Appendix G:
NYSDOT: *Standard Specifications Section 625 – Survey Operations*

624-4.03 Precast Concrete Gutters. The quantity to be paid for under this item will be the number of feet of gutter (laying length) placed in the work in accordance with the plans and specifications.

624-4.04 Cobble Gutters. The quantity of cobble gutters to be paid for under this work will be the number of square feet of exposed surface laid in accordance with the plans or as directed by the Engineer.

624-5 BASIS OF PAYMENT

624-5.01 Asphalt Concrete Gutters. The unit price bid per ton of asphalt concrete shall include the cost of furnishing all materials including the asphalt cement, the mixing, transporting, grading, placing, rolling and all equipment and labor necessary to complete the work including all necessary excavation below the finished surface, exclusive of any undercutting or excavation for special bedding materials. Payment of Quality Units will be made based on the Index Price listed in the contract documents. The index price shown in the itemized proposal for each Quality Unit shall be considered the price bid. The unit (index) price is not to be altered in any manner by the bidder. Should the bidder alter the amount shown, the altered figure will be disregarded and the original price will be used to determine the total amount bid for the Contract.

624-5.02 Conventionally Formed or Machine Formed Concrete Gutters. The unit price bid shall include the cost of furnishing all labor, materials and equipment necessary to complete the work including all necessary excavation below the finished surface exclusive of any undercutting or excavation for special bedding materials.

624-5.03 Precast Concrete Gutters. The provisions of §624-5.02 shall apply.

624-5.04 Cobble Gutters. The provisions of §624-5.02 shall apply.

Payment will be made under:

Item No.	Item	Pay Unit
624.01XX	Conventionally Formed or Machine Formed Concrete Gutters	Square Foot
624.020101	Asphalt Concrete Gutter	Ton
624.020110	Plant Production Quality Adjustment to 624.020101	Quality Unit
624.020601	Asphalt Concrete Gutters, as Detailed	Ton
624.020610	Plant Production Quality Adjustment to 624.020601	Quality Unit
624.03XX	Precast Concrete Gutters	Foot
624.0401	Cobble Gutters	Square Foot

Refer to the Standard Contract Pay Item Catalog for full Item Number and full Description.

SECTION 625 - SURVEY OPERATIONS

625-1 DESCRIPTION

625-1.01 General.

Some survey work is required be completed under the direction of a Land Surveyor or Professional Engineer in accordance with the professional license requirements contained in NYS Education Law.

625-1.02 Survey Operations.

This work shall consist of providing all necessary survey work to establish, spatially position, and verify the locations of existing and proposed terrain features and measure quantities of items in accordance with the contract documents or as directed by the Engineer. This work includes but is not

limited to the establishment, reestablishment or localization of primary and secondary control, the stakeout or layout of proposed features, the initialization, calibration and navigation of automated equipment operations, the location or verification of existing terrain or of constructed features, the verification of geospatial data for proposed construction work and the coordination and sharing of engineering data with the Department or other contract stakeholders.

625-1.03 Right of Way Markers.

This work shall consist of furnishing, installing and certifying right of way markers at the positions described on the right of way appropriation maps, in accordance with the contract documents and the Standard Sheet.

625-1.04 Permanent Survey Markers.

This work shall consist of furnishing, installing, and certifying permanent survey markers in accordance with the details shown on the appropriate Standard Sheet.

625-1.05 Supplemental Site Survey.

This work shall consist of providing all necessary field survey and terrain mapping necessary to locate, spatially position, verify and digitally map the locations of existing above or below ground terrain features as described in the contract documents or as directed by the Engineer. The limits of this supplemental survey will be described in the contract documents.

625-1.06 GPS Inspection Units.

This work shall consist of furnishing, configuring, installing, maintaining and removing Global Positioning System (GPS) units as needed for use by the Engineer and their inspection staff, including the training of the Engineer and their representatives on the use of the GPS units provided.

625-2 MATERIALS

625-2.01 General. None specified.

625-2.02 Survey Operations. None specified.

625-2.03 Right of Way Markers.

A. Concrete Right of Way Markers.

Concrete ROW Markers shall conform to the requirements of §712-05 *Precast Concrete Right-of-Way Markers*, and shall be in accordance with the details shown on the Standard Sheet.

B. Steel Pin and Cap Right of Way Markers.

Reinforcing steel used for the shank shall conform to ASTM A615, Grade 300 or Grade 420. It shall be epoxy coated for its entire length in accordance with §705-14 *Longitudinal Joint Ties* or §709-04 *Epoxy Coated Bar Reinforcement*.

The cap shall be aluminum or a corrosion resistant aluminum alloy. The cap shall weigh a minimum of 50 grams and fasten to the shank by means of threading or force fitting.

A commercial grade silicone sealant shall be used between the cap and the shank.

Steel Pin and Cap-Type Markers shall be anchored into rock using Concrete Grouting Material meeting the requirements of §701-05 *Concrete Grouting Material*.

625-2.04 Permanent Survey Markers.

The concrete shall meet the requirements of Class A Concrete in Section 501 *Portland Cement Concrete--General*, except that the requirements for inspection facilities, automated batching controls and

recordation do not apply. The batching, mixing and curing methods and the inspection facilities shall meet the approval of the Department. The Contractor may submit for approval by Director, Materials Bureau, a mix at least equivalent to Class A Concrete.

625-2.05 Supplemental Site Survey. None specified.

625-2.06 GPS Inspection Units.

Each GPS Unit shall include all necessary components, communication devices, integrated antennae and receiver, controller and/or data collector, cables, software, operating manuals, attachments, and fastening hardware to meet the minimum requirements described below.

A. All GPS Inspection Units.

1. All GPS units provided for a single contract shall be of the same model and manufacturer; and shall include, and be licensed to operate, the same versions of GPS planning software, data collection software, navigation software, stakeout software and post processing software. All software provided (including firmware) shall be the most current available from the manufacturer at the time of delivery of the GPS units. GPS units should be of the same manufacturer as those used by the Contractor. GPS units shall not be more than 2 years old from the date of manufacturing to the time of delivery. To verify the age of the GPS units, the Contractor shall provide a dated copy of the manufacturer's receipt(s) for the purchase, lease or rental of the units.
2. GPS units shall include both standard USB cable and Bluetooth wireless technology for data transfer.
3. Data shall be capable of being copied onto or from a removable industry standard data storage card (eg: secure digital SD Card). Each GPS Unit shall include 2 data storage cards, each with a minimum capacity of 4 GB.
4. GPS units shall include the ability to import/export and display point and alignment data which is in XML format, and also import graphics files which are in DGN or DXF format.
5. GPS units shall have an internal, or modular, rechargeable battery system capable of operating a minimum of 8 hours (may include interchangeable batteries), including the battery charger.
6. GPS units shall include a hard or soft shell carry case, and all appropriate operation manuals.

B. Survey Grade GPS Inspection Units.

1. GPS units shall be equipped to receive Global Positioning System (GPS), GLONASS and GNSS position data.
2. GPS units shall be equipped to receive, and be capable of utilizing, Real Time Kinematics (RTK) correctional data (current version of RTCM format) through internet protocol as provided from the NYS Continuously Operating Reference System (NYS CORS) Network. This shall include all necessary communication devices, repeaters and systems, data service plans and communications to meet the minimum required accuracy and not exceed a 2 second latency at the rover. Whichever communication method is utilized by the Contractor to broadcast the NYS CORS RTK correctional data, the Contractor shall ensure that the RTK data shall be available at all locations across the entire contract site during all hours of construction and inspection operations.
3. GPS units shall include the capability to "localize" both the horizontal and vertical control to local project monumentation (also known as calibrate), while utilizing RTK corrections from a reference network.
4. GPS units shall include either an integrated or modular communication device capable of receiving RTK correctional data to satisfy the requirement of using NYS CORS RTK corrections.
5. GPS units shall have the ability to display the number of satellites tracked at any one time, and indicate the accuracy quality of each measurement relative to the strength of signals, and the GDOP (Geometric Dilution of Precision).

6. GPS Unit shall include dual frequency receivers.
7. Minimum Required Kinematic Accuracy relative to primary project control (CORS): Horizontal: 0.033 ft + 1.0 ppm; Vertical: 0.065 ft + 1.0 ppm
8. All necessary hardware and software shall be included (including communication drivers) to connect the GPS unit to a Department provided Tablet PC and communicate/exchange positional data with Bentley™ OnSite software. Firmware used on the GPS unit shall be verified as interoperable with Bentley™ OnSite software. If the firmware cannot be verified as being interoperable with Bentley™ OnSite, the next older version may be used.
9. The data controller shall permit the user to program and store multiple configurations (also known as user preferences) prior to the actual field measurements. Configurations shall be capable of being stored and recalled in the field.
10. GPS units shall include one fixed height rover rod of 6.56 feet in length, one attachable bipod which is compatible with the rover rod, and one topo shoe.
11. A GPS unit set up to operate as a base station shall include all necessary additional cables, hardware, fasteners or accessories necessary to install it in a fixed semi-permanent location, . will not be considered as a rover unit, and therefore will not require a rover rod, a bi-pod, or a topo shoe.

C. Mapping Grade GPS Inspection Units.

1. Minimum Required Kinematic Accuracy: less than 3.0 feet in real time.
2. GPS units shall also provide standard support for the Wide Area Augmentation System (WAAS) position correction services.

625-3 CONSTRUCTION DETAILS

625-3.01 General.

A. Professional Responsibilities.

The following types of Survey Operations shall be completed by the Contractor under the direction of a Land Surveyor. This requirement is directly or indirectly associated with the professional license requirements contained in Article 145 of the NYS Education Law.

1. Establishment, reestablishment or localization of primary or secondary control which shall be used for:
   a. Establishing boundaries of new right of way appropriated for this contract.
   b. Location of property or highway boundary markers.
   c. Tie measurements to, or resetting of control points.
2. Location or resetting of existing highway and property boundary markers by reference ties to or from contract control to protect their integrity.
3. Establishment or certification of location of right of way markers and permanent survey markers.

The following types of Survey Operations shall be completed by the Contractor under the direction of either a Land Surveyor or Professional Engineer.

1. Establishment, reestablishment or localization of primary or secondary control which shall be used for:
   a. Establishing location for horizontal or vertical roadway alignment.
   b. Establishing location for the horizontal or vertical alignment of a structure.
   c. Establishing or localizing reference base station for Global Positioning System (GPS) control work.

2 Establishing new horizontal or vertical roadway alignment in the field from contract control either by conventional stakeout methods or by use of automated equipment operations.

B. Survey/Engineering Geospatial Data.

All establishments or reestablishment of contract primary or secondary control, and the survey collection of terrain data shall be performed in accordance with the standards and procedures required in the Department's *Land Surveying Standards and Procedures Manual.* The Contractor shall incorporate the NYS CORS network into contract control to facilitate the use of GPS survey within the site and on the same datum by other project stakeholders, or to align with other adjacent projects.

When the Department provides electronic copies of engineering data to the Contractor, files should follow the standard file naming conventions listed in Appendix 14 of the Department's *Project Development Manual.*

1. Existing Terrain Data. When an existing digital terrain model was developed during design and provided for construction purposes, and possibly updated during construction by supplemental survey, the Department and Contractor shall use that information as a basis from which to develop contract pay item quantities. The Contractor shall consider all existing terrain data supplied by the Department as being within acceptable tolerances, except where changes or additions have been approved by the Engineer. If the Contractor questions the accuracy of the existing terrain data provided, the Contractor may verify any or all portion(s) of the existing terrain model, at no additional cost to the State, in accordance with §105-10 *Survey and Stakeout*. All exceptions or discrepancies found with the supplied existing terrain data shall be brought to the attention of the Engineer, in writing, and terrain data modifications shall be mutually agreed upon and shared with both parties prior to beginning construction operations within those areas being modified. Changes to existing terrain data will not be accepted by the Department where existing terrain is verified to be within Departmental accepted positional tolerances in accordance with the Department's *Land Surveying Standards and Procedures Manual*, or after the Contractor has disturbed the existing ground surface.

2. Proposed Data. When proposed digital terrain models (or surfaces), proposed alignments and proposed graphics were developed during design and provided for construction purposes, or revised during construction due to site changes or redesign, the Department and Contractor shall use that information from which to position and compute applicable contract pay item quantities and to field verify positional locations of constructed items. When the Contractor and Department agree to utilize the proposed digital terrain data (surface), alignments or graphics the Contractor shall first review its consistency with all other contract information, and review for any perceived physical conflicts or inconsistencies of information prior to using the data in the field for any construction purpose. All exceptions or discrepancies with the supplied data shall be brought to the attention of the Engineer, in writing, and terrain data, alignment or graphics modifications shall be approved by the Engineer prior to beginning construction operations within those areas being modified. All approved changes shall be shared electronically with both the Department and the Contractor, and both parties shall acknowledge acceptance of such changes before beginning the work.

When proposed digital terrain model (or surfaces), alignments or graphics are not provided by the Department, the Contractor may choose to develop their own terrain model surfaces from the contract plans to facilitate their use of Automated Machine Guidance, at no additional cost to the State. A request by the Contractor to use Automated Machine Guidance shall be made as part of the Contract Control Plan. The Contractor developed terrain model surfaces shall be shared with the Engineer in a Department accepted format prior to beginning construction operations. Generation of proposed terrain model surfaces or other electronic engineering data does not constitute a redesign of the project, and the Contractor retains all responsibility to complete the work in accordance with the engineering intent conveyed in the contract documents unless otherwise agreed to in writing by the Engineer.

625-3.02 Survey Operations.

All Survey Operations shall follow either Traditional *Survey Stakeout* or Automated Stakeout and *Automated Machine Guidance Operations*, or a combination of both, for the establishment, positioning, equipment guidance or verification of construction items. The proposed method shall be approved by the Engineer as part of the Contract Control Plan prior to beginning any field construction operations. Both methods include the same basic requirements that: (1) both parties (Contractor and Department) utilize the same contract control, the same existing terrain data, and the same proposed feature data; (2) both parties utilize the same accuracy and tolerance limits; and (3) both parties utilize equivalent survey verification techniques to ensure that field features are constructed as proposed.

The Contractor shall establish the center line of bearings for all bridge abutments and piers, by setting offset hubs or reference points, so located and protected to ensure they remain undisturbed until such time as they are no longer needed. The Contractor shall mark the location of anchor bolts to be installed, establish the elevation of bearing surfaces and check bearing plates to ensure installation at their proper elevation. Before the erection of structural steel or concrete beams the Contractor shall verify the locations, both vertically and horizontally, of all bearings and the distances between associated bearings. Control used to establish center line of bearings shall be included in the contract control plan.

On contracts which include proposed and existing roadway alignments and profiles, the Contractor shall verify the roadway tie-in locations of where existing and proposed alignments meet prior to beginning construction operations and report the results to the Engineer. This requirement is intended to verify that no changes have occurred to the existing roadway and that the proposed design is buildable as designed.

A. Contract Control Plan.

The Contractor shall develop and submit a Contract Control Plan for all contracts which include the contract pay item for Survey Operations. Contract control includes all statewide or local primary and secondary horizontal and vertical control which will be used for the geospatial positioning of work items. Upon the Contractor's completion of initial survey reconnaissance and control verification, but prior to beginning primary field operations, the Contractor shall submit a Contract Control Plan document which is to be signed and sealed by a Land Surveyor or Professional Engineer in accordance with §625-3.01.*A Professional Responsibilities*, for acceptance by the Engineer. The Contract Control Plan shall include the below listed required control information and follow the acceptance procedure.

All revisions or additions to contract control for the purpose of stakeout or layout of proposed work items shall be provided in writing to the Engineer prior to beginning that revised portion of stakeout or layout work.

1. Acceptance Procedure.

a. The Contractor shall document required information and submit electronically to the Engineer at least 10 work days prior to beginning field operations.

b. The Engineer will coordinate review with the Regional Land Surveyor and provide comments.

c. Upon acceptance of the procedure by the Engineer, the Contractor shall submit 2 signed and sealed copies to the Engineer.

2. Control Information.

The Contractor shall list the following control information (tabular format is acceptable):

a. All contract control shown in the contract documents or in the Survey Control Report.
Note: The NYS CORS Network provides primary control for most Department contracts.

b. The following elements shall be submitted for all contract control points or benchmarks:

(1) Recovered in the field and did it appear undisturbed?

(2) Contract indicated coordinate or elevation.
(3) Field determined coordinate or elevation.
(4) Contractor adjusted coordinate or elevation, if necessary.
(5) Point or benchmark intended to be used for construction purposes.

c. Adjustment method is used to balance or adjust the control (ex: Compass Rule for Baseline or Calibration Report for GPS, etc). Attach a copy of the adjustment/calibration report.

d. Control network diagram (drawn to a legible scale) with roadways indicated.

e. New York State Plane Coordinate System (NYSPCS) Zone utilized.

f. Horizontal Datum used.

g. Vertical Datum used.

h. Combined Factor used to account for the ellipsoidal reduction factor and the grid scale factor.

i. Additional (new) control is anticipated to be needed and where will they be set?

j. When a GPS base station(s) is utilized on a project either for inspection or stakeout, provide the determined coordinate and elevation value of the station, and the datum differential from that localized value to a NYS CORS determined value.

3. Methods or Procedures.

The Contractor shall document and provide the following survey information on methods or procedures to be used:

a. Survey method used to verify the control (ex: Total Station, GPS/RTK, Auto Level, etc).

b. Survey method(s) used to stakeout which types of proposed features.

c. Survey method(s) used to stakeout proposed ROW Markers.

d. Survey method used for stakeout of proposed bridge structures (if applicable). How will control be set up and maintained around the bridge(s)?

e. Proposed manufacturer, model and software version for GPS Inspection Units.

f. Automated Machine Guidance (AMG) proposed for use on this contract.

g. Type and frequency of quality control measures included to maintain the proper calibration and adjustment of the AMG systems.

h. If GPS will be used for stakeout or for AMG, will the NYS CORS Network be used as its reference network or will base station(s) be used?

i. If a base station is to be used, describe the mounting location, attachment technique, and instrumental protection included which ensures a sound and reliable reference station will be provided.

B. Traditional Survey Stakeout.

The Contractor shall field locate all features to be constructed from survey control points which are identified in the Contract Control Plan. Any error, apparent discrepancy or absence in the data shown or required to appropriately accomplish the stakeout survey shall be referred to the Engineer immediately for interpretation when such is observed or required.

The Contractor shall place two offset stakes or references points along the center line at maximum intervals of 50 feet and at such intermediate locations as required to determine location and direction. From computations and measurements made by the Contractor, these stakes shall be clearly and legibly marked with the center line station number, offset and cut or fill from which the establishment of the centerline location and elevation can be determined. If markings become illegible for any reason the markings shall be restored by the Contractor. The Contractor shall locate and place all cut, fill, slope, fine grade, or other stakes and points for the proper progress of the work with a maximum station spacing of 50 feet. All control points shall be properly protected and flagged for easy identification.

The Contractor shall be responsible for the accuracy of the work and shall maintain all applicable reference points, stakes, etc. Damaged or destroyed reference points or bench marks made inaccessible by the progress of the construction shall be replaced or transferred by the Contractor. All control points shall be referenced by ties (4 minimum) to specific points on acceptable objects and recorded. Any alterations or revisions in the ties shall be so noted and the information furnished to the Engineer. All stakeout survey work related to highway control shall be referenced to the control line (or survey baseline) shown in the contract documents. Computations and survey notes necessary to establish the position of the work from control points, shall be made and maintained in a neat, legible and acceptable format by the Contractor. Computations, survey notes and other survey information shall be made available to the Engineer within 3 work days from the request. The Engineer may check all or any portion of the stakeout survey work or notes made by the Contractor. Such checking by the Engineer shall not relieve the Contractor of any responsibilities for the accuracy or completeness of the work.

C. Automated Stakeout and Automated Machine Guidance Operations.

Should the Contractor choose automated methods for the establishment, layout, measurement, equipment guidance or verification of work to be constructed, they shall submit their proposed automated methods including quality control measures as part of their contract control plan for acceptance by the Engineer. When utilizing these methods, all horizontal and vertical survey control, roadway alignment control, existing terrain data and proposed design engineering data shall be shared/exchanged electronically and kept current between the Contractor and the Engineer. All original version files of electronic contract data shall be maintained and stored by the Department. Prior to beginning field operations, the Contractor and Engineer shall mutually determine acceptable uses of and procedures for the technology being used, and how data can be exchanged for use in stakeout, automated machine operations, positional verification, quantity measurements and calculations. All record copies of engineering data shall be stored and shared in Department accepted standard formats, and shall be derived primarily from the original electronic data, when provided by the Department.

Automated survey operations have a high reliance on accurate control networks from which to make measurements, establish positions, and verify geospatial locations of features. Therefore, a strong contract control network in the field which is consistent with the project control used during the design of the contract is essential to the successful use of these technologies with the proposed digital terrain model and alignments. Consistent and well designed site calibration (localization) for all automated machine guidance, as described above under *Contract Control Plan*, is required to ensure the quality of the contract deliverables. The Contract Control Plan is intended to document which local horizontal and vertical control will be will be used for calibration during construction operations and how that calibration or adjustment will be maintained along the entire contract length. Continued incorporation of NYS CORS Network is essential to maintaining the integrity of positional locations and elevations of features.

The Engineer may perform quality assurance verifications of feature positions at any time during the contract. Dimensional tolerances shall hold a higher order of precedence than positional tolerances, but both may require verification. Quality assurance activities by the Engineer will not relieve the Contractor of any responsibilities for the quality control of the accuracy or completeness of the work.

The Department's verification of the positional locations of features, calculation and merging of supplemental terrain data surfaces, and the measurement and calculation for quantity payments will be performed using Department standard software. Both the Contractor and the Department shall utilize the following standards: (1) All terrain data collected for the purpose of being used for or merged with Department provided terrain data for the calculation of pay quantities shall be delivered in a format and correctly display in accordance with the current Departmental CADD Standards. (2) The Department will maintain record copies of electronic data files which will be available to the

Contractor using the Department's designated file management system or other method. This will ensure that both parties utilize the same credible data from which to establish locations and measure quantities. The Department will provide all available CADD resource files for use by the Contractor.

The Contractor may choose to introduce an additional new automated survey method or technology which involves a new technique for positioning features, measuring quantities, or verifying constructed locations. The quality and accuracy of this data produced by this method shall be demonstrated to the Engineer, for acceptance, by a comparison of this method to previously accepted techniques over a mutually agreed upon portion of the work. The new technology shall meet or exceed the quality and accuracy results provided by previously accepted techniques, and the Engineer shall make the final determination as to the acceptability of its use based on the resulting performance, cost savings, safety and effectiveness of the operation. Previous uses of this same method on other contracts or by other contractors are not acceptable evidence of a technology's viability, due to inherent variations in operator's experience levels, data availability, changing field conditions and differing technologies.

625-3.03 Right of Way Markers.

The Contractor shall verify with the Engineer that it has the most current vested Right of Way Acquisition Maps to determine the geospatial positions of all proposed right of way markers. Right of way markers are indicated in the contract for approximate locations and quantities, and shall not be positioned according to the contract information, but rather by the positions shown for the equivalent points on the ROW Maps.

Right of way marker locations shall be determined under the direction of a Land Surveyor from a closed traverse or GPS network which is included in the contract control plan and in accordance with Federal Geographic Data Committee (FGCC) C2-II, Second-Order, Class II (1 part in 20,000) accuracy, ensuring a local accuracy of 0.065 ft as described in the Department's *Land Surveying Standards and Procedures Manual.*

The Contractor shall install right of way markers at the station/offset positions specified on the vested Right of Way Acquisition Maps in accordance with the Standard Sheets to within an absolute positional tolerance of 0.065 ft relative to the primary project control network.

The Land Surveyor shall certify the as-built location of each installed right of way marker on certification forms provided by the Engineer, including contract information, and control line station and offset (proposed and as-built) to the marker. The record location of all right of way markers shall be recorded to the nearest 0.01 ft and reflect as-built coordinates from a closed traverse or GPS network which is included in the contract control plan and in accordance with FGCC C2-II, Second-Order, Class II (1 part in 20,000) accuracy.

Prior to placing the cap on a steel pin right of way marker, the cap shall be filled 2/3 full of silicone sealant and then fastened to the bar by threading or by force fit. During the driving operation for the steel pin right of way marker, the lettering on the cap shall be protected by the use of a metal sleeve or cushion block. The marker shall be driven so that the cap is flush with the ground surface.

625-3.04 Permanent Survey Markers.

The Contractor shall install permanent survey markers in accordance with the standard sheet at locations described in the contract documents and approved by the Engineer prior to installation. The Engineer will provide the Contractor with the sequential numbering required on the permanent survey marker caps in coordination with the Regional Land Surveyor.

The Contractor shall provide the as-built location of each installed permanent survey marker on certification forms provided by the Engineer, including contract information, as-built NYSPCS values, control line and centerline station and offset to the marker, distance and direction to adjacent markers, the elevation of the marker, and a sketch which shows the relative positions to the control line points, four physical ties to the markers, and a north arrow. The certification form shall be sealed and signed by a licensed Land Surveyor. The record location of all permanent survey markers shall be recorded to the

nearest 0.01 ft and reflect as-built coordinates from a closed traverse or GPS network which is included in the contract control plan and in accordance with FGCC C2-II, Second-Order, Class II (1 part in 20,000) accuracy as described in the Department's "*Land Surveying Standards and Procedures Manual.*"

625-3.05 Supplemental Site Survey.

The Contractor shall perform supplemental site survey work in accordance with §625-3.01 *General* and §625-3.02. *Survey Operations*. The limits of the survey and mapping and the need for property line or right of way determination shall be as described in the Special Note entitled *Supplemental Site Survey Requirements*. Changes to the contract established limits by the Engineer shall be considered changes to the scope of work. The work shall include:

1. The Engineer shall determine what level of detailed information may need to be added to the Contract Control Plan for a supplemental site survey. Significant additional requirements will be considered extra work.
2. For new locations, a minimum of 3 inter-visible horizontal control points and 2 benchmarks shall be set at each site.
3. All survey control and terrain data collection shall be performed in accordance with the standards and procedures required in the Department's *Land Surveying Standards and Procedures Manual.*
4. Survey shall include all readily identifiable surface and subsurface utilities, including, but not limited to drainage, sanitary, water supply, gas, electric and telephone. The Contractor shall contact the appropriate one call center to identify all underground utilities so they can be marked in the field at each site prior to survey.
5. If property or right of way markers are found inside of or within 30 ft of the survey limits, they shall be located and described as part of the survey.
6. For traffic signal intersection work, elevations of above-ground utilities at the poles and at sag points shall be provided for primary and secondary electric lines, telephone lines and cable television lines. Utility poles shall be identified, including pole numbers. The next pole by number, and next manhole or valve. Sign inventory shall include only a type designation (e.g. stop sign, no parking sign, etc.) without MUTCD code, or a brief description of a private sign.
7. For underground utility surveys, the horizontal positions and vertical elevations of all exposed public and private utilities within the described limits shall be located, mapped and appropriately identified by the Contractor according to the utility's identification. Horizontal positions and vertical elevations shall be determined from project control to within 2 inches of its absolute location. Linear utilities shall be located at all bend or angle points, junctions or termini, and at a spacing of no more than 50 feet.
8. Copies of original survey field data, tie diagrams, and control diagrams shall be provided in Department accepted formats.
9. All terrain mapping deliverables (DGN & DTM) shall conform to the requirements included in Chapter 20 and 22 of the Department's *Highway Design Manual*.
10. File naming convention shall conform to standards listed in Appendix 14 of the Department's *Project Development Manual*.

625-3.06 GPS Inspection Units.

The Contractor shall furnish, configure, install, maintain and remove the GPS units, and provide the Engineer and/or their representatives with training on the operation of the GPS units. The Contractor shall ensure all GPS units are fully operational and training has been provided before construction begins.

All projects shall utilize the NYS CORS as the spatial reference datum network from which RTK corrections are derived. The Contractor shall choose which communication technique and devices will be used which will insure the consistent and reliable delivery of RTK correctional data from the NYS CORS to the GPS units. When geographic location or lack of a reliable communications network prohibits the use of the NYS CORS, the Engineer may approve the use of a Survey Grade GPS Inspection unit as a

base station in place of the NYS CORS, which will be paid for separately. The Contractor shall semi-permanently mount the base station in a stable and secure location where it shall not be disturbed by construction activities nor be easily damaged by vandalism and where it shall be capable of providing radio signal coverage over the entire contract area. If the base station cannot broadcast a signal that covers the entire site, the Contractor shall provide adequate repeater radios or other communications. A GPS unit installed as a base station for inspection operations shall only be moved with the approval of the Engineer.

The GPS units shall be maintained and remain in service until either: (a) a maximum of one week after the Engineer requests its removal in writing, or (b) the State relinquishes the Engineer=s Field Office. The Contractor shall maintain all GPS units and software in good working condition and shall provide replacement due to breakdown, damage, or theft within 2 work days. The Contractor shall retain ownership of all supplied GPS units at the end of the contract.

A. GPS Training Provisions.

1. For all GPS units, the Engineer and/or their representatives shall be provided with a minimum of one 8 hour training session for GPS localization/calibration of the contract site.
2. For all Survey Grade GPS units, the Engineer and/or their representatives shall be provided with a minimum of two separate 8 hour minimum training sessions on the use and operation of the GPS units during the first year of the contract. One of these two sessions shall occur within one week of delivery of GPS units to the site. The second of the two classes shall occur upon the request of the Engineer. One additional 8 hour minimum training session shall be provided during each additional contract year that the GPS units are in service.
3. For all Mapping Grade GPS units, the Engineer and/or their representatives shall be provided with a minimum of one training session during the first year of the contract, being at least 8 hours in length, and to occur within one week of delivery of GPS units to the site. This training shall be separate from the Survey Grade GPS Unit training.
4. All training shall be performed by a manufacturer-verified trainer who is approved by the Engineer. The training shall occur at the Engineer's Field Office or at a location agreed to by the Engineer.

625-4 METHOD OF MEASUREMENT

625-4.01 General. (Vacant)

625-4.02 Survey Operations. This work will be measured on a lump sum basis.

625-4.03 Right of Way Markers. The quantity to be measured for payment will be the number of right of way markers installed.

625-4.04 Permanent Survey Markers. The quantity to be measured for payment will be the number of permanent survey markers installed.

625-4.05 Supplemental Site Survey. This work will be measured on a lump sum basis for each site location.

625-4.06 GPS Inspection Units. The quantity to be measured for payment will be the number of GPS Inspection units provided.

625-5 BASIS OF PAYMENT

625-5.01 General. (Vacant)

625-5.02 Survey Operations. The price bid shall include the cost of furnishing all labor, materials and equipment necessary to satisfactorily complete the work, including preparation of the contract control plan. Progress payments will be made in proportion to the amount of work completed.

625-5.03 Right of Way Markers. The unit price bid shall include the cost of furnishing all labor, materials, and equipment necessary to satisfactorily complete the work. Payment will be made after the complete and proper installation of the marker, receipt of the certification form by the Engineer, and after approval of the certification by the Regional Land Surveyor.

625-5.04 Permanent Survey Markers. The unit price bid shall include the cost of furnishing all labor, materials, and equipment necessary to satisfactorily complete the work. Payment will be made after the complete and proper installation of the marker, receipt of the certification form by the Engineer, and after approval of the certification by the Regional Land Surveyor.

625-5.05 Supplemental Site Survey. The price bid shall include the cost of furnishing all labor, materials and equipment necessary to satisfactorily complete the work. Payment will be made upon the satisfactory submission of the completed and certified mapping deliverables. Substantive additions to the work limits described in the contract will be considered extra work.

625-5.06 GPS Inspection Units. The unit price bid shall include the cost of labor, materials and equipment necessary to satisfactorily complete the work, including the cost of the required training and necessary maintenance.

Payment will be made under:

Item No.	Item	Pay Unit
625.01	Survey Operations	Lump Sum
625.03	Concrete Right of Way Markers Type H (High)	Each
625.04	Concrete Right of Way Markers Type L (Low)	Each
625.05	Steel Pin and Cap Right of Way Markers	Each
625.06	Permanent Survey Markers	Each
625.07nnnn	Supplemental Site Survey	Lump Sum
625.11nnnn	Survey Grade GPS Inspection Unit	Each
625.12nnnn	Mapping Grade GPS Inspection Unit	Each

SECTIONS 626 THRU 628 (VACANT)

SECTION 629 - PETROLEUM STORAGE TANK CLOSURE

629-1 DESCRIPTION

629-1.01 General. This work shall consist of emptying, purging/inerting, cleaning, removing, and disposing of petroleum storage tanks; endpoint sample collection and analysis; and proper documentation of the work in accordance with the contract documents and as directed by the Engineer.

629-2 MATERIALS (Not Specified)

629-3 CONSTRUCTION DETAILS