103571	0.9998140346
Sparks	0.99981103571	0.9998140346
Winnemucca	0.99975605952	0.9997440655
Wendover	0.99988001440	0.9998800144

DATUM STATEMENT SPECIFICATIONS

A bearing source at NDOT is a horizontal angle turned from grid north (a known azimuth) and being within one of three zones on the Nevada Coordinate System. All projects will thus be referenced to a common known meridian as defined under NAC327. It is necessary to document both the horizontal and vertical datum as every survey performed is considered a corporate resource and each must connect to another survey, the totality of which NDOT is responsible. The location and design of long transportation corridors leads the surveyor into encountering unique problems that can usually be solved with a professional application of the principles of the Nevada State Plane Coordinate System, knowledgeable expectations, and documentation of all datums relied upon. Required example datum statements are shown below and will be shown on drafted projects and at the top of all calculation sheets:

Example: Vertical*

Elevations are based upon NGVD1929, using published control points:

J837 = 6259.554'

T4 = 6293.846'

and reflect a positional tolerance: +/- 0.015'.

Example: Horizontal*

Bearings of this map were derived from Nevada State Plane Coordinates, NAD 27 Datum, West Zone, with a mean convergence of 0°-51'-19". Local network control points used for Basis of Bearings are Castle Rock, Folsom Peak, EDO 001, EDO 021, and 162201. Further data is archived at NDOT under LPN298.

Example: Distance Adjustment Factor*

Coordinates and distances reflect a combination adjustment factor of 0.9997700529. State plane grid coordinates will reflect a relative positional tolerance as defined by NRS625.780 not exceeding 0.05m.

Example: Combination*

Coordinates of this map were derived from Nevada State Plane Coordinates (NAD83) East Zone, using a datum adjustment ground-to-grid factor of 0.9998140349, and whose State Plane Coordinates reflect a relative positional tolerance not exceeding +/- .05m. Elevations are based upon NVGD1929. Further data is archived at NDOT under LPN298.

- All three of these statement blocks must be used, usually on plats. Combination statements contain all three elements and typically are on calculation sheets.

PERPETUATION OF SURVEY MONUMENTS

Monuments found during survey and mapping phases of Nevada Department of Transportation (NDOT) projects are to be perpetuated in accordance with NDOT Policy 3-1-3 and Nevada Revised Statutes (N.R.S.) 329 titled “Perpetuation of Corners”, and applicable Nevada Administrative Code (N.A.C.) 329. This policy, Nevada Revised Statute (N.R.S.) and Nevada Administrative Code (N.A.C.) state in a general sense the following.

- Found Public Land Survey System (PLSS) monuments must be perpetuated in place at the original position. This can be accomplished by setting a minimum of four reference marks outside of the construction area, surveyed from the PLSS corner with angles and distances taken to the reference marks. Alternately ties to a minimum of two NDOT Location Division, construction monuments, if the Location Division, Survey Section, has established them, with adjusted NAD83/94 coordinates will suffice. Copies of the monument control data sheets may be obtained through the State of Nevada Department of Transportation (NDOT), Location Division, Geodesy Section, at 1263 South Stewart Street, Room #206, Carson City, NV 89712 or by calling (775) 888-7256. A filed perpetuation record shall be made per N.R.S. 329.140, with a copy of the filed perpetuation record sent to the attention of the Chief Land Surveyor, NDOT, 1263 South Stewart Street, Room #206, Carson City, NV 89712.
- Stamped monuments set by a Nevada Professional Land Surveyor may be perpetuated outside of the travel area, if found in the oil. A minimum of two reference marks shall be placed outside of the construction area, with angles and distances taken to the reference marks. Alternately, ties to a minimum of two NDOT Location Division, construction monuments, if the Location Division, Survey Section, has established them, with adjusted NAD83/94 coordinates will suffice. Copies of the monument control data sheets may be obtained through the State of Nevada Department of Transportation (NDOT), Location Division, Geodesy Section, 1263 South Stewart Street, Room 206, Carson City, NV 89712 or by calling (775) 888-7256. A filed perpetuation record shall be made per N.R.S. 329.140; with copy of the filed perpetuation record shall be sent to the attention of the Chief Land Surveyor, NDOT, 1263 South Stewart Street, Room #206, Carson City, NV 89712.
- A corner perpetuation record must be filed at the County level per the requirements of NDOT policy #3-1-3 and Nevada Revised Statutes (N.R.S.) 329 “Perpetuation of Corners.” A perpetuation record must be filed within 90 days of the date of the completed survey per N.R.S. 329.140, with a copy of the filed perpetuation record sent to the attention of the Chief Land Surveyor, State of Nevada Department of Transportation (NDOT), 1263 South Stewart Street, Location Division, Room #206, Carson City, NV 89712.

NDOT TRANSPORTATION POLICY (TP 3-1-3)

Perpetuation of Survey Monuments

I PURPOSE:

To establish standards and procedures for the perpetuation of survey monuments, ensuring compliance with Nevada Revised Statutes (NRS) 329, 408 and 625.

II POLICY:

Monuments found during survey, mapping, construction, or maintenance phases of Nevada Department of Transportation (NDOT) projects are to be perpetuated under the direction of the Chief Land Surveyor.

III SCOPE:

This policy applies to all monuments placed in NDOT rights-of-way and construction zones.

IV RESPONSIBILITY:

A. The Location Division is responsible for:

- (1) Initiation and revision of this TP.
- (2) Administration of the perpetuation of monuments found in NDOT right-of-way.

B. All Divisions/Districts are responsible for:

- (1) Following the procedures in this TP.

V DEFINITIONS:

A. Corner: A geographic point on the surface of the earth which is on and a part of a line and which controls the location of such line.

B. Monument: A physical structure that occupies the exact position of a corner.

C. NDOT Reference Monument: A special monument placed by NDOT which does not occupy the same geographical position as a corner, whose spatial relationship to a corner, line, or centerline is recorded at NDOT and which serves to witness the alignment of the roadway center lines, rights-of-way corridor boundaries, and the location of found monuments.

- D. Property Corner or Property Controlling Corner Monument: A stamped or tagged monument set by a professional land surveyor used to control the location of the property.
- E. Tie Monument: A special monument placed outside the construction zone of the roadway but within one hundred feet of a found Public Land Survey Corner or Property Corner or Property Controlling Corner with a measured distance to the found monument established and stamped on the surface with the letters “TM” and PLS and the license number of the land surveyor that established the tie monument.
- F. Public Land Survey Corner: Any corner established and monumented in an original survey or resurvey used as a basis of legal description for issuing a patent for the land to a private person from the United States Government.
- G. Corner Record: A written record of the spatial relationship of a found monument to reference monuments or the reconstruction of a Public Land Survey Corner or Property Corner or Property Controlling Corner as described in NRS 329.
- H. Construction Zone: Any area within established rights-of-way or easements that may be disturbed during any construction or major maintenance activity, not including emergency projects.

VI PROCEDURE:

All visible stamped or tagged survey monuments and Public Land Corners found in NDOT rights-of-way that may be destroyed by construction or maintenance activities must be perpetuated under the supervision of a licensed Nevada professional land surveyor. This will be achieved for each found monument by the following:

- A. **Prior to the development of all construction or major maintenance contracts**
 - (1) The Design Division shall request the Location Division to verify the presence of any Public Land Survey Corners within the construction zone.
 - (2) The Location Division will conduct an in-house record search to determine if there are any Public Land Survey Corners within the right-of-way. If so, they will be verified in the field.
 - (3) All found Public Land Corners will be listed in the contract by the Design Division for perpetuation.
 - a. They must be perpetuated according to Nevada Revised Statutes Chapter 329 by a Nevada licensed professional land surveyor then tied to two (2) existing NDOT reference monuments utilizing NDOT’s “*Special Instructions for Survey or Mapping Consultants*” which is distributed by the Location Division. Public Land Survey Corners in the construction zone are to be set in a survey well and referenced by four (4) tie monuments set outside the construction zone. A copy of the recorded Corner Record for each monument with a written report identifying the character, location, description, and ties of the new monument and NDOT Reference Monuments shall be sent by the land surveyor to the Chief Land Surveyor, Headquarters Building, Carson City, Nevada 89712 (see page 35).

- (4) At the discretion of the Chief Land Surveyor, any Public Land Survey Corner found in the roadway will be tied to two (2) NDOT Reference Monuments set by the Location Division. A Corner Record will be sent by the Chief Land Surveyor to the appropriate county to be recorded.
- (5) Copies of the construction plans will be maintained in NDOT headquarters as well as the District Offices including Ely, Winnemucca, and Tonopah. The Chief Land Surveyor will maintain a record of all perpetuated Public Land Corners in the Geodesy Section.

B. Prior to staking a construction project

- (1) The Resident Engineer, under the direction of the Chief Land Surveyor, will follow the provisions in the Construction Manual (Sec.2-102.8) and field verify the presence of all visible monuments.
- (2) Any Public Land Survey Corners found and which are not listed in the contract plans for perpetuation will be added to the contract for perpetuation as defined in Procedure (3)(a).
- (3) All visible stamped or tagged Property Corner or Property Controlling Corner Monuments that may be disturbed will be tied by the Resident Engineer. The ties will be to two (2) existing inter-visible NDOT Reference Monuments or two (2) set inter-visible NDOT Reference Monuments which will not be disturbed during construction activities. Instruction on procedures used to tie a Property Corner or Property Controlling Corner Monument or to construct a Reference Monument will Found Monuments will be noted in the as-built construction plans and a written report identifying the character, location, description, and ties of the monument and NDOT Reference Monuments will be sent to the Chief Land Surveyor, Location Division, Carson City.
- (4) After review and acceptance of the written report, monuments used to reference a Public Land Survey Corner or Property Corner or Property Controlling Corner shall be approved to be stamped with the Chief Land Surveyor's registration number by memo from the Chief Land Surveyor to the Resident Engineer.
- (5) The Chief Land Surveyor will maintain a record of all tied Property Corners or Property Controlling Corner monuments in the Geodesy Section. Additionally, a Corner Record will be sent by the Chief Land Surveyor to the appropriate County to be recorded.

C. Prior to District maintenance activities that will cover or destroy monuments

- (1) The District Engineer, under the direction of the Chief Land Surveyor, will follow the provisions in the Construction Manual (Sec.2-102.8) and field verify the presence of any monuments.
- (2) Any Public Land Survey Corners found will be reported to the Location Division with a request that the monument be perpetuated prior to maintenance activities.
- (3) All visible stamped or tagged Property Corner or Property Controlling Corner Monuments that may be disturbed will be tied by the District Engineer. The ties will be two (2) existing inter-visible NDOT Reference Monuments or two (2) set inter-visible NDOT Reference Monuments which will not be disturbed during maintenance activities. Instruction on procedures used to tie a Property Corner or Property Controlling Corner or to construct a NDOT Reference Monument will be available from the Chief Land Surveyor.
- (4) Found and tied monuments will be noted in the latest as-built construction plans and a written report identifying the character, location, description, and ties of the monument and NDOT reference monuments will be sent to the Chief Land Surveyor, Location Division, Carson City.
- (5) After review and acceptance of the written report, monuments used to reference a Public Land Survey Corner or property Controlling Corner shall be approved to be stamped with the Chief Land Surveyor's registration number by memo from the Chief Land Surveyor to the Resident Engineer.
- (6) The Chief Land Surveyor will maintain a record of all tied Property Corners or Property Controlling Corner monuments in the Geodesy Section. Additionally, a Corner Record will be sent by the Chief Land Surveyor to the appropriate County to be recorded.