Section 6.2

PRECAST CONCRETE PIPES

6.2.1 PURPOSE

The procedure provides guidance for the development and implementation of the Quality Control (QC) and Quality Assurance (QA) programs for the manufacture, storage, and transportation of the precast concrete pipes for the Florida Department of Transportation projects. The precast concrete pipe may include, but are not limited to, round concrete pipe, elliptical concrete pipe, mitered end sections, and underdrain pipe.

6.2.2 AUTHORITY

(A) Sections 20.23(3)(a) and 334.048(3), Florida Statutes.

6.2.3 REFERENCES

(A) Design Standards, Topic No. 625-010-003, Florida Department of Transportation.

(B) Florida Department of Transportation Standard Specifications for Road and Bridge Construction.

(C) American Society for Testing and Materials (ASTM) Standard Test Methods and Specifications, Philadelphia, Pennsylvania.

(D) American Association of State Highway and Transportation Officials (AASHTO), Part I Specifications, and Part II Tests, Washington, D.C.

(E) Qualified Products List, Florida Department of Transportation.

(F) *Field sampling and Testing Manual, Florida Department of Transportation.*

6.2.4 SCOPE

This procedure is used by the Precast Concrete Pipe Manufacturers (Manufacturers), Florida Department of Transportation (Department), and consultants that are retained by the Department to perform the required

inspections and testing of the Precast Concrete Pipes (Pipes) during manufacturing. These requirements and activities pertain to the inspections, measurements, and necessary tests to substantiate materials and Pipes in conformity with the contract documents. The Manufacturer's Quality Control Plan (QCP) is designed to provide guidelines that are used by the Pipe Plants to produce Pipes in conformance with Department's Standard Specifications. The QC activities are performed by the Manufacturers or personnel retained by them.

The Department's QA plan includes the planned and systematic activities that provide adequate confidence of assuring that the Manufacturers will fulfill the requirements of the QCP and produce Pipes that conform to Department's Standard specifications. The QA plan is composed of the Verification, Independent Verification , Plant Qualification Review (PQR), and Independent Assurance (IA) inspection and testing. IA and PQR inspections may be performed by Department representatives who are not directly assigned to the Verification inspections and testing, by other local or state agency representatives, and by Federal Highway Administration (FHWA).

6.2.5 GENERAL INFORMATION

The Precast Concrete Pipe Plants (Plants) are responsible for the production, inspection, storage, and shipment of the Pipes that meet the requirements of the Department's Standard Specifications and other Contract Documents. The Department's District Materials Offices are responsible for verifying that manufactured Pipes conform to the requirements of Contract Documents. The State Materials Office will be responsible for maintaining the current Plant Qualification status, technical support, and QA program monitoring. All Plants shall be inspected and their QCP shall be accepted by the Department prior to commencement of any work.

The Quality Control/Quality Assurance Programs for Precast Concrete Pipes are composed of the Manufacturer's QCP and the Department's QA Plan. The Manufacturer's QCP shall include sampling, testing, and inspections. The Department's QA plan provides Verification and Independent Assurance inspection and testing.

6.2.6 PLANT QUALIFICATION PROCESS

6.2.6.1 General

The Department's Plant Qualification program constitutes a process for identification of facilities deemed capable of producing Pipes meeting the requirements of the Department's Standard Specifications.

6.2.6.2 Review of Plant's Proposed Quality Control Plan

The Manufacturer submits the proposed QCP to the Department's District Materials Office for the District in which the Plant is located. For out-of-state Plants, the QCP shall be submitted to the Department's nearest District Materials Office. Upon the Plant's submittal of a QCP, the District Materials Office will review the proposed QCP and make necessary arrangements for the initial PQR in accordance with Section 6.2.6.3. The District Materials Office may contact the State Materials Office for review of the proposed QCP. The District Materials Office will review and accept the proposed QCP. Modifications to the QCP shall be submitted for acceptance in the same manner.

The QCP shall include the work experience, Qualifications, and responsibilities of the Plant's production and QC personnel. The on-site Production Manager, Plant General Manager, QC inspectors/technicians, and Quality Control Manager (QCM) shall be identified. The key quality attributes and QC charts shall be identified along with examples. Responsibilities for monitoring key quality attributes and QC data are to be identified. The QCP shall include the information required in ***Sections 6-8, 105, and 449 of the Department's Standard Specifications***. The Manufacturer shall have a QCP that is accepted by the Department prior to commencement of any work. The QCP shall include a management statement of dedication to quality and to the QCP.

A copy of the Plant's proposed repair methods of the Pipe deficiencies shall be included as part of the QCP.

6.2.6.3 Plant Qualification Review (PQR)

The initial PQR will be performed on all production facilities that intend to produce Pipes for the Department projects. These production facilities include Plants that submit their first QCP and Plants that have not produced for the Department projects for more than a year. The Department will also perform routine PQR, at least annually, on all Plants that have continued furnishing Pipes for the Department projects.

The District Materials Office will form a Plant Qualification Review Team (PQRT) and makes necessary arrangements to perform the Plant's Qualification Review. The PQRT may be comprised of the District and State Precast Concrete Engineers, District Concrete Engineers, District and State Drainage Engineers, and representative(s) of the FHWA. The PQRT will

closely and thoroughly review the Plant's design, manufacturing process, QC testing, inspection, and documentation to ensure that they meet the Department's established standards. The PQR may include the review of the Plant's records, forming, reinforcing steel placement, concrete placement operations, storage, and shipment of the products. The PQRT will thoroughly check the production process of the Plants. The Plant will be notified by the District Materials Engineer to begin or continue production for Department projects, when the PQRT report indicates that the Pipes can be produced in compliance with the specifications.

6.2.6.4 Maintenance of Plant Qualification:

Upon the Department's satisfactory review of the proposed QCP, in compliance with ***Section 5.6 of the Materials Manual***, and satisfactory PQR, the District Materials Office will accept the proposed QCP and include the Plant on the list of Department's Qualified Pipe Plants. The State Materials Office will maintain the list of the statewide Qualified Precast Concrete Pipe Plants. The Manufacturer shall submit, in writing, any changes to the QCP.

Plants that are on the Department's Qualified Pipe Plants list will be subject to the PQR process at any time. The PQRT will perform at least an annual review of the Plants that are producing for the Department projects. Upon completion of the inspections, the PQRT will advise the Manufacturer regarding the results of their Plant's Qualification status. If the PQRT or Verification Inspector finds any process, which would result in products that would not meet Specifications, they are to be brought to the attention of the Manufacturer and documented. If the problems are not corrected, the Plant Qualification status may change and all Pipes manufactured subsequent to the date of notification will be considered unacceptable.

6.2.6.5 Plant's Qualification Status

The Plant shall produce Pipes that consistently meet the Department requirements in order to maintain Qualifications. The Plant Qualification status is characterized by, either full Qualification, Conditional Qualification, or Disqualification categories.

6.2.6.5.1 Plant's Full Qualification Status

The Plant's Full Qualification status indicates that the Plant is operating with an approved QCP and the results of the Verification Inspection and PQR indicate that the Plant has capability of consistently producing Pipes that meet Department's specified requirements.

6.2.6.5.2 Plant's Conditional Qualification Status

Plant's Conditional Qualification status indicates that the Plant is operating with an accepted QCP. Verification Inspection and/ or PQR indicates that discrepancies exist in the manufacturing process or QC, the Plant has failed to correct the deficiencies, or the same types of deficiencies have recurred. When a Plant fails to maintain compliance with the requirements of the Department's Standard Specifications, QCP, and Contract Document, as evaluated by the Department, the Plant may be placed on a Conditional Qualification status for a specific period of time. The District Materials Engineer will notify the Plant in writing of the reasons for status change and its effective date. The time period is at the discretion of the District Materials Engineer and will be for a period of time commensurate with the nature of the deficiencies and required corrective action, but not to exceed six months. The Plant's Conditional Qualification status will be changed to Qualified status after the deficiencies are resolved to the satisfaction of the District Materials Engineer.

A Plant that is on a Conditional Qualification status will not be allowed to fabricate Pipes for the subsequent projects until the deficiencies have been resolved. Stockpiled Pipes and currently produced Pipes may be accepted for Department use when the Plant is under an increased level of Verification Inspections as determined by the District Materials Engineer.

After the corrective actions, the Plants may provide a written request to the District Materials Engineer for a review of their Status.

6.2.6.5.3 Plant's Disqualification Status

The District Materials Office may withdraw the Plant from the list of Qualified Plants for any of the following conditions:

(1) Lack of maintenance of required records and improper documentation.

(2) Failure to maintain an approved QCP.

(3) Inability to fabricate Pipes that consistently meet specification requirements.

(4) Failure to satisfactorily resolve deficiencies identified by PQRT.

(5) Falsification of records.

The Department will not accept the currently fabricated or stockpiled Pipes until the Plant has met all requirements for re-qualification.

6.2.7 FUNCTIONS AND RESPONSIBILITIES OF PIPE MANUFACTURER

6.2.7.1 General

The Manufacturer is responsible for the quality of the finished Pipes and shall provide facilities and Qualified personnel to perform specified tests and maintain an acceptable QC program in compliance with the requirements specified herein and in ***Section 449 of the Department's Standard Specifications***. The Manufacturer is responsible for the QC inspection and testing of Pipes, Pipe materials, placement of reinforcing steel, and batching, placement, and curing of concrete during production. The Manufacturer shall also provide all necessary equipment and personnel to aid the Department inspector in performing QA testing, including facilities for inspection during production, and approved shop drawings for special designs. The Manufacturer shall ensure of the proper fit of the Pipes at time of utilization. The Manufacturer is responsible for the condition of the Pipe during Plant storage and shipment to the project site until the title is transferred to the Contractor.

6.2.7.2 Quality Control Manager

The QCM shall be an ACI Grade I Field Testing Technician and shall have at least two years of related experience in the QC inspection and testing. The QCM may serve in more than one Plant. The QCM shall ensure that the quality of the products at each Plant meets the quality requirements of the contract documents**.** The responsibilities of the QCM include, but not limited to, the following:

(A) Maintains the QC approval stamp and applies it to acceptable Pipes, or designates a technician, who is working under the direct supervision of the QCM to apply the Plant approval stamp. The Plant approval stamp mark shall be legible and applied to each Pipe before its shipment to the project site.

(B) Be present, or designates a technician/inspector working under the direct supervision of the QCM to be present, during the production of all Pipes that will be shipped to Department projects.

(C) Performs and/or supervises the QC testing and inspection.

(D) Ensures that the Plant has a sufficient number of QC technician(s)/Inspector(s) to maintain adequate inspection and testing during the production of Pipes for Department projects. In lieu of a permanent staff, the Plant may retain the services of a Qualified laboratory meeting the requirements of ***Section 6-9 of the Department's Standard Specifications***.

(E) Ensures that the testing equipment is maintained and calibrated in accordance with the applicable test methods and specifications.

(F) Visually inspects or ensures that a Qualified QC technician inspects each Pipe before it is shipped to the project site.

(G) Ensures that all materials used in the manufacture of the Pipes are from a Department accepted source.

(H) Maintains a daily production log of the Pipes.

(I) Ensures that all Pipes are properly stored and marked with Plant name and other information that is required in the applicable ASTM or AASHTO standards.

(J) Maintains the files of material certifications, test data, and inspection results.

(K) Arranges monthly meetings with the Verification Inspector and representatives of the Plant's production personnel to discuss any deficiencies and QC/QA issues.

6.2.7.3 Technicians/Inspectors

The QC technicians may perform any or all of the inspections, sampling, or testing as directed by the QCM, and may stamp the Plant approved Pipes, when directed by the QCM. The QC technicians who perform the sampling and testing of plastic concrete shall have a current American Concrete Institute (ACI) Field Testing Technician, Grade I certification.

6.2.7.4 Quality Control of Certified Materials

6.2.7.4.1 General

All materials used in the manufacture of Pipes shall come from approved sources and shall comply with requirements as specified herein.

6.2.7.4.2 Reinforcing Steel and Welded Wire Fabric

The QC inspectors shall obtain steel manufacturer's certifications for all welded wire fabric and reinforcing steel that are used for the manufacture of Pipes. The certification shall indicate compliance with the appropriate ASTM or AASHTO standards for wire, welded wire fabric, and for steel bars. The Department Verification Inspectors may take samples, at each Plant, from at least two randomly selected LOTs per year. A LOT is a single vehicle load of the reinforcing steel or welded wire fabric of the same grade and manufacturer that is delivered to the Plant. The reinforcing steel shall meet the requirements of ***Section 415 of the Department's Standard Specification***.

6.2.7.4.3 Coarse and Fine Aggregates

The District Materials Office may obtain Verification samples at the source or at the Plant. The aggregates delivery tickets shall include the following information:

(1) Name of producer

(2) Location of mine

(3) Department pit number

(4) Department material code

(5) Delivery date

(6) Aggregate producer's certification statement with each shipment indicating that the shipped products comply with Department specifications.

The Fine and Coarse Aggregate shall be maintained in separate stockpiles. Each stockpile shall have Department Identification pit number.

6.2.7.4.4 Cement

The delivered cement shall be accepted on the basis of the cement producer's certification indicating compliance with ***Section 921 of the Standard Specifications***. A certification for each shipment of cement is required. Verification samples may be obtained at the discretion of the District Materials Engineer.

6.2.7.4.5 Pozzolans and Slag

Pozzolans and ground granulated blast furnace slag shall be accepted on the basis of the supplier's certification indicating compliance with ***Section 929 of the Departments Standard Specifications*** and other Contract Documents. A certificate for each shipment of pozzolans and slag is required. Department Verification Inspectors may take a sample at Plant or Producer's source.

6.2.7.4.6 Batch Water

Water used for mixing concrete shall comply with ***Section 923 of the Department's Standard Specifications***.

6.2.7.4.7 Chemical Admixtures

Admixtures shall meet the requirements of ***Section 924 of Department's Standard Specifications*** and shall be approved by the State Materials Office, Value Engineering, or appear on the Qualified Products List.

6.2.7.4.8 Gasket Material

The gasket materials shall conform to the requirements of ***Section 942 of the Department's Standard Specifications***. A copy of the certification of compliance shall be maintained in the QC file. The Verification Inspector may sample the rubber gasket material at the discretion of the District Materials Engineer.

6.2.7.4.9 Gasket Lubricants

The producer of the gasket lubricant shall provide a certification statement indicating compliance with requirements of the Contract Documents.

6.2.7.4.10 Patching Materials

All patching compounds shall comply with ***Section 449 of the Department's Standard Specifications***. Pre-mixed packaged compounds may be used, when it is listed on the Qualified Products List or approved by Value Engineering prior to its use.

6.2.7.5 Quality Control of Concrete Production and Placement Equipment

Batching and mixing equipment shall be capable of properly proportioning and mixing the various ingredients into a uniform mixture

6.2.7.6 Calibration of Equipment

All testing apparatus shall be checked and calibrated for compliance with ***ASTM C 497***. A reputable licensed testing laboratory shall calibrate all jacks and gauges for the three-edge-bearing test equipment at least once every twelve-month period.

6.2.7.7 Priming Materials for Elliptical Pipes

For sealing of elliptical Pipe joints, cold adhesive preformed plastic gaskets shall be used as described ***Section 942 of the Department's Standard Specifications***.

6.2.7.8 Quality Control of Pipe Manufacturing Process

The following are QC inspections and testing, related to operations prior to, during, and after concrete placement.

6.2.7.8.1 Concrete Mix Design

Unless otherwise shown on the project Plans or required by the specifications, the concrete mix produced for the manufacture of Pipes shall comply with the strength requirements specified in ***Section 449 of the Department's Standard Specifications***, ***ASTM C-76*** for reinforced concrete culvert, storm sewer Pipe, ***ASTM C-507*** for reinforced concrete elliptical culvert, storm drain, and sewer pipe, ***ASTM C 985*** for non-reinforced concrete Pipes and ***ASTM C 1450*** for fiber reinforced concrete Pipe. When requested, the Manufacturer shall supply the QC and QA inspectors a copy of each mix design. The mix design information shall include the source of aggregates, cementitious materials, and admixtures, along with the proportions of all ingredient

materials

6.2.7.8.2 Pipe Materials Storage

The Rubber Gaskets shall be stored according to ***Section 942 of the Department's Standard Specifications***. All Reinforcing Steel shall be stored according to ***Section 415 of the Department's Standard Specifications***.

6.2.7.8.3 Forms

The condition of the forms shall be verified, especially the dented or bent areas. The inspector shall inspect the rings to be compatible with the approved joint design and meet the requirements of the Department's Standard Specifications. The bands and grooves used to form the gasket recess shall comply with the approved design. The annular space of the joint shall be computed for compliance with the requirements of the specification and other contract documents.

6.2.7.8.4 Reinforcing Steel Placement

The QC inspector shall randomly check the fabrication, positioning, and minimum cover requirements of steel reinforcement. The QC inspection shall include the measurements of the length, diameter, and reinforcing area of various sizes of cages currently being fabricated and record the results. The inspector shall verify if the steel reinforcement meets the specification requirements. The minimum steel area requirements for Pipe shall be checked according to the following:

(1) ***ASTM C 76*** for Round Pipe

(2) ***Department Standard Index No.280*** for Bell and Spigot ends of Round Pipe.

(3) **ASTM C 507** for Elliptical Pipe

(4) Area requirements for special Pipe designs shall be checked in accordance with the Approved Shop Drawings

6.2.7.8.5 Concrete Mixture and Placement Operation

Concrete mixture shall be mixed and placed in accordance with ***ASTM***

C 76, ASTM C 507, or any other applicable Standards to produce a homogeneous concrete. The placement method shall assure dense and consistent material meeting the performance requirements as specified herein.

6.2.7.8.6 Concrete Curing

The Pipes shall be cured in accordance with the applicable curing methods specified in ***ASTM C 76, ASTM C 507***, any other Standard curing methods, or alternative curing method that is included as part of the QCP.

6.2.7.9 Quality Control Testing and Inspection of Pipes

6.2.7.9.1 General

For the acceptance of the Pipes, the Manufacturer shall perform the QC inspection and tests at the frequencies and LOT (Group) sizes that are specified in the following applicable ***AASHTO and ASTM Standards*** for each type of Pipe, unless ***Section 449 of the Department's Standard Specifications*** and other Contract Documents have specified otherwise:

(1) *ASTM C 76*, Standard Specification for Reinforced Concrete Culvert, Storm Drain, and Sewer Pipe.

(2) *ASTM C 507*, Standard Specification for Reinforced Concrete Elliptical Culvert, Storm Drain, and Sewer Pipe.

(3) *ASTM C 985*, Standard Specification for Non-reinforced Concrete Specified Strength Culvert, Storm Drain, and Sewer Pipe.

(4) *ASTM C 1450*, Standard Specification for Non-Asbestos for Fiber-Cement Storm Drain Pipe.

The QCP shall include the QC test methods, inspections, and minimum frequency of tests that are used as the basis of acceptance of each type of Pipes. The QC inspectors shall obtain randomly selected samples from each LOT, not to exceed 300 Sections of the Pipes per LOT. The District Materials Engineer may approve the modified frequency of tests based on the performance history of the Plant as described in Section 6.2.7.9.3.

Each LOT of the Pipes components is accepted when:

(1) The test results and inspections meet the requirements as specified herein and in the applicable Standards and Specifications.

(2) The Manufacturer has completed all patching and repair work.

(3) The QCM or his/her designated technician has stamped the Pipes.

(4) The list of the Pipes and Plant's certification statement is included with each shipment of the Pipes to the project site.

6.2.7.9.2 Absorption Tests

Absorption tests are performed on steel reinforced Pipes at the minimum frequency of once per week for each Category of Pipes.

6.2.7.9.3 Modified Testing Frequency:

6.2.7.9.3.1 General

The District Materials Engineer may reduce the frequency of strength or absorption tests based on the Plant's demonstration of the satisfactory test data as shown below:

6.2.7.9.3.2 Strength Tests

If the average, D- load, compression test of cylinders, or core strength tests, of the latest fifteen consecutive QC tests of a mix design, exceeds the minimum strength requirements by more than 20% of the specified strength, using the same mix design, the frequency of the tests may be reduced to one test per four LOTs. If the average strength tests exceed the minimum strength requirements by 10% to 20%, the frequency of the strength testing may be reduced to one test per two LOTs. If at any time the average strength of the previous 15 consecutive tests falls below the 1.1 times the specified strength, the sampling and testing shall be performed in accordance with the originally established frequency as described in Section 6.2.7.9.1. The modified strength tests may be performed at the reduced frequency, but not less than once per week.

6.2.7.9.3.3 Absorption Tests

If the average absorption test results, of the latest fifteen consecutive QC tests, are below 8%, the absorption testing frequency may be reduced to one test per month for each Pipe category noted above. If the average absorption test results are in the range of 8% to 8.5% the absorption testing frequency may be reduced to one test per two weeks for each category noted above. If at any time the absorption of the previous 15 consecutive tests exceeds the 8.5% limit, the sampling and testing shall be performed in the originally established frequency, as Section 6.2.7.9.2.

6.2.7.9.4 Hydrostatic Test on Pipe Joints

When requested by the Department, the Manufacturer shall perform a hydrostatic test in accordance with ***ASTM C 497***. The test shall be performed in the presence of the QC and Verification inspectors. The test shall meet the performance requirements of ***ASTM C 443***, as modified in ***Section 449 of Department's Standard Specification.***

6.2.7.9.5 Appearance and Inspection of Final Finished Pipes

The QCM or his/ her designee performs final inspection of the finished Pipes, before the application of the QC approval stamp. Forms used in the manufacturing of Pipes shall be sufficiently rigid and accurate to maintain the Pipe's designed dimensions and avoid irregularities in the Pipe surface. Pipes may be repaired if necessitated by occasional imperfections in the manufacture or damage during handling, and will be considered acceptable if the repairs are sound and properly finished to conform to the dimensional tolerances of the specifications. Dimensional tolerances shall comply with the requirements of the applicable ***ASTM standards***, except as modified in ***Section 449 of the Department's Standard Specifications.***

The QC inspectors shall perform visual inspection of all finished Pipes, measure the dimensions of at least 20% of the randomly selected units in each LOT and maintain a record of the inspections, including the deficiencies. Minor deficiencies may be repaired in accordance with the repair methods included as part of the QCP. The Plant shall determine the cause of the repetitive nonconformance and develop a corrective action plan. The Plant shall revise the QCP to address the type of deficiencies and corrective action that will be taken to prevent or minimize the deficiencies.

6.2.7.9.6 Handling And Storage

Pipes shall be handled and stored to prevent damage. The QC inspectors shall inspect the Pipe handling operations and appropriate practices that prevent damage. The inspectors shall inspect Pipes in storage to ensure that they are stored in the correct stack and are not being damaged by point loading or stacking too high. Rejected Pipes shall not be stored in the same area with the acceptable Pipes.

6.2.7.9.7 Stamping

The Manufacturer shall affix the Plant stamp to each section of Pipe, indicating that the manufactured Pipe meets the requirements of the Contract documents. A certification statement from the General Manger of the Plant shall be included in the QCP regarding the stamp configuration.

6.2.7.9.8 Shipment

The QCM or QC personnel working under the direct supervision of the QCM, shall stamp the Pipes prior to their shipment to the project site**.** The QC stamp indicates that the Plant certifies that the Pipes are manufactured in conformance with the Plant's Quality Control Plan. Each shipment of the Pipes to the project site shall include the list of the Pipes. The Plant shall address its shipping policy as part of the QCP.

6.2.7.9.9 Documentation

The QCM shall maintain documentation files in each Plant. These documents shall be retained for a period of three years after the delivery of the Pipes to the project site. The documentation shall as a minimum include the following items:

(1) A copy of the QCP

(2) Approved shop drawings (if applicable)

(3) Applicable ASTM and AASHTO standards

(4) FDOT Standard Specifications and Design Standards

(5) QC Personnel training records

(6) Materials certification records for cement, aggregates, cementitious materials, chemical admixtures, reinforcing steel, welded wire fabric, and gasket materials.

(7) Concrete Mix designs

(8) Equipment calibration, including concrete batching equipment, water meter, admixture dispensing equipment, concrete compression testing machine, three-edge-bearing testing equipment, hydrostatic testing equipment.

(9) Joint forming equipment and gaskets, and Pipe test results.

(10) LOT number

(11) Number and type of Pipes in each LOT

(12) Applicable test data

(13) Disposition of all Pipes

(14) Record of the list of the delivered Pipes

(15) Record all deficiencies found as a result of QC inspection and testing or Verification inspection and testing and the corrective action taken. A copy of the deficiency reports shall also be maintained in the Plant's permanent file.

6.2.8 FUNCTIONS AND RESPONSIBILITIES OF DISTRICT MATERIALS OFFICE

6.2.8.1 General

The District Material Office is responsible for providing the QA function at all Plants that are located within the District. The QA review of Plants, located out of state, shall be the responsibility of the District Materials Office of the District in which the project is located. District Materials Offices providing the QA function may perform the QA program by their own personnel, consultant personnel under contract, or by other District Materials Office personnel through mutual agreement between Districts. QA inspectors shall monitor the Manufacturer's operations by performing PQR, Verification, and IA

inspections.

The PQRT will perform at least annual review of the Plants to ensure that the quality and acceptability of the manufactured Pipes are in accordance with the requirements of the Contract Documents. The inspections, sampling and testing are performed as specified herein and in the designated ASTM and AASHTO specifications and test methods, or as modified in ***Section 449 of the Department's Standard Specifications***. The Verification testing and inspection of reinforcing steel and welded wire fabric are performed by sampling at least from two LOTs per year and tested at the State Materials Office. The Verifications of Pipe materials are done by review of the Manufacturer's records that are maintained in the Plant's QC files.

The District Materials Office shall provide personnel for inspection of the Plants that are manufacturing Pipes for Department projects. The District Materials Office shall also provide all pertinent information regarding specifications, sampling, and testing to each field inspector. The Verification Inspectors will sample concrete for the compressive strength tests. Also, Verification Inspector will perform compressive strength and absorption tests on the concrete core samples that are provided by the Plant. The Verification Inspector will review the certification documents of the Pipe material components and observe the three-edge-bearing tests. The detailed functions of the Verification Inspectors, Resolution inspectors, Independent Assurance inspectors, and Independent Verification Inspectors are described in Sections 6.2.8.2- 6.2.8.6.

6.2.8.2 Verification Inspections, Sampling, and Testing

6.2.8.2.1 General

The Department or its representative will monitor the Plant's QC operations to assure conformity with the contract plans and specifications. The Department will perform inspection and testing of materials and of the manufactured Pipes to the extent considered necessary to verify the effectiveness of the Manufacturer's QCP and to assure acceptability of the finished Pipes. Department inspectors will not issue instructions to the Manufacturer's representatives on how to run its operations. However, the Department's inspectors will question or advise the Manufacturer's representatives against continuation of any operation or sequence of operations observed, which may result in unsatisfactory compliance with contract plan or specification requirements.

The Department will perform the required Verification Inspection and testing at the specified frequency to compare the results of the Verification tests with the QC test results. When there is a favorable comparison between the QC and the Verification test results, the QC tests, subsequent to the previous Verification tests, are used for acceptance. If there is not a favorable comparison, the Department and the Manufacturer will proceed to the Resolution inspection and testing. The QC and Verification tests are considered favorable, when the results of both tests are the same, either passing or failing. The test results are not favorable when one of the test results is passing and the other one is indicating failing result.

The Department's Verification inspection shall be of sufficient depth to assure that the plant's QCM and inspectors are performing the required inspections in compliance with the requirements of the QCP. The Verification Inspector shall perform random spot checks to ensure that the observed Pipes are fabricated in compliance with the requirements of the Contract Documents. A more in-depth review of some phases of work may be necessary at the discretion of the Verification Inspector.

The Verification Inspector shall assist PQRT during the initial and annual PQR.

The District Material Engineer will assign Qualified Verification Inspectors to each Plant that is manufacturing Pipes for Department projects. For the Pipe related concrete Verification inspection and testing, as a minimum, the Department's District Materials Office will assign Verification Inspectors that are certified as ACI Level I Field Testing Technician Grade I, when performing plastic concrete tests.

6.2.8.2.2 Materials Verification Reviews

(1) The Verification Inspector shall perform at least monthly reviews of the Manufacturer's records for materials received at the Plant and/or incorporated into the fabrication of Pipes, including the certified physical property reports. The Verification Inspector shall assure that the records are adequate to verify that all materials meet the requirements of the Contract Documents.

(2) Monthly, the Inspector shall check the handling and storage for each of the materials to assure compliance with the specifications. The steel materials shall be visually inspected for their condition.

(3) The Department's inspector shall bring all material deficiencies to the attention of the QCM. The Verification Inspector shall perform spot checks of the repair methods.

6.2.8.2.3 Sampling and Testing of Certified Materials

6.2.8.2.3.1 General

The Verification Inspector verifies that the QC inspectors maintain the required certification documents of the materials that are delivered to the Plant. The Verification Inspector will take samples of reinforcing steel and welded wire fabric. The sample of other Pipe materials may be taken at the discretion of the Verification Inspector. The sampling of the reinforcing steel and welded wire fabric shall be taken as described herein.

6.2.8.2.3.2 Reinforcing Steel

Each LOT of the reinforcing steel is accepted based on the certified mill analysis of the steel manufacturer and Department's Verification samples. The Verification Inspector shall take samples from at least two LOTs per year. From each of the randomly selected LOTs of reinforcing steel, three seven-foot long samples will be taken.

One of the samples from each LOT shall be sent to the State Materials Office for testing and the remaining samples, properly identified and tagged, shall be stored for future testing in the event of failure of the first sample. If the first sample meets the requirements of the specification, the LOT will be accepted based on the manufacturer's certification and the results of the Verification tests. All reinforcing steel subsequent to the previous Verification tests are considered acceptable. If the first sample fails to meet the specified requirements, the second sample shall be tested. If both samples fail to meet specified requirements, the heat or LOT of material shall be rejected and replaced with material meeting the requirements. If one sample fails and one sample meets the specified requirements, the third sample may be tested to confirm material acceptability. The LOT of the reinforcing steel will be rejected if the results of any two samples of the same LOT fails.

Each LOT of material that does not conform to the requirements of

the Contract Documents shall be rejected.

6.2.8.2.3.3 Welded Wire fabric

Each LOT of welded wire fabric is accepted based on certified mill analysis of the welded wire fabric manufacturer and the Department's Verification samples. The Verification Inspector shall take samples from at least two LOTs per year. From each of the two randomly selected LOTs of welded wire fabric, three samples shall be taken. Each sample of welded wire fabric shall cover at least an area of four intersections of transverse and longitudinal bars. The transverse wires of the welded wire fabric shall extend approximately six inches to both sides of the welded joints.

One of the samples from each LOT shall be sent to the State Materials Office for testing and the remaining samples, properly identified and tagged, shall be stored for future testing in the event of failure of the first sample. If first sample passes, the LOT is accepted based on the welded wire fabric manufacturer's certification and Verification test results. All welded wire fabric deliveries to the Plant, subsequent to the previous Verification test, are considered acceptable. If the first sample fails to meet the specified requirements, the second sample shall be tested. If both samples fail to meet specified requirements, the heat or LOT of material shall be rejected and replaced with material meeting the requirements. If one sample fails and one sample meets the specified requirements, the third sample may be tested to confirm material acceptability. The LOT of the welded wire fabric will be rejected if the results of the two samples of the same LOT fails.

Each LOT of material that does not conform to the requirements of the Contract Documents shall be rejected.

6.2.8.2.3.4 Other Certified Materials

The acceptance of aggregates, cementitious materials, chemical admixtures, Pipe gaskets, gasket lubricant, patching materials, and priming materials for elliptical Pipes is based on the certification or Qualified Products List. The Verification inspector shall check that the QC Inspector has maintained the required documentation.

At the discretion of the District Materials Engineer, the Verification Inspector may take samples of certified materials for the

Verification testing.

6.2.8.2.4 Verification Testing and Inspection of Pipes

The Verification Inspector shall review the approved plans, Standard Indexes, shop drawings, and specifications. The Department's Verification Inspector performs random review of the Manufacturer's fabrication methods, procedures, workmanship, and QC inspection records. The Verification inspections include the random review and visual inspections of all other major phases of work, such as form work, reinforcing steel, concrete placement, finishing and curing, dimensional checks, handling, storage, and shipping. The Verification Inspector shall document the inspections as part of the project's records and shall advise the Manufacturer against any observed manufacturing operations, which may result in unsatisfactory contract plans or specification requirements.

The Verification Inspector will perform periodic inspections, sampling, and testing, not less than once a month, when Pipes are being produced for Department projects to ensure of the quality and acceptability of the materials, methods, techniques, procedures, and processes being utilized by the Manufacturer in the fabrication of the Pipes.

The Verification Inspector may select a LOT of Pipes and will observe or perform the tests in accordance with the applicable ASTM or AASHTO Specifications, meeting the requirements of Section 6.2.7.9.1.

The tests will be performed at the plant or at the Department's testing laboratory. The Plant shall provide all material certifications, QC strength test results, reinforcing placement, and any other pertinent data for each LOT of products upon request by the Verification Inspector.

The Verification Inspector may inspect any finished products including the products that are stored in the Plant that have been stamped. Any Pipe that does not fully comply with the requirements of the Specifications or other Contract Documents will be rejected, the Plant acceptance stamps shall be removed and the rejected Pipe will not be re-inspected. After each inspection, the Verification inspectors or other QA inspectors will provide a list of deficiencies. The Plant shall correct all deficiencies identified by either QC personnel or the Verification, IA,

PQRT inspectors.

6.2.8.2.5 Hydrostatic Test

The Verification inspector or representative of the State Materials Office will observe the hydrostatic test that Manufacturer is performing in accordance with ***ASTM C 497***.

6.2.8.2.6 Miscellaneous Materials

The Verification Inspector shall check the Manufacturer's basis for acceptance of miscellaneous pipe materials.

6.2.8.2.7 Inspections of Finished Pipes

The Verification Inspector verifies the QC testing and inspection records, visually inspects the finished Pipes, and randomly selects at least one of the stamped LOTs to determine if the Pipes are free from the deficiencies.

The Verification Inspector shall also check the dimensions of the Pipes to verify if they meet the specified dimensional tolerances. The Verification Inspector will perform visual inspection of all finished Pipes and measure the dimensions of at least 5% of the randomly selected Pipes in each LOT. The Verification Inspector will provide a list of the deficiencies. If the deficiency rate of the inspected Pipes is below 10% of the total inspected Pipes, the Plant shall repair the failed Pipes in accordance with the repair method included as part of the QCP.

If the deficiency rate is between 10% and 20% of the total inspected Pipes, the Plant shall reject or repair the deficient Pipes in accordance with the repair method included as part of the QCP. The Plant may be placed on the Conditional Qualification Status. The Plant shall revise the QCP to address the type of deficiencies and take corrective action. If the failure rate of the Pipes exceeds 20%, the Plant will be removed from the Department's list of Qualified Pipe Plants. Upon review of the Plant's corrective action and five consecutive acceptable inspections, the Plant may be returned to the Department's list of Qualified Pipe Plants.

6.2.8.2.8 Meetings

The Verification Inspector will meet with the QCM at the completion of each inspection. During the meetings, the Verification Inspector shall discuss the product deficiencies that are found during the inspections. The QCM and Production Personnel shall discuss their plan to correct any deficiencies that may exist and corrective actions to prevent recurrence of the problems.

6.2.8.2.9 Verification Inspection and Testing Documents

The Verification Inspector shall perform monthly reviews of the QC reports and check of the Producer's documentation for Pipes prior to their shipment. The Verification Inspector shall visually inspect randomly selected Pipes after the Manufacturer has completed all work prior to shipment to ensure that proper documentation, including the list of the Pipes, is included with each shipment.

The Department's Verification Inspector shall maintain a diary and other documentation that reflects key inspection, sampling and testing activities. The diary shall also reflect key discussions relative to content decisions with Plant personnel. In addition, the Department's representative will maintain a record of the results of Verification testing performed on material and disposition of all material samples taken for testing elsewhere. For each component, the Verification Inspector shall assure that QCM has maintained documents indicating compliance with the requirements of the QCP. The Verification Inspector shall document the type of deficiencies that have caused the Plant to be removed from the Department's Qualified Plant list and maintain documents of the Plant's corrective actions.

6.2.8.3 Acceptance of Pipes

When the results of the Verification and QC test data of the same LOT indicate passing test results, the acceptance of the tested LOT and LOTs of the Pipes subsequent to the previous passing Verification tests are accepted based on the QC test data.

When the Verification inspection and test results for a LOT indicate failure and the QC inspection and test(s) are indicating passing results, a Resolution procedure will be used to determine the disposition of the LOT.

6.2.8.4 Resolution Procedure

The District Materials Office may initiate the Resolution procedure or request

the State Materials Office to initiate the IA Reviews of the sampling and testing. The Resolution procedure may consist of additional IA inspection, sampling and testing of the products. Upon the review of the records, sampling data, test procedures, and additional inspection, sampling and testing, the IA will report the cause of the non-comparable results. The test results of a LOT are considered to be non-comparable when one report indicates passing result and the other report indicates failing result.

If the Resolution testing compares favorably with the Manufacturer's QC data, the Manufacturer's data will be accepted. If the Resolution testing compares favorably with the Department's Verification data, the Verification is used for the acceptance.

Based on the results of the IA investigations, the Department will determine the disposition of the failed LOT and the LOTs subsequent to the previous Verification test. The investigations may consist of Verification/Resolution sampling and testing of the two available LOTs of the Pipes that have been manufactured immediately prior to the failed LOT. If any of the LOTs fails, the Verification Inspector will test two more available LOTs and continue testing backward until the results of the two Verification LOTs are compared favorably with the results of the QC testing. The Contractor shall reject all failed Verification/Resolution LOTs. The QCM shall identify the Department's projects that have been affected by the failed LOTs. The Resolution and Verification Inspectors will use the same type of tests that QC Inspectors are using.

6.2.8.5 Independent Assurance Inspection and Testing

The Concrete IA program is used to check the compliance of the sampling and testing technicians and equipment. The District or State Materials Offices performs the IA procedure. The IA program tests both the Manufacturer and the Department's QA technicians and equipment. The sampling and testing equipment may be removed when it does not meet the requirements of the specifications. If a technician fails to meet the requirements of an IA inspection, the technician may be given an opportunity to correct the deficiencies.

6.2.8.6 Independent Verification

The Department may perform the Independent Verification at any time by sampling and testing any Pipe or its material ingredients. This is a checking function outside of the general Verification program.

6.2.9 FUNCTIONS AND RESPONSIBILITIES OF STATE MATERIALS OFFICE

The State Materials Office will provide Precast Concrete Materials technical support for all Districts. When requested by the District Materials Office, a representative of the State Materials Office will accompany District personnel during IA inspections, Independent Verification, or serve as member of the initial and annual PQRT. The State Materials Office will maintain the list of the statewide Qualified Pipe Plants.

The State Materials Office is responsible for approval of material sources and suppliers. The State Materials Office will provide information regarding specification changes and inspection procedures to the District Materials Offices. The Precast Concrete Section of the State Materials Office will coordinate with the Manufacturer, District Materials Office personnel, and Construction Personnel to solve problems regarding the manufacture of Pipes.

6.2.10 FUNCTIONS AND RESPONSIBILITIES OF DISTRICT DRAINAGE OFFICE

The District Drainage Offices will provide any drainage related District-wide technical support.

6.2.11 FUNCTIONS AND RESPONSIBILITIES OF STATE DRAINAGE OFFICE

The State Drainage Engineer is the approval authority for review of plans for modified or special designs requested by the Manufacturer. The State Drainage Office will review and approve the Manufacturer's proposed modifications and distribute them to the Manufacturer, District Construction, District Materials, and the State Materials Offices.

6.2.12 FUNCTIONS AND RESPONSIBILITIES OF DISTRICT STRUCTURES DESIGN OFFICE

The District Structures Design Office will provide structures related District-wide technical support.

6.2.13 FUNCTIONS AND RESPONSIBILITIES OF STATE STRUCTURES DESIGN OFFICE

The State Structures Design Office provides technical guidelines to all Districts. Any change to the standard structural drawings requires approval the State Structures Design Office.

6.2.14 FUNCTIONS AND RESPONSIBILITIES OF DISTRICT CONSTRUCTION OFFICE

The Project Engineer accepts only Pipes that are properly marked by the Plant's approved QC stamp. The Project Engineer will not accept any Pipe that has been severely damaged during delivery or unloading. Problems encountered at the construction site shall be resolved through the District Materials Office. The Contractor will reject the Pipe, when it is damaged during the shipment or at the project site, or when it does not comply with the requirements of this Section.

The Project Engineer at the project site will ensure that legible stamp mark is affixed to each Pipe that is received at the job site. A Plant representative will include the list of the Pipe Sections with each shipment of the pipes.

The list shall be on the Manufacturer's letterhead and shall include as a minimum:

(A) Project Number

(B) Date shipped

(C) Serial Number of the Pipe Sections

(D) Certification statement

6.2.15 FUNCTIONS AND RESPONSIBILITIES OF THE STATE CONSTRUCTION OFFICE

The State Construction Office will review the proposed contract administration and specification changes to the statewide Contract Documents and provide technical support to the Districts.

6.2.16 DISTRIBUTION

This document is distributed through the Precast Concrete Section of the State Materials Office.

6.2.17 REVISIONS AND ADDITIONS

This section of the Materials Manual is updated periodically to reflect changes in specifications, Design Standards, ASTM, AASHTO, or needed changes in operating procedures. The Precast Concrete Section of the State Materials Office prepares the update after input is received from the District and State Materials Offices, Drainage Offices, Structures Design Offices, and Construction Offices. Updates are coordinated through Organization, Forms, and Procedures Office for conformance with the Standard Operating System.