

ORCHARD MESA SANITATION DISTRICT

DESIGN AND CONSTRUCTION
STANDARDS AND SPECIFICATIONS

Updated
April 2011

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INTRODUCTION AND

SEWER LINE EXTENSION AND AGREEMENT FORM

ORCHARD MESA SANITATION DISTRICT
INTRODUCTION TO
DESIGN AND CONSTRUCTION
STANDARDS AND SPECIFICATIONS

1.0 GENERAL

These are the minimum RULES AND REGULATIONS to be adhered to in the design, construction and installation of sanitary sewer lines constructed in the Orchard Mesa Sanitation District (OMSD). For the OMSD's reference, all subdivision plats, planned building groups, or any other proposed construction submitted for approval shall include adequate drawings of the entire water, sanitary sewer and storm sewer utility systems even though the OMSD is only responsible for the sanitary sewer. These RULES AND REGULATIONS will be updated periodically and it is the Contractor/Developer/Consultants responsibility to have in their possession an updated copy. The OMSD will not take any responsibility for upkeep on addresses or phone numbers of Contractor/Developer/Consultants. It is the responsibility of the Contractor/Developer/Consultants to make sure that all addresses and telephone numbers on file are current and up to date for future revisions.

2.0 ORCHARD MESA SANITATION DISTRICT EXTENSION AGREEMENT

Included is a copy of the OMSD Sewer Line Extension Application and Agreement accompanied by a flow chart which outlines the necessary procedures to be followed in executing an Extension Agreement with the OMSD. Extension Agreements are available at the WestWater Engineering's office located at 2516 Foresight Circle #1, Grand Junction, Colorado, 81505.

**ORCHARD MESA SANITATION DISTRICT
SEWER LINE EXTENSION APPLICATION
2013**

DATE: _____

EXTENSION NO.: _____

SUBDIVISION: _____

Please complete this application and submit to Orchard Mesa Sanitation District,
240 - 27¼ Road, Grand Junction, Colorado 81503, along with the requested documents.

Name of Property Owner

Name of Representative

Mailing Address

Mailing Address

Telephone Number

Telephone Number

Common location of property: _____

Description of proposed sanitary sewer extension: _____

Estimated total cost: _____

Commencement and completion dates of construction: _____

Number of taps to be served: _____

Submittals required: (1) a plat of the property to be served by the extension; (2) engineering design and specifications; and (3) processing deposit fee of \$2,500.00.

APPROVED BY DISTRICT: _____ Date _____

SIGNATURE OF APPLICANT: _____ Date _____

The following information shall be provided at the time of Initial Acceptance of the Extension:

Cost of Sewer Mains:	_____
Cost of Private Service Lines (from tap to end of line):	_____
Cost per Front Foot of Sewer Main:	_____
Date Installation Completed:	_____
Date of Initial Acceptance:	_____
Expiration Date (5 years):	_____
Date of Final Acceptance:	_____
Number of Taps Served on Date of Acceptance:	_____

The foregoing is accepted by the owner and the District.

OWNER:

ORCHARD MESA SANITATION DISTRICT:

By _____

By _____

LINE EXTENSION PROCEDURE

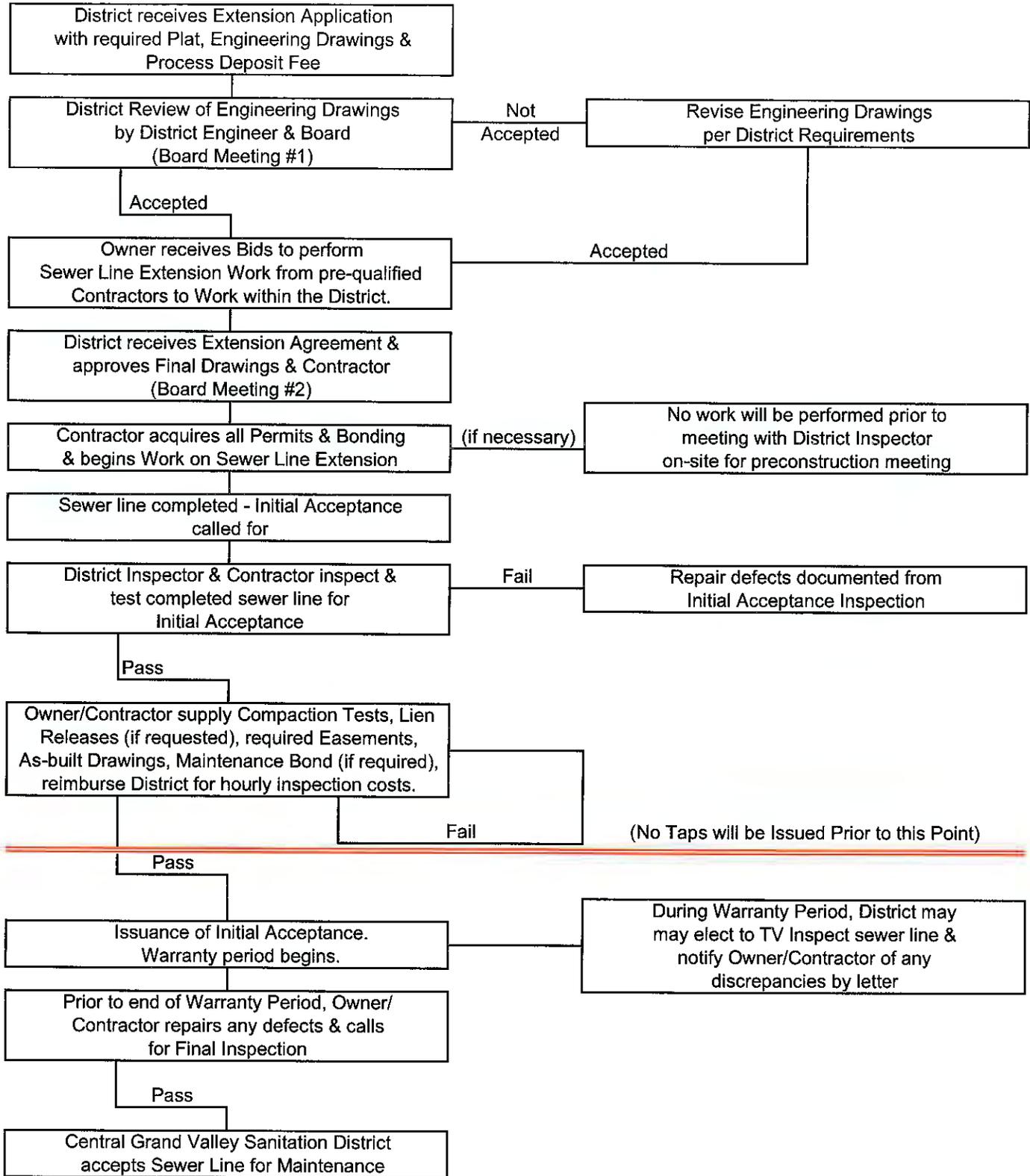
The property owner, or his representative, must submit a Sewer Line Extension Application to the Board along with the required submittals and the processing deposit fee. The Application will be reviewed by the District Engineer and the Board for compliance. If the Application is approved by the Board, the Applicant must obtain bids from Contractors qualified to work within the District.

The bid for construction must show the total construction amount. These bids must be submitted to the District for review and approval. The District will approve all qualified Contractors and all responsible bids and the Owner may select the Contractor of its choice from those so approved.

The District reserves the right to consider the qualifications and experience of all Contractors and to reject the applicant's Contractor if it is determined that the Contractor is not qualified to perform the work. The District may request such evidence as it deems necessary to demonstrate the Contractor's qualifications to perform the work.

Upon selection of the Contractor, the Owner shall submit a copy of the signed contract to the District and the Owner shall enter into a contract with the District for the extension of the sewer line. A form of the District's Public Sanitary Sewer System Extension Agreement is attached to this Application. Upon execution of the District's Extension Agreement by Owner and the District, and upon approval of the final design, the Owner may begin Construction, all in accordance with the terms of the District's Extension Agreement.

**PROCEDURES TO BE FOLLOWED BY DEVELOPER/CONTRACTOR
FROM EXTENSION APPLICATION/AGREEMENT TO
FINAL JOB ACCEPTANCE
ORCHARD MESA SANITATION DISTRICT**



**ORCHARD MESA SANITATION DISTRICT
Public Sanitary Sewer System Extension Agreement
2013**

Date: _____ Extension No.: _____
Owner: _____ Subdivision: _____
Address: _____ Location: _____
Phone No.: _____ Contractor: _____
Representative: _____ Total Extension Contract Price: _____

In consideration of the mutual covenants herein contained and the authorization from the Orchard Mesa Sanitation District ("District") for the above-named Owner, its heirs, successors and assigns, to construct and install a sanitary sewer system line extension ("Extension") under and along the public rights-of-way and/or easements of the District, all pursuant to the provisions herein, the parties agree:

1. The Extension shall be connected to the existing District sewer system at the sewer main location designated by the District, at the sole expense of the Owner, and using such materials and construction methods as are approved by the District. All construction shall conform to the most current edition of the SANITARY SEWER STANDARDS AND SPECIFICATIONS OF THE DISTRICT and the City of Grand Junction.

2. The District has accepted the above-named Contractor for the construction of the Extension for a total Extension Contract price of \$_____. All construction shall be done in strict accordance with the provisions of the Extension Contract between Owner (Developer) and Contractor. Any material deviation or change orders from the Extension Contract must be approved in writing, in advance by the District.

3. If construction will result in a street cut and if required by Mesa County or the City of Grand Junction regulations, the Owner or Contractor shall obtain a street excavation permit and all street and excavation construction shall be done in accordance with the appropriate regulations. The Owner or its Contractor shall produce evidence of proper bonding and licensing to comply with such regulations.

4. All easements required for the construction, installation and maintenance of the Extension shall be obtained by the Owner at its sole cost and expense, prior to the commencement of any construction of the Extension. The location and size of all easements shall be determined by the District. All such easements shall be deeded to the District and the Owner shall provide title insurance naming the District as the insured under the policy.

5. For proposed developments that will be constructed in separate phases, or developments with individual filing numbers and construction time periods, a separate Sewer Line Extension Application and Agreement shall be submitted to the District with the applicable

application processing fee for each phase or filing of said developments. An overall development plan, or conceptual plan showing the proposed phasing will be required prior to approval of the first phase or filing. A final as-built composite of all phases or filings will be required prior to Initial Acceptance of the final phase or filing.

Once sewer lines for a specific phase are constructed, the Owner shall be required to finalize the extension within 2 years of the date of the Extension Agreement. This includes complying with all requirements identified in paragraphs 6, 7, and 8 herein, in order for the District to issue Initial Acceptance of the sewer line extension. If Owner fails to comply with the terms necessary for the District to issue its Initial Acceptance within the time frame specified herein, the District shall have the unconditional right to enter onto the Owners property and remove all improvements related to the sewer line extension. All costs incurred by the District to remove the sewer line and appurtenances shall be reimbursed to the District by the Owner. In the event the District decides to enforce this clause of the Agreement, the District will notify the Owner in writing of the District's intent to remove the sewer line extension. Owner's address identified for service in this extension agreement shall be used for said written notification.

6. Immediately upon completion of the Extension, the Owner shall file with the District an application for Initial Acceptance along with a certified statement of all costs and a preliminary red-lined set of as-built drawings. Final inspection and testing of the Extension for the issuance of Initial Acceptance will take place only after roadways are brought to sub-base grade, all utilities (water, gas, electric, etc.) are installed and after the roadway has been paved and manhole rings and covers are at finished grade. All manholes and sewer lines will be clean and free of debris, and all of the District Engineer's comments addressed. The Owner or his representative will be responsible for notifying the District's Engineer and scheduling a time for final inspection and testing. Testing shall include:

- A. Pressure testing of the entire Extension including stubbed lines from manholes. Pressure testing will comply with District specifications for length of line, size and type of pipe being used.
- B. Mandrel test using a go-no-go Mandrel.
- C. Alignment verification by lamping and flow line testing to be completed after the line is cleaned. Lamping of the line will be performed preferably on a sunny day to allow use of mirrors to reflect sunlight. The Extension should reveal at minimum a $\frac{3}{4}$ moon sighting from manhole to manhole in either direction. Flow line testing will be accomplished after the line is flushed with sufficient amounts of potable water to remove any remaining sediment or dirt from the line that may act as a dam causing water to pond and the flow line test to fail. The consistency of the line and grade will be evaluated based on the width of water in the flow line of the pipe. Ponding of water will not be acceptable, and inconsistent widths of flow may deem the line unacceptable as determined by the District's Engineer.

If the Extension does not meet District specifications for a newly constructed system, the necessary repairs will be carried out by the Owner to ensure compliance with the District's Specifications.

7. Prior to the issuance of Initial Acceptance, the Owner shall provide to the District a full set of final "As Built" drawings in a form acceptable to the District's Engineer. As a minimum, as-built drawings shall be submitted on electronic disk in an ACAD 14.0 or later version Drawing File and on reproducible mylar, as prepared, stamped and signed by a registered professional engineer. The Owner shall also provide to the District proof of full payment to the Contractor and full lien releases from the Contractor and all subcontractors and suppliers if requested by District. All payments shall be made in accordance with the provisions of CRS 24-91-101, et seq.

8. Upon completion of construction of the Extension, upon full payment to the Contractor, upon the execution of lien releases by the Contractor and all subcontractors and suppliers (if required), and upon acceptance of the Extension by the District, the District will issue its Notice of Initial Acceptance and the District Lines shall become the property of the District. The date of the Notice of Initial Acceptance shall designate the beginning of the one-year warranty on the Extension as specified in the District's Standards and Specifications relative to workmanship and material used or installed in the original construction. To guarantee maintenance of the Extension, the Owner or Contractor may be required by the District to post a Maintenance Bond as provided in the Rules and Regulations of the District. At the end of the one-year warranty period, the Owner shall apply for a Final Acceptance of the Extension, and if the Extension still meets all standards of the District, and if there are no items of repair or maintenance yet to be performed by the Owner, then the District shall give Final Acceptance and shall assume full maintenance of the Extension, subject to the provisions of paragraph 14(g) of this Agreement. The District shall not assume ownership or responsibility for maintenance for any Private Line beyond the location of the tap into the District Lines. The property owners shall be responsible for maintenance of all service lines from the point of the tap to the point of service.

9. The District may issue a sewer tap upon the completion of the following conditions precedent:

- A. The District has issued its Initial Acceptance of the sewer lines. No taps will be issued until the District has issued its Initial Acceptance and full compliance with the provisions of paragraph 14. If the Owner or third party builder receives a building permit from Mesa County or the City of Grand Junction to begin construction of a home prior to Initial Acceptance, the Owner shall be prohibited from connecting the sewer service line(s) from the home(s) to the sewer line (District Line). If a physical connection is made so that the service line from the home(s) is connected to the District sewer line prior to Initial Acceptance, then the Owner shall be assessed a double tap fee for each improper connection and such amount shall be paid before any further connections are permitted. If the Owner fails to pay the penalty, then no additional taps will be approved by the District until the penalty is paid in full. This includes any taps for lots sold to or developed by other parties (e.g., builders), in which case, Owner will be responsible for double tap fee assessment.
- B. Full payments of all construction amounts to the Contractor.

- C. If a building permit is issued prior to Initial Acceptance and the Mesa County Building Department requires service line(s) from the home(s) to be connected to the sewer main (District Line) as part of the building permit inspection process, and said connection occurs prior to the District's final testing and Initial Acceptance of the sewer main, the Owner shall contact the District regarding building permit requirements to connect service line along with the proposed schedule for making the physical connection. For these instances, the District will waive the double tap fee penalty provided the Owner notifies the District prior to making permanent connection of service line for building inspection requirements. The Contractor will be responsible for providing any necessary test plugs on the service line in order to conduct final pressure test on the sewer main as required per paragraph 6 of the Extension Agreement.
- D. Full payment of the District's tap fee and the City's Plant Investment Fee for the property to be served by the tap. Monthly service charges will be charged on all taps upon issuance of a certificate of occupancy or 90 days after the issuance of the tap, whichever occurs first.
- E. Proper application for the issuance of a tap.
- F. Full compliance with the District Rules and Regulations.

The construction of the tap shall be in full compliance with the Standards and Specifications of the District and the District shall oversee the construction and connection of all such taps.

10. The Owner assumes complete responsibility for payment of monthly service charges which will begin to accrue for each building site on the day service is provided but in no event later than ninety (90) days from the date of issuance of a tap. The District shall not be responsible for providing taps, or for reimbursing Owner in the event of a sewer tap moratorium, or if taps cannot be issued for any other reason.

11. The Owner acknowledges that the Standards and Specifications of the District require the Contractor to warranty and guarantee his work, and to maintain the Extension for a period of one (1) year from the date of Initial Acceptance. Owner agrees to guarantee this warranty and the guarantee of the Contractor and if the Contractor fails to honor this commitment, the District may look to the Owner to guarantee the performance of the Contractor. All such guarantees shall include the costs incurred by the District in maintaining the Extension and fulfilling the one year maintenance obligation and in the enforcement of the guarantee or warranty, including legal fees, engineering fees, costs and expert witness fees.

12. Any engineering or inspection expenses, which are not the obligation of the Contractor as set forth in the Plans and Specifications, shall be at the sole cost and expense of the Owner. In addition, Owner shall pay to the District an engineering fee for inspection and any engineering administration required to oversee the project on behalf of the District at the rate of \$100.00 an hour to pay for the cost of the District's Engineer, \$70.00 an hour to pay for the cost of the Inspector, and \$40.00 an hour to pay for any associated secretarial or administrative costs, plus expenses to review or inspect the construction of the Development. No taps will be issued for lots within the Development covered under this Extension Agreement until engineering and inspection fees are paid to the District.

13. The license issued by the District pursuant to this Agreement for the construction of the Extension shall lapse and expire unless the construction shall begin within twelve (12) months after the date of this Agreement and/or the Plans being approved for construction, whichever may be later, and such construction is diligently pursued to completion. If construction has not commenced and diligently pursued within the one (1) year time limit, the Extension Agreement and Plans will be viewed to have expired. In these cases, a new Application and Agreement will need to be submitted to the District with another set of Plans for approval. A reapplication fee of double the application processing fee in place at the time will need to be submitted with the Plans prior to the new Application being considered. The District will notify the Owner in writing when the Extension Agreement and Approved Plans have expired.

14. In addition to the provisions herein contained, all construction performed under this Agreement is subject to the following general conditions:

- A. Owner shall call for and request construction inspection at least 48 hours in advance of the commencement of actual construction and in advance of any requested subsequent inspections.
- B. Owner shall have a copy of applicable District Standards and Specifications and an APPROVED set of construction drawings on the job site at all times.
- C. Owner shall be responsible for establishing safety measures to protect workers and the public until construction is completed.
- D. All construction shall be completed as shown on APPROVED drawings and shall be completed in accordance with current District Standards and Specifications.
- E. Owner agrees to pay promptly any inspection charges, including overtime charges where such overtime results from the operations of the Owner or its Contractor.
- F. The Notice of Initial Acceptance of the District Line shall not be issued until all required test reports applicable to the construction, including soils compaction tests, and a full set of final "As Built" drawings, are submitted to and approved by the District.
- G. For a period of five (5) years after the date of Initial Acceptance, the Owner shall pay all costs of adjusting any manholes to finished grade and alignment and shall indemnify and save harmless the District from such costs.
- H. For a period of one (1) year after the date of Initial Acceptance, the Owner shall pay all costs of repairing streets, curbs, gutters and sidewalks which result from improper compaction of soils or from the construction of the Extension.

15. The District reserves the right to construct any further sewer extensions and to make such connections to the sanitary sewer facilities owned by the District, including the District Lines authorized by this Agreement, as the District may from time to time allow, order or approve. No payment shall be made to the Owner for any such extensions or connections.

16. Owner and Contractor shall indemnify and hold the District harmless from all actions, claims, causes of action or damages to persons or property and which result from the acts of the Owner or Contractor during the period of construction.

17. The terms and provisions of this Agreement shall be binding upon the parties, their heirs, successors and assigns. This Agreement, the Contract for Construction, the District Standards and Specifications, the District Rules and Regulations, and other documents incorporated therein, contain the full agreement of the parties. Any modification to this Agreement must be in writing and signed by all parties to be effective. This Agreement shall be enforced in accordance with Colorado law and the non-defaulting party may collect all costs, including attorney fees, if enforcement hereof is required.

DATED the year and day first above written.

OWNER:

ORCHARD MESA SANITATION
DISTRICT

The following information shall be provided at the time of Initial Acceptance of the Extension:

Cost of Sewer Mains:	_____
Cost of Private Service Lines (from tap to end of line):	_____
Total Cost Installed:	_____
Cost per Front Foot of Sewer Main:	_____
Date Installation Completed:	_____
Date of Initial Acceptance:	_____
Expiration Date (5 years):	_____
Date of Final Acceptance:	_____
Number of Taps to be Served:	_____

The foregoing is accepted by the Owner and the District.

OWNER:

**ORCHARD MESA SANITATION
DISTRICT:**

By _____

By _____

DESIGN STANDARDS AND SPECIFICATIONS

ORCHARD MESA SANITATION DISTRICT
DESIGN STANDARDS AND SPECIFICATIONS

1.0 DRAWING SUBMITTAL PROCEDURE

Consulting engineers and developers seeking approval of Engineering design and development plans are required to follow the procedures outlined below. Cooperation in these guidelines will assist in an efficient review of development plans.

1.1 All Subdivisions, Planned Building Groups, Planned Unit Developments, or any other proposed development (except the actual construction plan of the building) submitted for approval shall include adequate Plans and Specifications (if specifications are not already covered by the Orchard Mesa Sanitation District Specifications). As part of the Plans submittal, all other improvement Plans shall be included with the District's Plan set. These include the ENTIRE Water Distribution System, Sanitary Sewer, Storm Drainage System, Grading and Drainage Plans, and Roadway Design, before approval of any phase of development will be made by the Orchard Mesa Sanitation District. The reason for an entire set of Plans is for the District's reference, even though approval will be for the sanitary sewer only.

1.2 Submit one legible print (either blueline or blackline) of each sheet to the Orchard Mesa Sanitation District for review.

1.3 The time for review will be an average of forty-five (45) working days per submittal. When a set of plans submitted for review contains more than five (5) sheets, the time for review may be extended beyond forty-five (45) working days. The consultant or his local representative will be notified by telephone or mail when review comments are ready to be picked up.

1.4 The checkprints will be returned to the consultant or his local representative if requested, along with the District's review comments and necessary revisions noted. Again, the consultant or his local representative will be notified by telephone or mail when the comments are ready to be picked up.

1.5 The consultant will make all the revisions requested on their original plans/report and resubmit according to the instructions of the Orchard Mesa Sanitation District. Seriously deficient plans will be marked incomplete and returned to the consultant for completion. The Orchard Mesa Sanitation District reserves the right to deny plan review until a sufficiently complete set of plans is submitted. This may require that the plan is reviewed several times prior to approval.

1.6 All previous checkprints and the Orchard Mesa Sanitation District review comments must accompany each resubmittal for further review and/or approval. If these are not included, the resubmittal will be returned to the consultant without further action until such time as they are included.

1.7 When indicated in the Orchard Mesa Sanitation District review comments, the consultant will submit mylar sepias of his original plans for approval. Once these are approved, they will remain on file in the District office. A minimum of six (6) complete sets of the approved construction plans will be provided to the District for approval signature. Three (3) sets will be

retained by the District for their records. The remaining sets will be returned to the consulting engineer for distribution, who will be notified by the District when they are ready to be picked up. Additional sets can be signed upon request of the consulting engineer or developer.

1.8 The length of time for final plan approvals after all review comments have been addressed will be an average of ten (10) working days. This time may also be extended under the conditions outlined in Section 1.3 of these specifications.

1.9 The following policy regarding order of processing (priority) will be used for all submittals. Each category is first-come, first-serve within that category, no exceptions.

1. Mylars for approval
2. Return package, further review required
3. New package
4. Return piecemeal
5. New piecemeal

Package submittals are those which include development plans as defined in Section 1.1 of these specifications. Piecemeal submittals are those which are missing one or more of the items listed in Section 1.1 of these specifications. When plans are returned to the consultant for lack of adequate information, or in the event of replatting or major site plan revisions after the initial review, the resubmittal will be considered a new submittal rather than a return. A thorough technical review will not be completed by the District's Engineer until adequate information is provided.

1.10 Development plans are approved initially for one (1) year. After one (1) year, they automatically become void and must be updated before any further permits can be issued.

Whenever updates or revisions to previously approved development plans are necessary, the consultant will contact the District stating which (update or revision) is required, the plan(s) drawing number and sheet number(s). An outline of the complete revisions is to be stated also. The District has the right to review and require changes before updating said plans.

In the case of revisions, the District will make a copy of the mylar sepia(s), file it, and return the sepia(s) to the consultant, less all original approval signatures.

The consultant will then make his requested revisions and resubmit under the guideline found in Section 1.2 of these specifications. This submittal will be considered a return package and will be reviewed accordingly.

Requests for updates will be considered only if there are NO revisions to the original development plan(s). The District will review the original development plan(s) for compliance with CURRENT SPECIFICATIONS under normal review procedures (requests for updates will

be considered a return package), and if found in compliance with current specifications, the development plan(s) will be updated and re-issued according to Section 1.7 (disregarding the first sentence) of these specifications. If corrections for compliance with current specifications are necessary, the development plan(s) will be returned to the consultant as outlined above.

1.11 Excessive telephone calls concerning the status of plans in the review process only serve to lengthen the time required to review plans. Plans are reviewed on a first-come, first-serve basis as outlined in Section 1.9 of these specifications. Current status can be obtained by calling the City of Grand Junction at (970) 244-1430. Please limit calls to those absolutely necessary.

2.0 DRAFTING STANDARDS

2.1 GENERAL

All development plans and detail sheets for sewer line extensions submitted to the District for approval shall conform to the following minimum criteria and drafting standards. The District also authorizes the District Engineer to require any other information or documentation that is deemed necessary by the District Engineer but not specifically addressed herein.

2.2 GENERAL DRAFTING STANDARDS

- A. Design Plans. All District submittals for proposed sewer lines shall include separate standard plan and profile sheets for all sections of the sewer line extension. Dual plan and profile sheets will not be accepted nor will plans with separate profile sheets from the plan sheets. All sewer line plan and profile sheets will be exclusive to the specific sewer line extension; composite sewer line and street plan and profile sheets will not be accepted. Stationing is also to be exclusive to the sewer line.

Plans shall be 24" x 36". Final plans shall be mylar originals or mylar sepias of the original, clean, clear, and free from objectionable background.

- B. Date of Plans. The original date of the Plans and any subsequent revisions are to be shown on the Plans.
- C. Existing Utilities. The type, size, and location of all existing utilities shall be shown on the Plans and sewer line profile with dashed lines. Existing utility appurtenances are to be shown with open line designations (i.e., open circle for existing manholes). Field verified elevations and locations are required on all development Plans for existing underground utilities which will potentially conflict with the sewer line design or construction. It will be the responsibility of the Contractor to verify the existence and location of all existing underground utilities along the alignment of the sewer line extension prior to commencing any new construction.
- D. Proposed Improvements. Proposed sewer line improvements shall be clearly shown and labeled on each sheet of the development Plans and include, as a minimum, a utility composite and separate plan and profile sheets. All new sewer mains and service lines shall be shown with solid lines and manholes with solid circles. Directional flow arrows shall also be provided on Plan views for all segments of sewer lines.
- E. Detail Sheets. The District's standard sanitary sewer detail sheet shall be included with all development submittals.
- F. Lettering. Letter size shall not be less than one-tenth (0.10) of an inch. (No. 100 Leroy template).
- G. Shading. AutoCAD hatch patterns or stick-on type patterns are acceptable for shading. **PENCILED OR COLORED SHADING** will not be accepted.

3.0 DEVELOPMENT PLAN REQUIREMENTS

3.1 GENERAL

All development plans shall be prepared by, or under the direction of, a Professional Engineer, registered in the State of Colorado, and shall be reviewed for the minimum requirements set forth herein, the Orchard Mesa Sanitation District Design Criteria, and when applicable, the Orchard Mesa Sanitation District standards and specifications. The Engineer should be aware that whenever unusual or serious problems are anticipated in conjunction with a proposed development, additional information and analysis beyond the minimum requirements of these specifications and criteria will be required.

The Orchard Mesa Sanitation District is not responsible for the accuracy and adequacy of the design or dimensions and elevations on the Plans (which shall be confirmed and correlated at the job site). The Orchard Mesa Sanitation District, through the approval of the development plan, assumes no responsibility, other than as stated above, for the completeness and/or accuracy of the development plan.

3.2 VICINITY MAP

Minimum scale is 1"=2000' showing the location and name of all arterial roadways within one mile of the proposed development and all other roadways in the vicinity of the proposed development. The project area shall be indicated by shading or circling. This map is required on the cover sheet.

3.3 ALL DEVELOPMENT PLANS AND DETAIL SHEETS

All development plans and detail sheets shall conform to the following criteria and show the following information. Additional specific requirements are discussed later in these specifications.

- A. Title Block. A title block is required on every sheet and cover sheet submitted for review and approval. The subdivision name and filing number; Planned Building Group or Planned Unit Development name (if applicable); the type of improvement; name, address, including zip code, and telephone number of the consultant; and sheet number (consecutive) shall all be included in the title block.
- B. Approval Block. A signature block is required on every sheet pertaining to the sanitary sewer and cover sheet of the development plans submitted for review and approval. Sanitary sewer plans require the signature of the District Engineer.

The approval block shall be located in the lower right hand corner of the sheet, just above the title block only. THE APPROVAL BLOCK SHALL INCLUDE ONLY THOSE SIGNATURES NEEDED ON EACH SHEET AND SHALL BE CONFIGURED AS SHOWN BELOW.

Examples of approval blocks:

ORCHARD MESA SANITATION DISTRICT Approved for Construction for 1 Year from this Date	PHASE or FILING (if applicable)
_____	_____
District Engineer	Date

ORCHARD MESA SANITATION DISTRICT Initial Acceptance	PHASE or FILING (if applicable)
_____	_____
District Engineer	Date

In the event the development is constructed in phases or filings, a signature block should be provided for each phase of construction and should be labeled appropriately.

- C. Required Notes. These notes shall appear on a General Note sheet. If a General Note sheet has not been used, they shall be put on every sheet of the submittal relating to the sanitary sewer extension or improvements.
1. The Orchard Mesa Sanitation District plan review is only for general conformance with the Orchard Mesa Sanitation District Design Criteria. The District is not responsible for the accuracy and adequacy of the design, of dimensions, and elevations which shall be confirmed and correlated at the job site. The Orchard Mesa Sanitation District, through the approval of this document, assumes no responsibility other than as stated above for the completeness and/or accuracy of this document.
 2. All sewer line construction shall conform to the Orchard Mesa Sanitation District's Standards and Specifications.

3. All materials and workmanship shall be subject to inspection by the District. The District reserves the right to accept or reject any materials and workmanship that does not conform to its Standards and Specifications.
4. The Contractor shall have one (1) signed set of the Plans (approved by the Orchard Mesa Sanitation District), and one (1) copy of the appropriate Orchard Mesa Sanitation District STANDARDS AND SPECIFICATIONS at the job site at all times. The Contractor shall also have a copy of any permits necessary to complete the Work.
5. The Contractor shall notify the District at least 48 hours prior to commencement of construction.
6. All sanitary sewer pipe shall be PVC SDR 35 unless otherwise specified. All pipe joints shall be 13 foot joints unless otherwise approved by the District Engineer.
7. All sewer mains shall be laid to grade utilizing a pipe laser.
8. All service line connections to the new main shall be accomplished with full body wyes or tees. Tapping saddles will not be allowed.
9. All trenches shall be compacted to 95% as determined by AASHTO T-99. Contractor shall be required to perform all necessary compaction tests through a certified soils lab to a level required by City of Grand Junction's Standards and Specifications. A copy of the compaction test results shall be provided to the District during the course of the project.
10. A minimum 10-foot separation shall be maintained at all times between waterlines and sewer line (except at specified crossings).
11. All sanitary sewer services to be 4" PVC SDR 35 unless otherwise specified.
12. Sewer service stub-outs shall extend 14 feet beyond the property line and shall be glue-capped and marked with a 2x4 post painted green.
13. Manholes shall be constructed as shown on the Orchard Mesa Sanitation District Standard Sanitary Sewer Detail sheet. At the District's direction, the Contractor shall field vacuum test manholes to ensure that they are of watertight construction and that manholes have not been damaged during installation.
14. No service lines shall be connected directly into manholes.
15. For sewer lines requiring flat top lids for shallow manholes, lid slabs should not be installed until all street subbase preparation has been completed. This will help

facilitate lamping and testing of the proposed sewer mains. Manholes should be temporarily covered with steel plates or other material to prevent debris from entering the manhole during subgrade and subbase preparation.

16. For shallow manholes using flat top lid slabs, cast in-place bases shall be used with a 1-foot barrel section placed on the base. Precast bases can be used only if total height of base section is 24-inches.
17. For dead-end manholes the invert channel shall be a minimum $\frac{3}{4}$ of the length through the manhole base to facilitate testing and access for the District's maintenance equipment.
18. Manhole cone and flat top sections shall be positioned such that the manhole ring and cover are offset 20 degrees to 30 degrees from the upstream main sewer line into the manhole. Manhole steps shall be installed in vertical alignment with the ring and cover.
19. Steel paving rings are not allowed for grade adjustment unless otherwise approved by the District.
20. The Contractor is responsible for all required sewer line testing to be completed in the presence of the District Engineer or their representative. Final testing is to be accomplished only after all other infrastructure has been installed. This includes waterlines, gas lines, electric lines, etc. Testing will be performed after all compaction of street subgrade and prior to street paving. Final lamping will also be accomplished after paving is completed to insure that the line is clean. These tests will be the basis for issuing Initial Acceptance of the sewer line extension.

D. Scale. The scales listed are minimum. Larger scales may be required where necessary to clearly show details.

1. All plan and profile sheets:

Horizontal: 1"=50'

Vertical: 1"=5'

2. Overall utility plans; site plans; etc. shall use minimum scale of 1"=50' (1"=30' minimum for overall utility plans for multifamily and commercial developments).

E. North Arrow. North shall point towards the top or right hand margin of the sheet only.

F. Date of Plan. The original date of the plan and any subsequent revision.

- C. Lot and block numbers.
- D. Streets and street names.
- E. Existing sanitary sewer facilities including size and material.
- F. Existing water lines including size and material.
- G. Existing storm sewer facilities including size and material.
- H. Proposed construction including manholes, valve boxes, fire hydrants, water meters, mains and service lines, inlets and appurtenance etc., plainly labeled.
- I. Proposed sewer line including manholes and appurtenances which will be plainly labeled, and stationed. Stationing is to be exclusive to sewer line.
- J. Proposed outfall points for the sanitary sewer from the development.
- K. Proposed outlots (easements) for sewer mains within and outside the development.
- L. Directional flow arrows for existing and proposed sewer lines between manholes.

3.5 CONSTRUCTION PLANS AND DETAILS

Construction plans and details shall show the following:

A. Plan View.

- Property lines, lot and block numbers, and ownership or subdivision information
- Street names and outlots (easements) with width dimensions
- Existing and proposed utilities and structures shall be shown for the District's reference in streets or utility easements where sewer lines are located, including:

Water lines	Electric
Sanitary sewer lines	Telephone
Storm sewer lines	Cable T.V.
Gas	Irrigation

B. Plan and Profile.

- Scale: Vertical 1"=5'
 Horizontal 1"=50'

- Vertical and Horizontal grids to scale

- Final grade (solid)

- Existing grade (dashed)

- Existing and proposed utility lines where crossed

- Benchmark Elevations

- Pipes, showing:
 - Size, length, type and structural class of pipe, including SDR designation

- Grades with elevations

- Special structures or details as required

3.6 EASEMENTS

A “utility outlot/easement” will be required for any sanitary sewer which is not on Public Right-of-Way and which will be considered "PUBLIC". For areas where the sanitary sewer crosses a lot(s) within a proposed development, an all weather paved surface “outlot” shall be created for the sanitary sewer. A width of twenty (20) feet will be required when one utility is proposed. Thirty (30) feet will be required when two utilities (i.e., water, sanitary sewer) will run in parallel in the same outlot/easement. A wider outlot/easement may be required at the discretion of the District Engineer for large sanitary sewers. At no time will the utility be less than ten (10) feet from the edge of the outlot/easement, or less than ten (10) feet from a parallel utility line. In no case shall any trees, walls, large rocks, fences, etc. be within an outlot/easement unless prior approval has been obtained from the District, and a revocable license has been obtained. It is the responsibility of the consulting engineer to coordinate the site development to avoid this problem.

4.0 DESIGN CRITERIA

4.1 GENERAL

All plans will be checked for conformance with the minimum design criteria set forth in these standards and specifications prior to approval for construction.

4.2 SANITARY SEWER SYSTEM DESIGN CRITERIA

Table 4-1 shows the recommended sewer loading rates for a variety of types of developments. These rates for the design of sanitary sewers will be used as a general guide for designers in addition to the ASCE Manual on Engineering Practice No. 37 DESIGN AND CONSTRUCTION OF SANITARY AND STORM SEWERS.

Where possible, counts of actual number of units will be made for all residential zoning. The peak flow will be based on Curve "A" for the ratio of peak to average daily sewage flow as determined and shown on page 33 of the ASCE Manual on Engineering Practice No.37, DESIGN AND CONSTRUCTION OF SANITARY AND STORM SEWERS.

The equation for Curve "A" is:

$$\frac{5}{p^{0.167}} \quad \text{where } p = \text{population in thousands}$$

A maximum peaking factor of 4 and a minimum of 1.7 will be used for this equation.

The overall utility plan should include the estimated peak quantity of wastewater generated. The proposed outfall points for wastewater from the development should also be included in the design. All sanitary sewer systems shall be designed in accordance with the criteria established by the Colorado Department of Health with the following exceptions.

1. There will be no horizontal or vertical curves on sanitary sewers.
2. All sanitary sewer mains shall end with a manhole.
3. The flow velocity shall not exceed ten (10) feet per second flowing full.

RECOMMENDED SEWER LOADING RATES
FOR DIFFERENT TYPES OF DEVELOPMENTS
TABLE 4-1

Type of Development	Household Size	Avg. Daily Flow/Cap (gpcd)	Avg. Daily Flow/Acre (gpd)	Equivalent Pop/Acre
Single Family attached	2.1	80		
Single Family detached	3.2	80		
Multi-Family	1.7	80		
Mobile Homes	2.3	80		
Office Bldgs. (1-3 story)			500	6.25
Dept. Stores			500	6.25
Office Bldgs. (3-8 story)			1,500	18.75
Neighborhood Shopping Center			2,000	25.0
Restaurants & Fast Food			7,500	93.75
Professional Centers			4,500	56.25
Car Washes & Service Stations w/Car Washes			15,000	187.5
Auto Dealers, Service Station & Trade Business			4,000	50.0
Motels-Hotels			5,000	62.5
Industrial Warehouse			100	1.25
Industrial Factory			600	7.5

4. Allowable minimum slope for a new sewer line extension will be as shown below.

<u>Sewer Size</u>	<u>Minimum Slope in Feet Per 100 Feet</u>
8 inch (203 mm)	0.40
10 inch (254 mm)	0.28
12 inch (305 mm)	0.22
14 inch (356 mm)	0.17
15 inch (381 mm)	0.15
16 inch (406 mm)	0.14
18 inch (457 mm)	0.12
21 inch (533 mm)	0.10
24 inch (610 mm)	0.08

These minimum slopes shall apply only when a scouring velocity of 2 fps can be achieved a minimum of twice daily during peak hour flows for the proposed units to be served. Design of sewer extensions utilizing larger than 8-inch diameter pipe, for the sole purpose of constructing the sewer line with a minimum slope less than 0.4%, without meeting the minimum scour velocity criteria, will not be allowed.

5. Minimum drop through manhole from inlet to outlet shall be as shown below.
- a. 0.20 feet on straight through runs
 - b. 0.20 feet on bends
 - c. pipe laid through manhole will be at a slope of upstream or downstream pipe slope
6. A maximum inside drop of 0.40 feet is allowed from any inlet pipe to the outlet pipe, but only if conflicts exist. If greater drop is needed, an external drop configuration will be required. Minimum external drop is 15".
7. Clay cut off walls or other suitable material shall be placed around the sewer pipe upstream of each manhole to inhibit groundwater flow through the sewer line bedding material.

4.3 SEWER SERVICE TAPS AND SERVICE LINES

Sanitary sewer service lines shall be 4 inch SDR 35 PVC pipe unless otherwise specified, and shall be installed in accordance to the latest edition of the Uniform Plumbing Code. Minimum grade for sewer service lines shall be ¼ inch per foot (2.08%) unless otherwise approved by the building department inspector. All taps on new sewer lines shall be accomplished with full body wye or tee fittings.

Each single family residence and all duplex and triplex units, and each business or commercial building shall purchase a separate tap and each such single family residence, duplex, triplex and business or commercial building shall have and maintain its own separate service line to the point of the tap into the District sewer main. No single tap shall be used to service more than one business except as noted below.

For a multiple-unit building that will not be individually owned that is defined as any single building containing more than four single family units and specifically includes apartment houses, and all office and commercial buildings with more than one tenant or user, each separate multiple-unit building can be serviced by a single tap on the District sewer main upon approval by the District. The size of the service line and the size of the tap shall be approved by the District based on the number of units served by the tap in accordance with the latest edition of the Uniform Plumbing Code.

Direct service line taps will not be allowed on sewer mains larger than 18 inches in diameter or directly into manholes

4.4 SANITARY SEWER ALIGNMENT, AND DEPTH

Sewer lines shall be designed so that they are located under the paved street with a minimum 3-foot offset from the edge of curb. Sanitary sewer manholes shall be placed at the street center line or center of lane. In no instance will manholes encroach on curb and gutter section, crosspans, etc. Alignment of sewer lines at manhole connections shall have a deflection angle of no less than 90° between the inlet pipe(s) and outlet pipe (acute angles between inlet and outlet pipes are not allowed).

Minimum depth of cover required for new sewer line extensions will be 72-inches (6-feet). Where grade does not allow, the minimum depth requirements may be waived. Where sewer lines have less than 3.0-feet of cover from the pipe invert to the finished street grade the trench shall be backfilled with concrete flowfill. This is to protect the sewer line during street construction. The flowfill backfill requirement also includes sewer service lines.

When waterlines cross sewer lines, whenever possible the waterline shall be laid above the sewer line with an eighteen (18) inch minimum vertical separation. In the case when 18 inch separation cannot be maintained, or the waterline is below the sewer line, the sewer line shall be encased in concrete for a distance of 10 lineal feet either side of the intersection for a total encasement distance of 20 lineal feet. The standard encasement detail is included on the District's Standard Detail Sheet.

Sanitary sewers will extend to the end of street stubs or through the property being served if there is any possibility of a future extension of the main. A manhole with a glued capped stub out will be provided for any future extensions.

4.5 MANHOLE SPACING

The maximum distance between manholes shall be as follows:

<u>SANITARY PIPE SIZE</u>	<u>MAXIMUM DISTANCE</u>
8" to 15"	400'
18" to 30"	500'
larger than 30"	600'

4.6 BARREL SIZE

The alignment of pipes into the manhole will determine the barrel size for the size of pipe used. The internal diameter of the manhole barrel shall be as follows:

<u>SANITARY PIPE SIZE</u>	<u>BARREL SIZE</u>
12" or less	48"
15" to 27"	60"
30" to 48"	72"

Manholes larger than seventy-two (72) inches will be allowed with special written permission of the Engineer.

**CONSTRUCTION STANDARDS AND
SPECIFICATIONS**

ORCHARD MESA SANITATION DISTRICT
STANDARD SPECIFICATIONS

SECTION 1
EXCAVATION AND BACKFILL FOR BURIED PIPELINES
(SUBSECTION A1-GENERAL)

1.1 GENERAL INFORMATION

1.1.1 Scope of Work. The Work to be performed under this Specification shall include all labor, materials, equipment, and services as are necessary for the excavating and backfilling of all pipeline trenches. Any modifications or additions to this Specification are set forth in the Project Specifications and/or in the Plans and Drawings.

The Work shall include the excavation and backfill of whatever substances are encountered to the depths shown on the Plans, or stated herein, or modified in the Field by the Engineer.

1.1.2 Related Standard Specifications. Corresponding Standard Specifications of City of Grand Junction, and/or the Colorado Department of Transportation shall apply except where modified herein.

1.1.3 Related Project Specifications. Specific Project Specifications will apply if provided on individual projects.

1.1.4 Excavation Classification. All excavation will be unclassified and no allowance will be made for classification of excavated material unless otherwise specified for such items as “Rock Excavation,” or “Removal of Unstable Materials.”

1.1.5 Method of Excavation. All excavations shall be made by open cut unless otherwise specified or shown. The use of trench-digging machinery will be permitted except where its operations will cause damage to such trees, buildings or existing structures above or below the ground. At such locations hand methods shall be employed to avoid such damage. Permission may be granted to tunnel under driveways, crosswalks, curbing, walkways, and utility installations, but such tunnels shall not exceed 6 feet in length.

1.1.6 Length of Open Trench. The Contractor shall excavate in advance of the pipe laying operation only a sufficient length of trench to assure steady progress in the installation of pipe. In public and private rights-of-way, the amount of open trench permitted shall be in accordance with these specifications or the instructions of the Engineer and permit requirements.

1.1.7 Subsurface Exploration. Except as may be shown on the Drawings or set forth in the Project Specifications, no subsurface exploration has been made along the pipeline alignment.

1.1.8 Excavation for Appurtenances. Excavation outside the limits of the trench shall be made as required for the satisfactory installation of manholes, boxes and other appurtenant structures.

1.1.9 Performance of Work. All trenching operations shall conform to applicable codes regarding safety, protection of property and utilities, and related items.

1.1.10 Underground Obstructions and Utilities. The Contractor shall locate all underground utility lines and pipelines and man-made obstructions such as waterlines, gas lines, sewer lines, telephone lines, culverts and similar items. No extra payment will be allowed for the removal, replacement, repair or possible increased cost caused by such underground obstructions. Any such lines or obstructions indicated on the Drawings show only the approximate location and must be verified in the field by the Contractor.

1.2 SURFACE PREPARATION

1.2.1 Within Easements, Cultivated or Agricultural Areas. All vegetation, such as brush, sod, heavy growth or grass or weed, decayed vegetative matter, rubbish and other unsuitable material within the area or excavation and trench backfill storage shall be stripped and disposed of in accordance with the requirements of Section 5, the Orchard Mesa Sanitation District, and the City of Grand Junction.

Topsoil shall be removed from the area to be excavated and stockpiled, or the Contractor may elect to import topsoil to replace that lost during excavation. Topsoil shall be removed to a depth of 8 inches or the full depth of the topsoil, whichever is less.

1.2.2 Within Unpaved Roadway Areas. The Contractor shall strip the cover material from graveled roadways or other developed, but unpaved traffic surfaces to the full depth of the existing surfacing. The surfacing shall be stockpiled to the extent that it is acceptable and usable for restoration purposes.

1.2.3 Within Paved Areas. The removal of pavement, sidewalks, driveways, or curb and gutter shall be performed in a neat and workmanlike manner. The width of the asphalt cut shall exceed the width of the trench at the subgrade by 12 inches on each side of the trench.

Concrete pavement, sidewalks, driveways or curb and gutters shall be cut with a power saw to a depth of 2 inches prior to breaking. The concrete shall be cut vertically in straight lines and avoiding acute angles.

Bituminous pavement, sidewalks, driveways or curb and gutter shall be cut with a power saw, pavement breaker or other approved method of scoring the mat prior to breaking or excavation. The bituminous mat shall be cut vertically, in straight lines and avoiding acute angles. The final cut prior to paving will be by saw cut only if stated in the Project Specifications. The final pavement cut shall follow a line parallel to the roadway adjacent to the trench wall.

All excavated paving and concrete shall be stockpiled separately and disposed of by the Contractor off site of the work at his own expense and shall not be used as trench backfill material.

In the event pavement beyond the original pavement cut is undermined or damaged during construction, additional pavement shall be removed after trench backfilling. The additional

pavement shall consist of a cut parallel to the pipe center line with transitions to the original cut on each side. The District shall not be responsible for the condition of the existing pavement, and any paving that is damaged by the Contractor outside the allowable limits (as stated in the Project Specifications) shall be replaced at the Contractor's expense.

Crossings under sidewalks, curbs and gutters or other utility lines may be made by tunneling only if approved by the Engineer.

1.2.4 Surface Widths. See Subsection 1.3.2 for policy regarding allowable width at trench surface.

1.3 TRENCH EXCAVATION

1.3.1 Trench Alignment and Depth. Horizontal alignment shall conform to the alignment shown on the Plans and to the staking approved by the Engineer. Trench center line shall not deviate more than 3 inches from a straight line between staked points. Trench depth is given on the Plans.

1.3.2 Trench Width. The trench shall be of sufficient width to allow the proper laying and backfilling of the pipe. Since trench width at the top of the pipe directly affects soil load imposed upon the pipe, width at this location is restricted.

A. Width at Top of Pipe: The following table gives the normal minimum and normal maximum trench widths at and below the top of the pipe for various pipe sizes:

Pipe Diameter, Inches	2	3	4	6	8	10	12	15	18	21	24
Maximum Width of Trench, Inches	20	21	22	24	26	28	30	33	36	39	42
Minimum Width of Trench, Inches	14	15	16	18	20	22	24	27	30	33	36

In areas where a maximum trench width is more restrictive, it will be so indicated on the Plans or in the Project Specifications. If the Contractor exceeds the maximum trench width at or below the top of the pipe, he shall be required, at no additional expense to the Owner and subject to the approval of the Engineer, provide a bedding or an encasement which will properly support the pipe being installed, regardless of any provision herein to the contrary.

B. Width At Top of Trench: Unless otherwise required by the Plans or the Project Specifications, the width at the top of the trench may be as wide as needed, at the Contractor's discretion, to assure trench stability and enhance pipe installation in accordance with 29 CFR Part 126, OSHA-Excavations; Final Rule. However, when sloping or benching is undertaken, any excavation, surface restoration, or special backfill material required will be measured and paid for on the basis of trench width set forth in the Project Specifications or Plans. No backfill, surface restoration or excavation outside of these specified trench widths will be

measured for payment; sloping and benching, and extra surface restoration costs shall be at the Contractor's option and expense, unless otherwise indicated on the Plans or Project Specifications.

- C. Trench With Multiple Pipes: Trench widths where more than one pipe is to be placed in the same trench shall be as indicated on the Plans or as directed by the Engineer.

1.3.3 Trench Wall Stability. All excavation operations shall be conducted in a manner to maintain stability of trench walls for the safety and protection of workmen, equipment and materials. It shall be the Contractor's responsibility to assess stability and undertake preventative measures to prevent collapse or sloughing. All excavation shall be in accordance with 29 CFR Part 126, OSHA-Excavations, Final Rule.

Any damage to pipes or structures occurring through settlements, heaving, water or earth pressures, slides, caving, or other causes, due to lack of, or failure of shoring, or due to any other negligence on the part of the Contractor, shall be repaired by the Contractor at his own expense.

During excavation, material suitable for backfilling shall be piled in an orderly manner. A clear area shall be maintained a sufficient distance away from the edges of trenches, minimum 2'-0", to avoid overloading the sides of the trench, and thus reduce potential for slides or caving of the trench walls.

1.3.3.1 Sloping or Benching. If the Contractor elects to slope or bench the trench walls, sloping or benching shall terminate at a depth not less than one foot above the top of the pipe barrel, and from that point down the trench wall shall be vertical.

1.3.3.2 Sheet piling and Shoring. Where conditions so warrant, and except where banks are cut back on a stable slope, excavation for structures and trenches shall be properly and substantially sheeted, braced, and shored, as necessary, to prevent caving or sliding. Sheet piling, bracing and shoring shall be designed and built to withstand all loads that might cause earth movement, and shall be rigid, maintaining shape and position under all circumstances. If the Engineer is of the opinion that at any point the trench walls are not properly supported, he may order the placement of additional supports by and at the expense of the Contractor. Compliance with such an order shall not relieve or release the Contractor from his responsibility for the safety of the work.

Shoring shall be removed as work progresses, unless otherwise approved in writing by the Engineer. Payment for wood shoring left in place if approved by the Engineer, will be made based on an allowance for the cost of the lumber only and in accordance with provisions covering changes in the Work.

Where trench sheet piling is left in place, such sheet piling shall not be braced against the pipe, but shall be supported in a manner which will preclude concentrated loads or horizontal thrusts on the pipe. Cross braces installed above the pipe to support sheet piling may be removed as the backfill progresses.

As backfill is placed, if shoring is to be withdrawn, it shall be withdrawn in increments such that the trench walls are sufficiently stable but not exceeding 4 feet horizontal and the void left by the withdrawn shoring shall be backfilled and compacted.

1.3.4 Drainage and Dewatering. The area adjacent to the pipe trench shall be graded as required to prevent the entrance of surface water into the trench. The Contractor shall provide all pumping and temporary trenching necessary to keep trenches dewatered. Water shall be disposed of in a suitable manner without damage to adjacent property or without being a menace to public health and convenience. In the event water is discharged to existing ditches or drainages, the Contractor shall ensure that flooding or other unacceptable conditions do not occur downstream along the ditch or drainage. All costs for drainage and dewatering shall be incidental to the project, unless otherwise indicated in the Project Specifications.

1.3.5 Rock Excavation.

1.3.5.1 Classification of Rock. If a pay item for Rock Excavation is included in the Bid Schedule, excavation shall be considered classified, and Rock Excavation will be paid as a separate item. Rock Excavation for pipeline trenches shall be defined as removal of (1) igneous, metamorphic and sedimentary ledge rock of such hardness and consistency that it can only be removed by continuous blasting, or through use of rippers mounted on crawler tractors; or (2) boulders greater than 1.0 cubic yards in volume.

Where rock, hard pan or other unyielding material is encountered, it shall be removed 6" below the designed grade. Any extra depth excavation due to boulders, rock, etc. shall be backfilled with compacted granular bedding material at the expense of the Contractor. No material will be paid for as rock excavation except when so classified by the Engineer prior to its removal.

Measurement shall be made on the basis of the number of cubic yards of rock excavated from its original position for the width of trench at the invert. If a boulder greater than 1.0 cubic yards has to be removed, payment will be for volume of the entire boulder removed regardless of width of trench.

Payment shall be on the basis of the unit price per cubic yard for "Rock Excavation."

1.3.5.2 Blasting. The Contractor shall notify the Engineer, each public utility, and all residences in proximity to the site at least 24 hours prior to any blasting. All blasting shall be done in accordance with the explosive statutes of Colorado and be done by a licensed explosives engineer. The Contractor's explosives shall be stored in a secure manner in compliance with all laws and ordinances, and all such storage places shall be clearly marked. The Engineer shall have the right to limit the use of explosives or to order the discontinuance of any blasting methods which, in his opinion, may endanger any part of the public or private property, the safety of inhabitants of the area, or the traveling public. Blasting shall be done in such manner that rock is not loosened or disturbed below the pipe foundation. Contractor shall abide by all applicable codes for safety procedure and protection of property and other limitations on blasting.

1.3.6 Unstable Material Excavation. If a pay item for unstable material is included in the Bid Schedule, excavation shall be considered classified and unstable material will be paid as a separate item. Unstable Material shall be excavated below the embedment zone of the pipe invert and backfilled with compacted granular bedding material so as to provide a stable pipe foundation. No material will be paid for as unstable material excavation except when so classified by the Engineer prior to its removal.

Measurement shall be made on the basis of the number of cubic yards of unstable material excavated for the width of the trench at the pipe invert. Payment shall be on the basis of the unit price per cubic yard for "Unstable Material Excavation".

1.3.7 Confinement of Right of Way. In all cases, the trenching operation, including the spoil bank, shall be confined to the width of the combined permanent and temporary rights of ways, if any. Under no circumstances will the Contractor use any areas outside the right of way without receiving written permission holding the Owner harmless from the property owner.

1.3.8 Costs for Trench Excavation. All costs for excavating the trench, including sloping and benching undertaken at the Contractor's option, will be included in the price of the installed pipeline, except where there is a specific pay item in the Bid Schedule.

1.3.9 Pipe Boring and Jacking.

1.3.9.1 General. Where it is indicated on the Drawings that open trenching for the pipeline across railroad tracks, highways, water courses, or other obstructions is prohibited, the pipe shall be installed by boring and jacking. The Contractor shall furnish any special insurance, traffic control, flag persons and any other special requirements imposed by the owner of the right-of-way as detailed in the Project Specifications. The completed installation shall be suitable in all respects for transporting the utility (water, sanitary sewage, irrigation, storm sewer, etc.) without affecting the stability and integrity of the overlying roadbed or water course.

1.3.9.2 Protection of Roadbed. No excavation for boring and jacking pits will be permitted within 15 feet of the centerline of any railroad track or within 15 feet of the shoulder of any highway unless otherwise approved by the owner of the right of way in writing or specified in the Project Specifications. If required, sides of pits shall be supported by sheet piling to prevent any movement or slippage of the earth during the excavation and boring and jacking operations. The Contractor shall work in close cooperation with the regulatory agency having jurisdiction to insure the protection of their property and traffic.

Boring and jacking operations shall not result in measurable settlement, movement, or cracking of overlying roadbeds, embankments or adjacent structures. If any movement or settlement occurs which causes or might cause damage to roadways, roadbeds, embankments or structures over, along or adjacent to the Work, operations shall stop immediately except for those activities which will assist in making the Work secure and prevent further movement, settlement or damage. Work may resume only after all necessary precautions have been taken to prevent further movement, settlement or damage.

1.3.9.3 Boring Pit. The boring pit shall be excavated on one side of the right-of-way under which the pipe or casing is to be installed. The pit shall be graded to a level surface or to the grade of the pipe being installed and shall be only of sufficient length to provide room for the boring machine or the jacking head, the jacking frame, the reaction blocks, the jacks, and one or two lengths of pipe, depending on the kind of pipe to be jacked or bored into place. The pit should be of sufficient width to permit ample working space. The end of the pit nearest the roadbed shall present a vertical face into which is to be excavated the entrance for the pipe. All excavations for the boring pit shall be properly and substantially sheeted, braced and shored, as necessary to prevent caving or sliding.

The exit or retrieval pit shall be excavated up to the casing pipe, and be only of sufficient size to continue installation of the carrier pipe, fittings and all necessary connections to the system. All pit subgrades shall be kept continuously free from ground and surface water. Ground water control along and at the face of the casing pipe shall include chemical grout stabilization as required.

1.3.9.4 Boring and Jacking of Pipe Casing. The casing shall be installed by jacking it through the earth, while excavating by boring or mining methods, to the lines and grades as shown on the Plans, or as directed by the Engineer. Jacking operations for the casing pipe shall be continuous and precautions shall be taken to avoid interruptions which might cause the pipe to "freeze" in place. A bearing plate shall be provided as necessary to distribute bearing pressures of jacking operations and to prevent movement of the boring pit wall. If additional stabilization is required such as piers or soil anchors, requirements will be specified on the Plans or in the Project Specifications.

Under no circumstances shall boring operations precede casing pipe installation by more than 12 inches. Pulling a casing pipe through a completed bore shall not be approved.

Adequate equipment shall be provided so as to insure a smooth, continuous and uniform operation leaving no exterior voids along the casing pipe.

If voids occur between the surrounding soil and the casing pipe which, in the opinion of the Engineer, would result in settlement of the material above, movement or cracking of roadways or adjacent structures, grout holes shall be provided in the casing pipe and voids around the casing pipe pressure grouted to a specified pressure before installing the carrier pipe.

After each section of casing pipe has been jacked to the limit, the following section shall be connected to the preceding by a full penetration butt weld around the entire circumference of the joint. The quality around the weld shall conform to AWWA Standard C206-75, and shall develop full strength of the pipe wall.

The Contractor may elect to provide a casing pipe larger in diameter than that shown on the plans to facilitate his boring excavation, however, the thickness of the casing actually used must meet the permit requirements of the regulating agency or ruling authority. No additional payment shall be made for any increases in the size of the casing pipe. The requirements for the casing pipe to be jacked or bored shall be specified on the Drawings or in the Project Specifications.

If an obstruction is encountered during boring and jacking of the casing pipe that inhibits advancing the boring machine and/or casing pipe, the boring machine and all debris shall be removed from the casing pipe, and the obstruction removed by hand tunneling or mining methods.

1.3.9.5 Carrier Pipe Installation. Following the completion of the installation of the casing pipe, the carrier pipe shall be installed with the insulation securely attached, if required. The carrier pipe installation shall conform to the requirements of the system being installed and as specified on the drawings or in the Project Specifications. Carrier pipe insulators shall be spaced to provide adequate support of the pipe when filled with water, but shall not exceed 8'-0" spacing on centers, unless otherwise allowed by the Project Specifications or Plans. The casing seal on each end of the casing shall be as shown on the drawings or as specified in the Project Specifications. Dried blown in sand or flowable fly ash slurry shall be installed between the casing pipe and the carrier pipe where required by ruling agency or ruling authority and as specified in the Project Specifications.

1.3.10 Uranium Mill Tailings. In the event excavations encounter material that may be classified as uranium mill tailings, the Contractor shall continue excavating, but shall stockpile the questionable material separate from native material. Precautions shall be taken to minimize intermixing or spreading the suspect material with native materials. The Contractor shall notify the Engineer immediately upon discovery of suspect material in order for the Engineer to contact regulatory agencies on acceptable subsequent handling of the material. Where the material is a distinct purple color, all equipment in contact with the tailings shall be cleaned or hosed off at the end of each day to prevent spreading the material throughout the project and workers are advised that it is desirable to wash the material off of clothing and skin if contact has been made.

When excavated material is classified as uranium mill tailings, the Contractor shall handle the questionable material separate from native material to prevent mixing the tailings with other soil. If approved by a regulatory agency, backfill and compact tailings in the lower portion of trenches in a manner to minimize the spread of potential contamination to native soils, and as specified herein. All costs for excavating, separate stockpiling, backfill and compaction of potential mill tailing material will be included in the price of the installed pipeline.

In the event mill tailings are unsuitable for backfill as determined by regulatory agency's opinion, the material shall be hauled off-site to an appropriate disposal site or an established interim storage facility that is approved to accept said waste material, and the excavation backfilled with remaining native material. If uranium mill tailings are hauled off-site as unsuitable material it will be paid for at a negotiated price. If import backfill is necessary it will be paid for at a negotiated price based on the number of tons of import backfill material delivered to the site and installed as backfill. Payment shall be based on a unit price per ton of Imported Backfill. No uranium mill tailings hauled off-site as unsuitable material and imported backfill will be paid for except when mill tailings are so classified by the regulatory agency and import backfill approved by the District prior to mill tailings disposal.

1.3.11 Asbestos Cement Pipe (ACP). If asbestos cement pipe is encountered during the excavation, the Contractor shall immediately notify the Owner of the pipe if know and shall follow the guidance regulation of the Colorado Department of Public Health and Environment. If it becomes necessary to remove asbestos pipe, Contractor shall immediately contact the Air Quality Control Division of the Colorado Department of Public Health and Environment to determine if asbestos cement pipe is classified as a regulated asbestos containing material (RACM) and what steps must be taken to legally dispose of the material. Contractor shall exhibit extreme care so as not to damage any asbestos cement pipe in execution of the Work unless otherwise specified on the Plans.

1.4 PREPARATION OF PIPE FOUNDATION

Note on Terminology: The meaning and limits of the terms Foundation; Bedding; Haunching; Springline; Initial Backfill; Final Backfill; and Embedment as used in these specifications are shown on the Plans or in the Standard Drawings.

1.4.1 Definition: The pipe foundation refers to the trench surface and/or condition of the surface, on which the pipe rests. There are two categories of foundation:

1. The natural, undisturbed trench bottom
2. An over-excavated trench bottom, with suitable replacement material.

1.4.2 Foundation Requirements. The excavated trench bottom must have a soil texture that is uniformly graded and stable, free of oversize cobbles and rock, that will provide a uniform and continuous bearing surface over its entire length. Over-excavation and replacement with suitable material will be necessary for the conditions listed below:

- A. Uneven Bearing Surface: For areas where rock or large stones are encountered, such that hand-shaping of the trench is impractical, the trench shall be over-excavated approximately 4 inches, and the trench bottom brought to correct grade with approved bedding material. If the bottom is solid rock, Granular Bedding shall be used.
- B. Unstable Materials: Wherever peat, soft clay, quicksand, or other unstable materials are encountered, such material shall be removed and the excavation backfilled to trench grade with granular material, placed and compacted in layers not more than 4 inches in loose thickness to a density of not less than 95 percent. The over-excavation and gravel stabilization material will be paid for to the elevation of the bottom of the embedment zone.

If over-excavation of the trench bottom to remove unstable material is limited to the bottom of the embedment zone depth or less (such as may occur during a temporarily saturated condition), payment for over-excavation and placement of Granular Bedding material shall be included under the pay item for Granular Embedment or Special Embedment.

If unstable conditions are due to Contractor's carelessness in allowing excessive surface drainage or water from broken utilities to enter the trench, Granular Bedding shall be placed at no cost to the Owner.

- C. Groundwater: If there is excessive groundwater, over-excavation and replacement with granular material may be necessary, for the purpose of stabilizing the bottom or keeping groundwater below pipe inverts to allow installation under dry conditions. The trench bottom shall be brought to grade with granular material prior to installing the pipe to provide a stable pipe foundation without voids.

1.4.3 Inadvertent Over-Excavation. Trenches shall not be excavated below the depths specified, shown on the Plans or established by the Engineer, except as authorized for "Improved", "Granular" or "Special" Embedment, for encasement, or for removal of unstable material. Any over-excavation (for other reasons) shall be backfilled with material selected and compacted as specified for replacement of unstable material at no additional cost to the Owner.

1.5 EMBEDMENT REQUIREMENTS

1.5.1 Definition: The Embedment section extends from the foundation to 6" over the pipe crown.

1.5.2 Embedment Material: The embedment material must be approved by Engineer.

A. Acceptable Materials

- 1. Granular Materials. Granular Embedment Material shall be required unless otherwise approved by the District Engineer in writing prior to pipe installation. Granular bedding material shall be stable when saturated and shall be a well-graded material meeting the following requirements:

<u>Sieve Size</u>	<u>% Passing</u>
¾"	100
No. 200	20 max.

- 2. Concrete. 2500 psi concrete as specified in Section 4 (used for Concrete Encasement).

B. Acceptable Under Restricted Conditions: Silt, silty clays, and clays, including inorganic clays and silts of medium to high plasticity and liquid limits. These materials are acceptable only where future saturation of the trench is unlikely. Included are 'stick' clays, 'adobe' gumbo, muck and similar soils, which compact poorly and are spongy when not properly compacted.

C. Not Acceptable: Organic soils as well as soils containing frozen earth, debris, rocks larger than ¾ in. (19mm) in diameter, and other foreign materials.

1.5.3 Embedment Sections: Acceptable methods for embedment are shown in the Typical Embedment sections on the Standard Details or on the Plans. Applications and materials requirements are described below.

A. Embedment Methods for Dry, Stable Foundations.

1. Flat Bottom Embedment: This type of embedment may be used only for ideal conditions and with rigid pipes. It shall not be used for flexible (PVC) pipes, and can only be used upon written permission of the Engineer. Bell holes are required.
2. Ordinary Embedment: Ordinary Embedment shall be used for all pipeline construction whenever foundation conditions permit, as specified in Section 1.4 and the foundation can be properly shaped to uniformly support the pipe. Bell holes shall be provided.
3. Improved Embedment: Where a hard, rocky or otherwise uneven foundation exists, the Contractor shall use Improved Embedment. Improved Embedment may be suitable material from the natural trench soil (no rocks larger than $\frac{3}{4}$ " (max. 10% passing No. 200 sieve) or if not reasonably available on site, may be imported from other sources. If rock is excavated below the embedment zone that is otherwise a stable pipe foundation, material shall not be classified as unstable material and shall be considered part of the improved embedment zone. An additional payment will be made for the use of Improved Embedment where specified.

B. Embedment Methods for Wet and/or Unstable Foundations.

1. Granular Embedment: Granular Embedment should be used only with rigid pipe, unless otherwise directed or authorized by the Engineer.
2. Special Embedment and Backfill: Special Embedment shall be installed where shown on the Plans or where directed or authorized by the Engineer. Its primary use will be to increase the pipe load factor (to compensate for extra depth or width), and/or for use with all flexible pipes.

C. Embedment for Special Installations.

1. Encasement: Concrete pipeline encasement, as shown on the Typical Embedment sections at the end of this section or on the Plans, shall be installed where shown on the Plans or where directed or authorized by the Engineer.

Note: The table below converts terminology used in these specifications to standard loading classes, listed below in order of increasing load bearing capacity.

<u>Category</u>	<u>Project Specifications</u>	<u>Std. Loading Classes</u>
Natural	1. Flat Bottom Embedment	Class D (not permitted for Foundation flexible pipe)
	2. Ordinary Embedment	Class C, Shaped Bottom
Over-excavation and Replacement with Suitable Material	3. Improved Embedment	Class B, Shaped Bottom
	4. Granular Embedment	Class C, Granular
	5. Special Embedment	Class B, Granular
	6. River Embedment	Class B, Granular
Encasement	7. Concrete Encasement	Class A

- D. Clay Cut-Off Walls. Clay cut-off walls shall be provided as shown on the Plans, installed around the pipe and extend from 6 inches below the pipe to 9 inches above the pipe, and be at least 6 feet long. Cut-off walls are to extend the full width of the trench. The purpose for the clay cut-off walls is to prevent subsurface water from draining through the granular bedding.

The clay cut-off wall material shall consist of a suitable clay material.

At the Contractor's option, bentonite may be used to condition native clays. Only dry clay may be mixed with bentonite. The bentonite to be mixed with native clay shall be a high swelling sodium bentonite, which is commercially processed in powder form and conforms to ASTM D-698. Mix bentonite with native clay at a minimum rate of 15% bentonite by total weight. If clay is wet or saturated, addition of bentonite is unacceptable. Once clay and bentonite is well mixed, add water and allow the mixture to hydrate 24 hours before constructing cut-off walls.

The cut-off wall material shall be at optimum moisture to plus 4% optimum moisture when compacted with sled-type or vibratory plate compactors. A sheepsfoot roller shall not be used on the clay cut-off walls. Compaction shall be to 90% per AASHTO T-99. Carefully compact the clay material to prevent displacement of the sewer line alignment or grade, and to prevent excessive deflection of PVC pipe.

1.5.4 Source of Embedment Material (for Ordinary or Improved Embedment). Whenever feasible, embedment material for Ordinary or Improved Embedment shall come from excavated material adjacent to the trench. To accomplish this, it may be necessary for the Contractor to segregate or screen out stones larger than 1½ inches (either by hand or with equipment) or to transfer materials from other locations along the trench. No extra cost will be paid for this screening and/or hauling of backfill material, as long as the material is from trench excavation.

If sufficient material suitable for Ordinary or Improved Embedment is not reasonably available from the trench excavation material, the Contractor shall import embedment material from an

approved source. Generally, this material shall be natural material. Payment for importing this type of embedment material will be under the category of Improved Embedment.

1.5.5 Placement of Embedment Materials. Placement of fill around and over the pipe will comply with the following, regardless of Embedment material:

- A. Placement of Embedment up to Pipe Springline (Haunching): Embedment material shall be deposited in the trench uniformly at both sides of the pipeline for the full width of the trench. This embedment material shall be tamped in 4-inch layers and shall be thoroughly compacted under, and on each side of the pipe to provide support free from voids. If the trench is over excavated to 4-inches below the pipe, the excavated area shall be backfilled and compacted with embedment material prior to installing the pipe, and placing of subsequent lifts of embedment material around the pipe.
- B. Placement of Initial Backfill: Backfill material in this category shall be placed and compacted in distinct separate lifts not to exceed 6 inches of loose depth from the pipe springline to 6-inches above the pipe.
- C. Approved Methods of Compaction: Non-mechanical hand tampers will be required below the crown of the pipe. Tamping bars of the type shown in the Standard Drawings or as recommended by pipe manufacturer's installation manual, must be provided by the Contractor and used for hand tamping up to the pipe crown. Mechanical tampers may be used above this point if sufficient cover is available above the pipe to prevent damage to the pipe. All embedment material shall be compacted to a density of 90% of optimum density as determined by ASTM D698.

1.6 FINAL BACKFILL (6-inches above pipe to surface).

1.6.1 General. Prior to final backfill, all foreign materials and debris shall be removed from the trench. Sheeting used by the Contractor shall be removed just ahead of backfilling operations unless it is ordered by the Engineer to be left in place. Backfilling and compaction shall be performed as soon as practicable, but shall not be backfilled until the pipe installation has been approved by the Engineer. The amount of open trench on or adjacent to public right of way shall not exceed 200 feet at any time; otherwise, open trenches shall not exceed 800 feet.

1.6.2 Material for Final Backfill: Three categories of Final backfill are recognized: Ordinary Backfill, Select Backfill, and Flowable Fill Backfill. Unless otherwise specified on the Plans or Project Specifications, Ordinary Backfill shall be used.

1.6.2.1 Ordinary Backfill Material shall be the material obtained from trench excavation (if suitable) or from other approved sources as required to obtain material suitable for the required compaction. Final backfill material shall be free from frozen material, excessive organic material, lumps of clay, rocks or stones larger than 8" in diameter, boulders and trash. The moisture content shall be within 2% of optimum for compaction purposes. Clay and similar material with a plasticity index in excess of 15 shall not be considered suitable for backfilling

the trenches located in improved streets, roads, highways, and thoroughfares. If excavated material is not satisfactory for use as backfill, or whenever there is a shortage of satisfactory backfill material from any approved source, the Contractor shall furnish all necessary suitable backfill material and shall dispose of the condemned material. All costs for Ordinary Backfill, including supplying and disposing of backfill, shall be included in the cost of the installed pipeline, unless there is a specific bid item, such as "Imported Final Backfill".

1.6.2.2 Select Backfill shall be used in roadways whenever ground water or clayey soil with a plasticity index in excess of 10 is encountered within three feet of the surface, or where required in the Project Specifications. Select backfill shall be road base crushed or pit run gravel, all of which passes a one inch sieve and not more than 30 percent passes a No. 80 sieve. Select backfill is a separate Pay Item.

1.6.2.3 Flowable Fill Backfill. Flowable fill concrete backfill shall be installed in conformance with the locations and requirements as detailed in the Plans.

1. Product. Flowable fill concrete backfill shall consist of the following materials and mix proportions:

<u>MATERIAL</u>	<u>STANDARD</u>	<u>PER CUBIC YARD OF CONCRETE</u>
Cement	ASTM C-150	42 lbs.
Sand	ASTM C-33	1845 lbs.
Size #57 Aggregate	ASTM C-33	1700 lbs.
*AEA	ASTM C-260	5.0 oz.
Water	ASTM C-94	325 lbs. (39.0 gal.)

*NOTE: Air entraining agent may be used to increase flowability.

The above weights are based upon aggregates in a saturated, surface dry condition. Batch plant corrections must be made for moisture in aggregates.

DESIGN PHYSICAL PROPERTIES:

Slump Obtained - 6-8 inches
28-Day Compressive Strength - 100 psi

2. Placement. After all pipe and appurtenances have been placed in the trench, bedded and partially backfilled, and the work approved in place, the trench shall be backfilled with flow-fill concrete to base of subgrade, pavement or as otherwise specified. The flow-fill concrete shall be rodded or vibrated as necessary to assure voids will not be present in the flow-fill concrete or around or under pipe, fittings, and appurtenances.

The backfilled trench shall not be opened to any traffic until the flowfill concrete backfill has attained sufficient strength to support such traffic without observable deformation, unless a

traffic rated steel plate or other approved means is placed over the backfilled area to support traffic loadings.

Placement of subsequent lifts of base course or paving shall not occur until the flow-fill concrete backfill has attained sufficient strength to support construction equipment without observable deformation.

1.6.2.4 Fly Ash Slurry Fill. A fly ash slurry used for plugging abandoned pipes or for backfilling trench excavations above the pipe embedment zone shall be installed in conformance with the locations and requirements as shown in the Plans.

1. Material. Fly ash slurry shall consist of the following materials and proportions for the desired flowability of the slurry and strength of the cured mix.

<u>MATERIAL</u>	<u>STANDARD</u>	<u>REMARKS</u>
Class C Fly Ash	ASTM C-618	Must have cementitious properties.
Water	ASTM C-94	Available through on-site fire hydrants or hauled to the site.

DESIGN PHYSICAL PROPERTIES:

Minimum 28-Day Compressive Strength - 100 psi
Maximum Shrinkage - 1.0 % by volume
Initial Set Time - Less than 24 Hours

An alternate fly ash slurry using Class F fly ash may be considered on a case-by-case basis, pending review and approval of Contractor's proposed mix design and material conformance test results. A slurry using Class F fly ash must contain a cementitious product, as well as have a documented mix design and testing from an approved testing facility. The Contractor shall be responsible for providing the alternative slurry mix design and conformance testing for the submittal that shall meet the following minimum mix proportions:

- a) Fly Ash Slurry Proportions for use in Abandoning Existing Pipes. Minimum mix shall comprise of 565 lbs cement/CY, 1,070 lbs Class F fly ash/CY and 940 lbs water/CY. If the minimum mixture does not meet the desired strength or flowability, the proportions may be modified to no more than 65% fly ash and 35% water. If a mixture is desired that is out of the range described above, it must first be approved by the Engineer.
- b) Fly Ash Slurry Proportions for use in Open Excavations. Shall be comprised of 50% fly ash and 50% water as a minimum. If the 50/50 mixture does not meet the desired strength or if a faster set time is desired, the proportions may be modified to no more than 70% fly ash and 30% water. If a mixture is desired that is out of the range described above, it must first be approved by the Engineer.

2. Installation. The following installation of fly ash slurry should be followed unless otherwise stated in the Project Specifications and Plans. Alternative applications may be considered upon approval by the Engineer.

- a) Abandoning Existing Pipe. Fly ash slurry used for pipe abandonment shall be placed in pipes to be abandoned using pumps or tremie chutes with positive hydraulic head above the crown of the pipe. Each section of pipe shall be adequately vented and the slurry placed in a manner to assure complete filling of the pipe. When shown on the Plans the end(s) of each pipe segment shall be blocked with suitable form work or plug to prevent migration of the slurry beyond the limits of the pipe abandonment. The fly ash slurry shall exhibit flowing characteristics such that the pipe is filled to the crown with no voids. If directed by the Engineer, holes shall be cut in the top of the pipe to confirm complete filling of the pipe.

- b) Open Excavation Backfill. After all pipe and appurtenances have been placed in the trench, bedded and partially backfilled, and the work approved in place, the trench shall be backfilled with fly ash slurry to base of subgrade, pavement or as otherwise specified.

The backfilled trench shall not be opened to any traffic until the fly ash slurry backfill has attained sufficient strength to support such traffic without observable deformation, unless a traffic rated steel plate or other approved means is placed over the backfilled area to support traffic loadings.

Placement of subsequent lifts of base course or paving shall not occur until the fly ash slurry backfill has attained sufficient strength to support construction equipment without observable deformation.

3. Contractors Qualifications. The Contractor and his on-site superintendent shall have a minimum of 2 years direct experience with application of fly ash slurry.

1.6.3 Disposal of Excess Material. Unsuitable or excess materials removed in excavating shall be removed and disposed of by the Contractor at his expense, off the right-of-way and public property, to areas selected by the Contractor.

1.6.4 Compaction of Final Backfill. There are two categories of Compaction for Final Backfill: Normal Compaction and Special Compaction. Costs of Normal Compaction are to be included in the installed price of the pipeline; Special Compaction is a separate bid item unless otherwise specified.

Final Backfill for Special and Normal Compaction shall be in accordance with the typical trench backfill detail given in the Standard Drawings or shown on the Plans. Those trenches requiring Special Compacted backfill will be indicated on the Plans, in the Project Specifications, or as directed by the Engineer. All trenches under or within 10 feet of structures shall have Special Compacted backfill. The Engineer may direct the use of Special Compacted backfill for other areas and may delete the requirement to use special compacted backfill from certain areas.

Regardless of the type of Final backfill required, the Contractor shall be responsible for repair of detrimental settlement, as specified in Section 1.8.

1.6.4.1 Special Compaction (Hydraulic Methods). Compaction by inundation or jetting will be permitted by the Engineer only if soil conditions are suitable for this method of soil consolidation. It is important that proper precautions be taken to prevent floating of the pipe when hydraulically compacting the trench, and the Contractor shall be wholly responsible for damage resulting from neglect of these precautions.

1.6.4.2 Special Compaction (Mechanical Methods). Backfill material shall be deposited in lifts with each lift to be compacted by surface or internal vibrators, hand or power tampers, or other suitable compaction equipment. Unless otherwise approved, compaction equipment shall be a sheepsfoot type roller, unless material is not suitable for sheepsfoot type equipment as determined by the Engineer. Compaction by means of a loaded dump truck, front end loader, or smooth drum roller is not an acceptable method to achieve special compaction requirements. Each lift shall be compacted to the required degree of compaction prior to the placement of subsequent lifts. Maximum lift thickness shall be dependent upon compaction equipment used to meet the required compaction density, but in no case shall be greater than 18 inches above the initial lift over the top of pipe, unless otherwise approved by the Engineer. Lift thickness shall be reduced if the compaction equipment and compaction effort does not provide the required degree of compaction. Lift thickness may be increased only when sufficient compaction tests are provided to the Engineer which verify that piece of equipment can compact to a depth exceeding the lift depth.

The first backfill lift shall be placed to a depth of 30 inches above the top of pipe before vibratory roller or compacting hammer type compaction equipment is used over the pipe. The Engineer may require a change in equipment or method used if, in his opinion, the methods being used by the Contractor are liable to cause damage to the pipe or detrimental settlement of the backfill. Any damage resulting from backfilling shall be repaired by the Contractor at his own expense immediately upon discovery of the damage.

The material in each backfill lift spread for compaction shall contain plus or minus 2% of the optimum moisture content for compacting purposes, and this optimum moisture content shall be uniformly distributed throughout the lift. Harrowing or other working of the material may be required to produce the required uniformity of moisture content.

1.6.4.3 Density Control. Control tests of densities and moisture contents will be made by the Engineer as work progresses. Any material which is not properly compacted, in the opinion of the Engineer, shall be excavated and replaced with properly compacted material at the Contractor's expense. Where density tests are required below grade, the Contractor shall excavate and backfill the test hole at no additional cost to the Owner.

1.6.4.4 Normal Compaction. Unless otherwise specified, Normal Compaction shall consist of placement of Ordinary Backfill into the trench up to 1 foot from the surface without compaction, followed by wheel rolling and then placement and wheel rolling of the final lift. Normal compaction is allowed in unimproved areas such as non-irrigated fields or landscaped

areas and must first be approved by the Engineer or otherwise specified in the Project Specifications. Backfill shall be mounded above the trench to allow for settlement.

1.7 MAINTENANCE OF BACKFILL AND STREETS.

1.7.1 Maintenance of Backfill. The Contractor shall repair or remove and recompact any areas where detrimental settlement of backfill occurs, and repair or replace any structures, utilities, or surfacing damaged by settlement of backfill in accordance with the terms of the Contractor's guarantee. In the interim period after the backfill and prior to final inspection, the Contractor shall maintain the trench surface under roadways and walkways by grading to a smooth surface so as to provide a passable and safe condition for vehicular and pedestrian traffic.

When the Contractor is notified by the Engineer that any backfill is hazardous, or provides an unsatisfactory passageway, he shall correct such hazardous conditions at once. If the Contractor fails to comply with said request, the District, after giving one day written notice, shall undertake this work and shall charge the costs there of for said maintenance to the Developer. In addition, the Developer shall be responsible for the cost to the District for all claims and damages filed against the District because of hazardous conditions in the trench.

1.7.2 Maintenance of Streets. Streets and sidewalks adjacent to trenches shall be maintained in a safe and passable condition. Non-paved streets shall be graded on a routine basis to a smooth surface. Waste material from the trench shall be scraped from the street surface.

The Contractor shall implement a regular and routine program for dust, loose rock and mud control, through use of motor graders, brooms, sweepers, water sprinkling, and similar equipment, as required by the Orchard Mesa Sanitation District. No extra payment will be made for mud and dust control unless otherwise specified.

After Final Backfill has been placed, access will be maintained to all driveways, sidewalks, and parking areas.

1.8 RESTORATION

1.8.1 General. Unless otherwise specifically indicated on the Plans or Project Specifications, the Contractor shall restore and/or replace paving, curbing, sidewalks, gutters, shrubbery, fences, sod or other disturbed surface or structure to a condition equal to or better than that before the Work began to the same elevation and alignment and to the satisfaction of the Engineer, and shall furnish all labor and materials incidental thereto. No permanent surface shall be placed within 30 days after the backfilling has been completed, except with written permission of the Engineer. Upon completion of construction, surplus materials, equipment, tools, and temporary structures shall be removed by the Contractor. All dirt, rubbish and excess earth from excavations shall be disposed of by the Contractor and the construction site shall be left clean and orderly.

1.8.2 Street Restoration.

1.8.2.1 Acceptance of Backfill. Prior to placement of finished surface, all backfill must comply with the following requirements:

- A. Compaction Tests - all compacted fill must equal or exceed minimum density requirements, unless waived by the District.

1.8.2.2 Proof Rolling. All trenches will be proof-rolled with not less than two passes of a loaded dump truck. Depressed, but stable backfill shall be brought to grade; soft, unstable or spongy (plastic) backfill, which cannot support the test vehicle or which undulates up and down in front and back of the wheels, shall be removed and replaced with stable backfill at no extra cost to Owner.

1.8.3 Unpaved Roadways.

1.8.3.1 Trench Surfacing. Gravel surfacing, removed during trench excavation shall be replaced to a depth stated in the Project Specifications. Salvaged gravel shall be moved near the top of the backfill, but below the new gravel. The gravel shall be compacted by a smooth drum roller or rubber-tired roller to the elevation of the undisturbed surface, unless otherwise directed by the Engineer. All replacement gravel shall be 'new' material. The gravel shall conform to the requirements of the Section 3 and the Project Specifications.

1.8.3.2 Roadway Surfacing. All accumulated waste material will be scraped off existing gravel surfaces. Gravel surfacing of the entire roadway will be required only if so specified in the Project Specifications.

1.8.4 Paved Roadways.

1.8.4.1 Pavement Design. After the backfill has been approved by the Engineer, and the Highway or Street Department having jurisdiction, a 6-inch base course shall be added and the paving shall be replaced to the same depth as the undisturbed paving, using hot-mix asphaltic concrete material, except the thickness of the paving shall not be less than 3 inches thick, but shall equal the depth of the existing paving, if such is more than 3 inches thick, unless otherwise specified in the Project Specifications or as shown on the Plans.

1.8.4.2 Base Course. Base material shall consist of hard, durable particles free from organic matter and balls of clay and which, when placed and compacted, will result in a firm, dense, unyielding foundation. Base material shall meet the following grading requirements (ASTM C33. Gradation 67):

<u>Standard Size of Sieve</u>	<u>Percentage by Weight Passing Sieve</u>
¾ inch	100%
No. 4	30-60%
No. 8	25-50%
No. 200	5-12%

<u>Standard Size of Sieve</u>	<u>Percentage by Weight Passing Sieve</u>
Liquid Limit	25 max.
Plastic Limit	6 max.

1.8.4.3 Asphalt Materials and Placement. The hot mix asphalt and concrete shall be as specified in the Project Specifications. Surface preparation for paving shall include cleaning and prime tack coats. After placing the material, the pavement shall be compacted to a minimum density of 95% of maximum Marshall with a smooth roller. The final lift shall be feathered one (1) foot on both sides of the street cut. All methods shall meet the requirements of the Highway Department having jurisdiction. If the local authority has no requirement, methods and materials shall comply with Colorado Department of Highways Specifications.

1.8.4.4 Unfavorable Weather Conditions. Whenever weather conditions are not favorable for permanent surfacing, the Engineer may require that a 2" thickness of temporary bituminous cold mix street surfacing be placed over the backfilled and compacted trench in all paved streets and leveled with existing pavement at the Contractor's expense. This will be done in all pavement. This surfacing shall be removed by the Contractor at a later date when weather conditions permit and be replaced with a permanent surfacing. The permanent work shall not be started until favorable weather conditions exist. As the temporary cold mix surface settles or is displaced by traffic, it shall be replaced immediately and the surface maintained level with the existing pavement until such time as the Contractor is permitted to place the permanent surface.

1.8.4.5 Other Structures. Subgrade and footings for sidewalks, curb and gutter, driveways, and other structures which have been disturbed or removed during construction shall be compacted and proof rolled; imported materials shall be used as necessary to assure a stable base.

1.8.4.6 Concrete. All concrete used in restoration work, including all curb, gutter, sidewalk and concrete street replacement work, shall conform to the requirements set forth in "Section 4, Concrete" and the Highway or Street Department having jurisdiction.

1.8.4.7 Locations Other Than Streets. Sod, defined as densely grassed turf, which is removed, shall be replaced with sod of the same quality, or the sod removed may be put back if it has been properly stored and remains in a healthy condition. Fields requiring reseeding and replanting shall be designated on the Plans.

1.8.4.8 Finish Cleanup and Grading. The Contractor shall grade the completed trench line on graveled roads to effect a neat and workmanlike appearance. When so directed by the Engineer, final backfill, including gravel surfacing, shall be mounded over the top of the trench to compensate for potential future settlement.

Stones and debris shall be removed from the project right-of-way and disposed of in areas selected by the Contractor and approved by the Engineer. Drainage ditches and culverts shall be cleaned of all excavated material and restored to their original condition and operation.

1.8.4.9 One Year Guarantee on Trench. Following final inspection by the Engineer, the Contractor shall maintain the surface of trenches, curbs and gutters, sidewalks, shrubbery, fences, sod, and other disturbed surfaces for a period of 18 months after such inspection. The one year warranty time frame shall be extended as necessary for any portion of the Work that is subject to special permit(s) for the project (i.e., Colorado Department of Transportation), to the warranty time frame(s) specified by the permit(s). All material and labor required for the maintenance of the trench surfaces and structures shall be supplied by the Contractor, and the work shall be done in a manner satisfactory to the Engineer. Areas which have settled shall be restored to grade.

1.8.4.10 Costs for Restoration. All costs for work in restoration will be included in the price of the installed pipeline, except where there is a specific pay item in the Bid Schedule.

1.9 CONFLICTS IN SPECIFICATIONS

When the City of Grand Junction or the Colorado Department of Transportation have Standards and Specifications, or requirements that differ for those specified herein, the greater quantity or better quality shall govern whichever may be applicable.

ORCHARD MESA SANITATION DISTRICT
STANDARD SPECIFICATIONS

SECTION 2
SEWER PIPE SYSTEMS: MATERIALS AND INSTALLATION

2.1 GENERAL

2.1.1 Scope. This section includes General Standard Specifications for pipeline installation and materials. Specific Project requirements with regard to type and size of pipe, fittings and appurtenances are given on the Plans, or in the Project Specifications.

2.1.2 Related Standard Specifications. Corresponding Standard Specifications of City of Grand Junction shall apply except where modified herein.

2.1.3 Related Project Specifications. Specific Project Specifications will apply if provided on individual projects.

2.1.4 Certification. If requested by the Engineer, the Contractor shall furnish notarized certificates stating that all pipe, manholes, fittings, and appurtenances have been inspected and tested and meet all the requirements specified. The Contractor shall deliver certificates in duplicate to the Engineer.

2.1.5 Shop Drawings and Descriptive Data. Shop drawings and/or descriptive data consisting of catalog cuts, manufacturer's descriptive data, details and specifications for items installed, shall be submitted for approval for the following items (when used on the Project):

Main Line Pipe	Manhole Lids & Steps
Pipe Fittings	Tapping Saddles
Special Fittings and	Service Line Pipe
Adaptors	Manholes

2.2 MATERIAL REQUIREMENTS FOR MAINLINE GRAVITY SEWER PIPES.

2.2.1 General. This section lists material and dimensional standards for the accepted types of mainline, gravity flow sewer pipes. Mainline pipe is defined as all pipe with a diameter 8 inches or greater. The specific type of pipe considered most applicable to the specific conditions of each project, and for which bids will be accepted, is listed on the Plans, Drawings, or Project Specifications.

2.2.2 PVC Plastic Pipe and Fittings. All PVC (poly vinyl chloride) solid wall sewer pipe and fittings shall meet the following criteria:

Reference Standard	ASTM D3034 (4" through 15") ASTM F679 (18" through 27")
SDR (Standard Dimension Ratio)	35
Pipe Lengths	14' maximum. 20' lengths will not be accepted without the Engineer's approval.
Joints	Bell and Spigot conforming to ASTM 3212
Sealant	Synthetic Rubber Gaskets

Pipe shall be as manufactured by CertainTeed Products Corporation or Johns-Mansville Corporation or equivalent.

PVC pipe delivered to the project site shall be subject to inspection and acceptance by the Engineer or his representative. Acceptance is contingent on meeting physical and structural criteria for new pipe; criteria for rejection may include, but is not limited to apparent age, ultraviolet (U.V.) degradation, physical damage, out-of-round or egg-shaped pipe and excessively bowed pipe. Pipe which is faded or discolored, and/or pipe having a thin chalk-like film on exposed surfaces may be rejected on the basis of age or U.V. degradation. Physical defects such as pipe crimped by strapping bands, egg-shaped pipe that exceeds 5% deflection, and pipe which has bowed in excess of the long-term longitudinal bending allowed by the pipe manufacturer may be rejected on the basis of structural damage. Allowable bending of new pipe is defined as the maximum offset distance measured from a straight line strung between ends of pipe (from behind the bell to the insertion mark) to the pipe belly. The maximum allowable measured offset distance is as follows:

<u>Pipe Diameter</u>	<u>Maximum 14' Joint</u>	<u>Offset Distance 20' Joint</u>
8"	2.2"	5.4"
10"	1.7"	4.4"
12"	1.4"	3.6"
15"	1.2"	3.1"

2.2.3 Ductile Iron Pipe and Fittings. All ductile iron pipe (DIP) and fittings for mainline sewers shall have a cement mortar interior lining and bituminous exterior coating. Pipe shall comply with the following criteria and standards:

Pipe Standard.....	AWWA C104/ANSI 121.51
Thickness Class.....	50 (Unless otherwise specified)
Pipe Lengths.....	18' to 21'
Cement Mortar Lining.....	ASA A21.4
Bituminous Coating.....	ASA A21.6
Joints.....	Bell and Spigot (Push On or M.J.)
Sealant.....	Synthetic Rubber Gasket
Polyethylene Encasement.....	8 mil., AWWA C105 color coated green for sewer

Fittings shall conform to A21.50, Class 125. Lining and joint requirements are the same as for pipe.

2.3 PRESSURE SEWER PIPE MATERIALS

All pressure sewer materials shall conform to requirements specified for standard water supply pressure pipe. The type of pressure sewer pipe required will be indicated on the Plans.

2.4 INSTALLATION OF GRAVITY SEWER PIPE

2.4.1 General The following categories of gravity sewer pipe are recognized by these Specifications:

- Flexible Thermoplastic Pipe.....SDR 35 PVC
- Rigid.....Ductile Iron Pipe

The installation specifications will apply equally to all categories of pipe. Special care must be used in selecting and compacting embedment materials for flexible pipes to reduce deflections.

The pipe must be installed in accordance with the manufacturers' installation guide and applicable reference standards, except as herein modified or otherwise indicated on the Plans and Specifications. The Contractor must obtain and distribute manufacturer's installation manuals to the job superintendent, job foreman, pipe layer, equipment operators, inspector, engineer, and owner's maintenance representative prior to installing any pipe.

2.4.2 Handling, Placement and Protection of Pipe. Pipe shall be handled, stored and transported in a manner to prevent damage to the pipe or lining. All pipe and fittings shall be inspected for damage and defects before assembling or laying and any damaged or defective items shall be repaired or replaced as directed by the Engineer at no additional cost.

PVC pipe can suffer physical and material damage when exposed to direct UV radiation through organo-chemical reactions. To avoid potential UV degradation, all PVC pipe is to be covered with minimum 6 mil. polyethylene or vinyl sheeting when pipe is stored on-site for more than 30 days. In addition, pipe may be removed from cover and strung along the trench no more than 30 days in advance of installation and backfill to reduce exposure to UV radiation and to minimize potential degradation and/or thermal deformation of pipe.

Before being lowered into the trench, the interior of the pipe shall be thoroughly cleaned of foreign material and shall be kept clean during laying operations by plugging or other approved methods.

All pipe, fittings, and accessories shall be carefully lowered into the trench using suitable equipment in such manner as to prevent damage to pipe and fittings. Under no circumstances shall pipe or accessories be dropped or dumped into the trench.

Plain-end pipe installed in push-type joints or cut pipe installed in any joint shall be properly smoothed and beveled to prevent cutting or rolling gaskets. Any pipe that has the grade or joint disturbed after laying shall be taken up and relaid. Pipe shall not be laid when weather conditions are unsuitable for the work. No pipe fittings or appurtenances shall be laid in wet trench conditions which preclude proper bedding as specified, or on frozen trench bottom, or when, in the opinion of the Engineer, the trench conditions or the weather are unsuitable for proper installation.

Where groundwater is encountered, the Contractor shall furnish such pumping or other means as will insure a satisfactory trench to joint the pipe, protect the fittings and inspect the work. When work is not in progress, open ends of pipe and fittings shall be securely closed so that no trench water, earth or other substances will enter the pipes or fittings. Whenever water is excluded from the interior of the pipe, adequate backfill shall be placed on the pipe to prevent floating. Any pipe which has floated shall be removed from the trench and be relaid as directed by the Engineer.

Any section of pipe found to be defective before or after laying shall be replaced with sound pipe without additional expense to the Owner.

Pipe ends left for future connections shall be plugged or capped and the plug or cap is to provide a watertight seal. Ends of mains and stubs for future lines shall be marked by 4x4s set vertically, set 4 feet into ground and 4" above grade where possible.

Pipe shall be laid with the bell ends up grade. Cutting of pipe shall be done in a neat and workmanlike manner, without damage to the pipe or linings, and so as to leave a smooth end at right angles to the axis of the pipe. Cut ends and rough edges shall be ground smooth and beveled as necessary.

2.4.3 Alignment and Grade. Pipe shall be laid to the grade and alignment shown on the Plans, and shall form a straight line at a continuous slope between manholes (unless otherwise specified) with no sags, deflection, curves, humps or changes in slope. Variations of grade between manholes will not be allowed. If grade variations exist upon inspection by the Engineer, the Contractor shall be responsible for relaying the section of sewer line not in compliance.

Horizontal line and vertical grade shall be established and maintained by the Contractor by means of a pipe laser, unless otherwise specified and checked with a surveyor's level and transit on each section between manholes. Pipe laser shall be rated for 600-lineal feet for the vertical and horizontal tolerance specified. Survey information shall be recorded and given to the Engineer.

When a section of pipe from manhole to manhole is installed at a continuous grade with no sags, humps, or changes in slope, variance from established line and grade at the manhole shall not be greater than 0.10 foot horizontally and 0.10 foot vertically. The allowed variance accounts for pipe installed at slightly greater or lesser slope than as designed, but is not to be a cumulative variance. When a variance is allowed, the elevation difference between design and as-built conditions may either carry through from one manhole to the next, thereby retaining

design grades, or the slope of subsequent pipe runs may be adjusted up or down to compensate for the elevation difference. The Engineer will provide written direction to the Contractor in regard to adjusting designed grades of subsequent pipe runs. Whenever the pipe is found to be outside the specified limits, the misaligned sections shall be removed and relaid to the correct line and grade at the Contractor's expense.

If the Contractor chooses to install bowed or curved PVC pipe which does not exceed long-term longitudinal bending allowed by the manufacturer, every effort must be made to straighten the pipe in the trench with bedding material or other firm lateral support. Install the pipe so that the curvature is left to right in the trench, rather than up and down; and alternate joints of pipe to curve the opposite direction as previous pipes. In any event, horizontal tolerance of 0.10 foot horizontally as identified in the paragraph above, shall apply to each joint of pipe. Curved or bowed pipe which cannot be installed and straightened to meet established lines and grades shall be subject to rejection.

2.4.4 Pipe Foundation (Bedding). The trench foundation and pipe bedding shall conform to Sections 1.4 and 1.5, and shall have been inspected and accepted by the Engineer before pipe is laid. All replacement bedding in over excavated areas shall be compacted to 90% relative density.

2.4.5 Embedment Material (Haunching and Initial Backfill). Placement and compaction in the haunching and initial backfill zones shall conform to requirements of Section 1.5. Embedment materials shall be ¼-inch to ¾-inch angular graded stone (Type A) as shown on the Standard Sanitary Sewer Detail Sheet, unless otherwise approved by the District Engineer in writing prior to pipe installation. Silt, silty clays, and clays, organic soils, frozen earth, debris, or rocks shall not be allowed in these zones.

The Contractor shall have available at the site, tamping bars of the type recommended by the manufacturer's installation manual.

2.4.6 Unstable Material. When the trench bottom is determined to be unstable, the Contractor shall over-excavate to a depth determined by the Engineer and backfill with granular material in order to stabilize the pipe foundation, in accordance with the standard details shown on the Plans.

2.4.7 Clay Cut-Off Walls. Whenever the pipe is bedded in well-drained, permeable material, clay cut-off walls shall be provided. Clay cut-off walls are to be installed at the upstream side of all new manholes located around the sewer pipe and shall extend from 6 inches below the pipe to 9 inches above the pipe, and be at least 6 feet long. Cut-off walls are to extend the full width of the trench. The purpose for the clay cut-off walls is to prevent subsurface water from draining through the granular bedding.

The cut-off wall material shall be at optimum moisture to plus 4% optimum moisture when compacted with sled-type or vibratory plate compactors. A sheepsfoot roller shall not be used on the clay cut-off walls. Compaction shall be to 90% per AASHTO T-99. Care should be exhibited when compacting the clay material to prevent displacement of the sewer line alignment or grade, and to prevent excessive deflection or sags in the PVC pipe.

2.4.8 Curved Sewers. In the event that curved sewers are required by the Plans, maximum joint deflection shall be as indicated by the manufacturer. In the event that greater curvature is required than is allowed by joint deflection, angle couplings or deflection sweeps should be used at the joints.

2.4.9 Relation to Water Mains. Sewers shall be located a minimum of ten feet horizontally from existing or proposed water mains (centerline distance) unless otherwise approved by the Engineer. Where sewer lines cross water mains or come within 10 horizontal feet of a water main, the sewer pipe shall be a minimum of 18 inches clear vertical distance from the water main. If this clear distance is not feasible, the crossing must be designed and constructed so as to protect the water main. Minimum protection shall consist of the installation of an impervious and structural sewer (DIP or SDR-26 PVC). Accepted crossings are:

- a. One length of structural pipe at least 18 feet long centered on the water main. Joints between the sewer pipe and the special pipe shall be made with mechanical joint solid sleeve couplings with transition gaskets specifically designed for the connection, or made directly with bell and spigot joint between SDR-35 and the special SDR-26 pipe. The joint shall be encased in a concrete collar at least 6 inches thick and extending at least 6-inches either side of the joint.
- b. SDR-35 PVC sewer pipe with reinforced concrete encasement. Encasement shall be at least 6 inches thick and extend a distance of 10 feet either side of the water main.

In all cases, suitable backfill, proper soil compaction or other structural protection shall be provided to preclude settling and/or failure of either pipe.

2.4.10 Control of Live Sewage. Continuous and uninterrupted flow of live sewage is a requirement of the Work. When it is necessary to bypass or control live sewage flow to complete a portion of the Work, the Contractor shall provide adequate sewage pumps, discharge hose and/or piping to bypass pump sewage to downstream manholes or piping approved by the Engineer. Bypass pumping shall be continuously provided while any portion of the existing sewer system is out of service until such time that unobstructed gravity flow service is restored. Sewage pumps shall have a capacity greater than the existing peak sewage flow so that the level of sewage in the manhole at the bypass pump does not exceed the top of the lowest inlet pipe. Sewage shall not be allowed to surcharge the existing sewer lines to prevent backups of upstream service taps or overflowing upstream manholes. Pumps and hose/piping shall be maintained in good condition, adequately protected and restrained to prevent inadvertent spills of raw sewage. If the manhole begins to surcharge, the Contractor shall immediately correct the problem through additional pumps, increased pumping capacity, etc., or restoration of normal gravity flow service as directed by the Engineer. If the Contractor fails to correct the problem and sewage backup occurs and enters buildings or overflows manholes, or if pump discharge hose/piping fails and sewage is spilled onto the ground, the Contractor shall be responsible for cleanup, repairs, property damage and claims, and shall be liable for any damages or fines assessed by regulatory agencies because of the Contractor's failure to control live sewage flow.

2.5 SPECIAL APPURTENANCES FOR PIPELINES.

2.5.1 Dissimilar Pipe Connections. Connection between different types of pipe shall be made by one of the following methods:

1. Preferred Method: Use flexible couplings specifically designed for the connection, such as made by Fernco Joint Sealant Company or Joints, Inc. Encase the joint in concrete collar to prevent settlement or lateral displacement.
2. Alternate Method: Solid sleeve mechanical joint coupling with transition gaskets. Encase joint in concrete saddle to prevent displacement.
3. Alternate Method: Insert spigot into adjoining bell (butt joints not permitted) and encase in concrete, with minimum 6 inch thickness and extending 8 inches either side of joint.

2.5.2 PVC to PVC Pipe Connection. At locations where connections are necessary between PVC pipes that cannot be made with normal bell and spigot joints, the connection shall be made with SDR 35 PVC repair (closure) couplings. Flexible or "calder" type couplings on new sewer lines that connect to existing PVC pipe are not acceptable.

2.5.3 Pipeline Encasements.

1. Description and Application: Pipeline encasements shall consist of an encasing pipe (or casing pipe) surrounding the carrier pipe (sewer pipe) with necessary skids, end plugs and bedding material of the length and design shown on the Plans or Standard Details. Pipeline encasements are used for two applications: (1) For boring or jacking the pipeline across (beneath) inaccessible areas and (2) in certain open cut areas, where it is necessary to provide additional protection for the carrier pipe, or to allow future access to the carrier pipe.
2. Installation of Encasing Pipe: The procedures for boring and/or jacking the casing pipe are given in Section 1.3.9. In open-cut installations, the encasing pipe will be placed in the same manner as sewer pipe. In both instances, the encasing pipe must be at exactly the same grade as the proposed sewer pipe. The slope of the casing pipe shall equal that required for the carrier pipe.
3. Encasing Pipe Materials: The following types of pipe are acceptable for encasing pipe:
 1. Butt welded steel pipe with asphaltic coating, conforming to AWWA C-200, with a minimum thickness of 0.188 inches, unless otherwise specified.
 2. Bell and spigot concrete pipe, either reinforced or non- reinforced.
 3. Bell and spigot ductile iron pipe (thickness as indicated on the Plans).
 4. Bell and spigot PVC water pipe, Class 200, SDR-14.
 5. Corrugated metal pipe.

The type of pipe, wall thickness and specific material requirements will be given on the Plans or in the Project Specifications. PVC casing pipe shall be straight, with no more

than ¼" warp, bow or curve along its length. All boring and jacking operations will require welded steel pipe.

4. Encasing Pipe Diameter: The minimum diameter of the encasing pipe will be equal to the outside bell diameter of the carrier pipe, plus 2 inches.
5. Installation of Carrier Pipe: The procedure for installation of carrier pipe in the encasing pipe shall be as follows:
 1. Injection molded polyethylene casing insulators at each joint and at mid-length of pipe (3 per joint) or four equally spaced wooden skids be attached at 90 deg. axis points along the length of the pipe, with length-wise spacings as shown on the Standard Details.
 2. Lubricate the bottom half of the casings by pulling rags saturated with a joint lubricant through the casing.
 3. Either push or pull the carrier pipe through the casing, adding a section at a time until the full 'string' is installed.
 4. Backfill the space between the carrier pipe and casing with sand, preferably by flushing sands through the space with a high-pressure hose.
 5. Place a watertight plug of concrete, spray foam or a flexible rubber adaptor in each end of the encasing pipe. If concrete is used, it must be a lean mix of 4 part sand to 1 part cement.

2.6 ACCEPTANCE TESTS

2.6.1 Tests Required. Each reach of sewer pipe shall meet the requirements of any or all of the following tests:

<u>Parameter</u>	<u>Test</u>	<u>By Whom</u>
1. Alignment.....	Lamping.....	Engineer
	T.V. Inspection.....	Contractor
	Flowline Test.....	Engineer
2. Water Tightness.....	Air Leakage or Water Exfiltration.....	Contractor
3. Deflection.....	Rigid Go/No-Go Mandrel.....	Contractor
	Rigid Go/No-Go Mandrel.....	Engineer
4. Infiltration.....	Rate of Flow Measurement.....	Engineer

A reach of sewer pipe is defined as each section between manholes. All tests will be required unless stated otherwise on the Plans. All defects shall be repaired to the satisfaction of the Engineer.

2.6.2 Alignment. Each section of sewer line between manholes shall be straight and uniformly graded. Each such section will be lamped (visual sighting from manhole to manhole, with directed sunlight reflected off two mirrors). If at all possible, the lamping will be accomplished on a sunny day. The Engineer may delay lamping of the line until a sufficiently sunny day. The Contractor shall furnish suitable assistants to the Engineer. The pipe shall be laid sufficiently straight so that at least a three-fourths circle of light may be observed both vertically and horizontally. Under special circumstances, the Engineer may modify the $\frac{3}{4}$ circle of light requirement.

2.6.2.1 T.V. Inspection and Cleaning. When required by the Project Specifications, each section of sewer line between manholes shall be cleaned by high velocity water jetting and TV inspected. Cleaning operations are to be conducted by high velocity/high pressure water jetting. Methods which involve pulling or pushing cleaning plugs, pigs or spheres through pipes are unacceptable unless otherwise approved by the Engineer. Contractor is responsible for locating a source for clean water for jet cleaning. All grit, gravel and debris in each section of pipe is to be captured at downstream manholes and removed from the sewer system. Each pipe run from manhole to manhole shall be jetted a minimum of two complete passes. A pass is defined as one complete cycle of the jet through the sewer and return. Additional jetting may be necessary if this minimum does not result in a clean line.

The TV inspection shall be performed on individual lengths of pipe between two connecting manholes at a time. Television equipment is to consist of self-contained waterproof color camera with flood lights, a color TV monitoring unit and a DVD recorder, with connecting coaxial cables. Record the television inspection on a DVD disc complete with audio dubbing, foot counter and programmable titles. Titles are to include identification of the beginning and ending manhole of each section and the date of inspection. Also provide a legible written report for each section of pipe inspected. Report shall identify the pipe location from manhole to manhole and whether the camera travels upstream or downstream. Include observed pipe features and the location by feet from starting manhole, by clock position and by video tape counter. Features to record include, but are not limited to, service tap location, rolled gaskets, ponded water, out of round conditions, offset joints, irregularities in alignment or grade, active leakage and broken or damaged pipe. The Engineer must be notified 24 hours in advance prior to TV inspection. TV inspection(s) shall be completed prior to placing the new line in full service, or as required in the Project Specifications.

2.6.2.2 Flow Line Test. During lamping of the line, the flowline test will be accomplished by the Engineer. Prior to the flowline test, the Contractor will be responsible for cleaning the line of all dirt and debris. After the line is cleaned, the Contractor will flush the line with a sufficient amount of potable water so as to remove any remaining sediment or dirt from the line that may act as a dam causing water to pond and the flowline test to fail. It will be the responsibility of the Contractor to collect all debris which is cleaned out of the pipe. Within 24 hours after flushing of the line, the Engineer will lamp the line. During the lamping of the line, the Engineer will evaluate the consistency of the grade of the line based on the width of

water in the flowline of the pipe. If the width of water in the flowline is not consistent, the Engineer may deem the line unacceptable. No ponding of water in the line will be accepted.

2.6.3 Water Tightness. An exfiltration or leakage test shall be performed on all newly constructed sanitary sewers. The Contractor will determine whether the test will be made with water or air pressure and shall furnish all labor, tools, and equipment necessary to conduct the test. The Contractor shall arrange for the water supply. The Engineer must be notified 24 hours in advance of the test.

2.6.3.1 Water Exfiltration. Exfiltration tests shall be conducted by blocking other openings in the upper manhole and plugging the line where it enters the lower manhole of the reach to be tested, filling the line and the manhole with water (but not more than 20 feet of total hydraulic head at the lowest point on the reach being tested), and measuring the water required to keep the manhole full. The total exfiltration shall not exceed 100 gallons per inch of nominal diameter per mile of pipe per day for each reach tested, except that an allowance of an additional 20 gallons per inch of nominal pipe diameter per mile of pipe per day shall be permitted for each additional two feet of head over a basic 6-foot minimum internal head (as measured to the invert at the mid point of the reach being tested). Groundwater depth shall be deducted from internal head in calculating the basic 6-foot minimum internal head. The total internal head for the purpose of calculating the additional allowance for exfiltration will be considered to be the average hydrostatic head in feet for the reach of pipe and manholes being tested. For purposes of determining maximum allowable leakage, manholes shall be considered sections of 48-inch pipe. The exfiltration test shall be maintained on each reach for at least two hours and as much longer as necessary, in the opinion of the Engineer, to locate all leaks.

If the leakage in any reach exceeds the allowable maximum, it shall be retested after the leaks are repaired.

2.6.3.2 Air Test. In lieu of the exfiltration test, the Contractor may conduct an air test. The pipe manufacturer's criteria for allowable air loss will be the governing criteria. The test will be based upon allowing a minimum time (for various pipe diameters) for a specified pressure drop of either 0.5 (Table 2-1) or 1.0 psig (Table 2-2) from a 3.5 psig starting point. The methodology for conducting the test, with regard to safety practices, preparation of the sewer line, and addition of air, shall comply with Uni-Bell UNI- B-5 "Recommended Practice for the installation of Poly Vinyl Chloride (PVC) pipe." The Contractor shall obtain and provide two copies of this reference at the job site if this test is used.

Pressure gages used by the Contractor shall have a maximum scale of 0-15 psig; 0-10 psig is preferred. The gage scale shall be in increments of no more than 0.5 psi; 0.10 psi is preferred.

If the air test fails to meet the above requirements, the leaks shall be located and repaired at the Contractor's expense, and the pipeline retested until the leakage is within the allowable limits.

In areas where the groundwater level is above the pipe, the hydrostatic pressure of the groundwater above the pipeline shall be determined and added to all test pressures. The test pressure correction which must be added to the 3.5 psig starting pressure, shall be calculated by

dividing the average vertical height, in feet of groundwater above the invert of the sewer pipe to be tested, by 2.31. The result gives the air pressure correction in pounds per square inch to be added to 3.5 psig. In no case shall the starting test pressure exceed 9.0 psig.

2.6.4 Pipe Deflection. Maximum deflection of PVC sewer pipelines under load is limited to five percent of the pipe diameter, at the time of testing. No sooner than 30 days prior to final acceptance of the project, the Engineer may request that the pipeline be measured for deflection by either the Contractor, or an independent testing laboratory acceptable to the Engineer, at the expense of the Contractor.

The deflection test will be performed by pulling a "go-no go" mandrel upgrade through the pipe from manhole to manhole. Where deflection is found to be in excess of allowable testing limits, the Contractor shall excavate to the point of excess deflection and remove the deflection by recompacting around the pipe or other approved method. After backfilling, the line shall then be retested for deflection. If the line has failed to return to its original size (inside diameter) the deflected pipe shall be replaced by the Contractor at his expense.

2.6.5 Infiltration of Water. If the sewer line is in an area where the water table is above the pipeline, the Engineer's representative will conduct an infiltration test. The infiltration of groundwater will be measured with special made weirs which will be inserted into the pipeline at manholes where flow is present. The infiltration rate shall not exceed 200 gallons per inch of nominal pipe diameter per day per mile of sewer line. If the infiltration exceeds this flow rate, the leaks shall be located and repaired at the Contractor's expense. Infiltration tests shall be completed prior to placing new sewer lines in service.

2.7 INSTALLATION OF PRESSURE SEWER LINES (FORCE MAINS).

2.7.1 Reference Specifications. Installation requirements for pressure sewer lines shall follow the applicable requirements of standard waterline specifications.

2.7.2 Additional Specifications. In addition to the Orchard Mesa Sanitation District's specifications, pressure sewer mains shall comply with the following:

- A. Cleanouts: Pipe cleanout systems shall be installed at locations shown on the Plans. A cleanout will be required at every bend greater than 20 degrees.
- B. Vertical Alignment: Sags and depressions in the line must be avoided.
- C. Drains: If required by the Engineer, a pipe drain system will be installed on the pipeline.

2.8 MANHOLES; MATERIALS AND INSTALLATION

2.8.1 Manhole Types. Three types of manholes are standard in the collection system. These are described as follows:

1. Standard Manhole: These have a sidewall depth greater than 4.0 feet, with conical tops. The pipe channel runs directly through the manhole base.
2. Shallow Manhole: These have a sidewall depth less than 4.0 feet, with the top being either a flat lid or a shallow cone.
3. Drop Manhole: These have a special drop pipe, either inside or outside the manhole, used when the difference in elevation between inlet and outlet pipes is 18 inches or greater.

If special manholes, or modifications to standard manholes are used, they will be so indicated on the Plans, or on the Standard Detail Sheet.

Drawings of the three standard manholes are shown on the Plans, or on the Standard Detail Sheet.

2.8.2 General Construction. The riser (wall section), top (cone or flat cover), and grade rings shall be precast concrete, with a cast iron frame and lid. Bases shall either be poured-in-place, or precast concrete, as specified on the Plans.

All cast-in-place and all precast concrete work shall conform to requirements of Section 4: Concrete and Reinforcement, Materials and Construction Requirements.

The manhole shall be set to the line and grade shown on the Plans and be vertically plumb. Materials and dimensional requirements for the various components are given in the following paragraphs.

Manholes shall be watertight with no visible signs of infiltration from groundwater entering the manhole. Manholes installed below the water table are to be waterproofed with an application of concrete sealant on exterior surfaces if required by the Project Specifications.

All backfill placed within two (2) feet measured horizontally from any structure or manhole shall be compacted with hand operated mechanical equipment to 95% relative density (AASHTO T-99).

Drop manholes shall be protected against hydrogen sulfide corrosion with an application of protective coating on interior surfaces as specified in Section 2.8.13 of the District's Specifications or on the Plans.

2.8.3 Subgrade Preparation. The manhole shall be placed on a stable, firm subgrade. This will normally be 8" of $\frac{3}{4}$ " granular material (Paragraph 1.5.2.2) placed over undisturbed natural soil. Additional compaction to 90 percent relative density may be required in backfill areas, or on soils with low bearing capacity. Granular material will also be required in areas with unstable subgrades. Additional payment will be made for granular material as "Unstable Material", unless the unstable conditions are due to failure of the Contractor to control drainage or broken water mains, and excepting the 8 inch layer normally required under precast bases.

Any damage resulting from differential settlement shall be repaired in accordance with the terms of the Contractor's guarantee.

2.8.4 Manhole Base. Two types of manhole bases may be used on the project as follows:

- a) Poured-in-Place Bases. Manhole bases of this type shall be constructed in the field with dimensions as shown on the Plans or in the Drawings. Concrete slump shall not exceed 4 inches and concrete shall be vibrated or manually agitated to reduce honeycombing.

Inlet and outlet pipes shall be placed within the base structure with the crown below the base of the first riser section, such that the manhole riser will not bear on the pipe.

If elevations between inlet and outlet pipes are greater than 6 inches, and the elevation difference has been approved by the Engineer in advance, the inlet pipe should be placed through the wall of riser section. The floor should be filleted at the inlet on the inlet side to prevent deposition of solids.

- b) Precast Bases. Manhole bases of this type have an 8-inch thick floor precast monolithically with the lower wall section. As a minimum, the precast concrete manufacturer shall be capable of casting precast bases in 24" and 36" heights from top of base to tongue and groove joint. Concrete shall be placed inside the manhole base to form the flowline and the channel section and floor shall be formed as shown on the Plans or in the Standard Details and as described in Section 2.8.4.1.

Inlet and outlet holes shall be blocked out during pouring of the manhole section or core drilled after the concrete has cured. Each pipe blockout or core drilled hole shall be equipped with a pipe inlet seal (Section 2.8.5). The invert of the lowest pipe hole shall be a minimum of 3 inches above the precast floor to allow placement of the concrete invert channel section.

The type of manhole base to be used on the project shall be specified on the Plans, or in the Project Specifications.

2.8.4.1 Flowline Inverts. Unless directed otherwise on the Plans, a 0.20 foot elevation drop shall be provided between inlet and outlet pipe connections. Pipe channels within each base shall be formed and smoothly finished to match the shape of each pipe flowing in and out of the manhole, and the cross-section width of the pipe channel is to be uniform through the length of the flowline. In no case shall the invert cross-section through the manhole be greater than that of the diameter of the outgoing pipe. Transitions in the invert channel between a small diameter inlet pipe and large diameter outlet pipe are to be uniform. Pipe channels may be precast or hand-formed and smoothly finished to the equivalent of steel troweled float finish.

In the event finished inverts are rough and unacceptable, the Contractor shall submit a proposed method of repair for Engineer's approval. Concrete invert flow lines shall be constructed flush with inlet and outlet pipe inverts within no more than 1/16 inch tolerance. When it is necessary to provide a thin grout layer for smoothing the flowline invert or for raising the invert to match

inlet and outlet pipe inverts, Rapid Set grout with acrylic additive shall be used and installed per manufacturer's written instructions and recommendations. Construct top of bench per details on the Plans or in the Standard Details and use a float finish or equivalent.

2.8.4.2 Epoxy Coated Flowline. Precast manhole flowline inverts having less than 0.10-foot fall between the inlet and outlet pipes shall be coated with epoxy gel to provide a smooth finish. Apply epoxy gel to clean dry concrete surface free of dust, dirt, grease, laitance, curing compounds and other foreign matter by sandblasting, mechanical abrasion or hydro blasting in accordance with the manufacturer's recommendations. Air surface temperature during application and curing shall be 40°F or above. Mixing shall be accomplished using a low speed drill with a jiffy mixer paddle. Epoxy shall be mixed in a clean dry container free of foreign matter or debris. Mixing rates shall be as recommended by the manufacturer. Prior to applying epoxy, grind the length of the flowline channel as necessary to provide a continuous slope through the manhole from inlet to outlet pipe connections. Epoxy may be brush applied in thin coats to provide a slick surface through the concrete invert of the manhole. Epoxy performance is enhanced if applied within the first 10 to 12 minutes of pot life. The cured surface of the epoxy coating shall be free of brush marks and shall have a cross section consistent with that of the PVC sewer pipe.

2.8.5 Manhole Adaptors. All sewer pipes entering manhole bases and walls shall have special provisions to prevent water leakage and to accommodate long-term differential settlement.

A. Water Seals: To assure a watertight seal with plastic pipes, the following special fittings are required:

1. Precast Base: Use rubber 'boot' with power expansion SS sleeve and SS take-up clamps (PSX-Positive Seal Gasket, Press Seal Gasket Corp.) Carefully place and compact granular or flow-fill bedding and haunching material beneath and around the boot to prevent differential setting of the pipe at the manhole during backfill and compaction of the trench.
2. Poured-in-Place Base: Use rubber water stop (double O-ring gaskets or Rub'R-Nek or WaterStop 'RX' banded to the pipe), as recommended by manufacturer. Pipe connections at poured-in-place bases are considered rigid connections.

B. Flexible Fittings: To prevent shear due to differential settlement of the manhole, flexible fittings shall be provided within 18 inches of rigid connections to manholes if required in the Project Specifications. Acceptable methods include a short section of pipe stubbed to a bell and spigot joint, or a short section of pipe stubbed to a PVC closure coupling connection.

2.8.6 Manhole Riser (Wall Section), Tops and Grade Rings. All manhole construction shall conform to ASTM C-478 "Precast Reinforced Concrete Manhole Sections" except as herein modified or otherwise indicated on the Standard Details. As a minimum, the precast concrete manufacturer shall be capable of casting barrel sections in heights of 12", 18", 24", 36" and 48",

and eccentric cone sections in heights of 24", 30" and 36" to provide flexibility in assembling manholes.

Risers and conical sections shall be made with tongue and groove sections, and shall be placed and aligned to provide vertical sides that are plumb and ladder rungs in straight vertical alignment. Joints shall be sealed with an approved flexible plastic gasket (Ramnek, Rub'R-Nek or equal). Use a double gasket in manhole joints. Lifting holes that penetrate through the walls will not be acceptable.

The cone top will be eccentric for standard and drop manholes or flat lid slab for shallow manholes, as shown on the Plans, Standard Details, or Special Notes and shall be set in vertical alignment with the manhole steps.

Precast concrete grade rings shall be used to adjust new manhole ring and covers to grade as specified in Section 2.8.7. Steel paving rings are not allowed to adjust ring and cover to grade.

2.8.7 Adjustment to Grade. The manhole ring and cover shall be adjusted by one of the following methods:

- A. Precast concrete grade rings as necessary. Steel paving rings are not allowed to adjust ring and cover to grade. The total height of grade rings (i.e., the vertical section of 24 inch diameter opening) shall not be more than 12 inches. Concrete grade rings shall be pre-soaked and set in a bed of non-shrink grout. The cast iron ring shall be set in a bed of non-shrink grout as shown on the Plans or Standard Details at the finished grade elevation shown on the Plans. Acceptable alternate to grouting concrete grade rings and cast iron manhole ring is to use Ramnek or Rub'R-Nek gaskets.
- B. A manhole rising system utilizing pre-molded thermal plastic form trimmed to appropriate grade. Area behind plastic mold to be filled with flowable grout or concrete vibrated in place to bottom of manhole ring. Care should be exhibited so no voids exist in grout/concrete that will support the ring and cover.

Manhole lid placements shall normally be set to the following elevations, unless otherwise indicated on the Plans or Project Specifications:

1. Paved Streets - At grade, with the top of knobs $\frac{1}{4}$ " to $\frac{1}{2}$ " below the asphalt surface
2. Unpaved Streets - Two inches below grade
3. Cultivated Areas -
 - a. Hay Fields - Two inches above grade
 - b. Cultivated Fields - Below plow level
 - c. Pastures (not mowed or cultivated) - 6-8 inches above grade.

Where the manhole is in an unpaved street, alley, or other area where grade has not been established, the manhole shall be set at grade and 6 inches of grade rings shall be placed between the top of cone and bottom of ring and cover to allow future adjustment of the ring.

If it is found necessary to readjust the manhole ring after being properly set and accepted, separate payment will be made.

2.8.8 Steps. Manhole steps shall have slip resistant tread, at least 10 inches wide. Legs shall be long enough to provide 3 ½ inch minimum embedment length and 5 ½ inch projection from the wall. Steps shall be aligned and equally spaced, with spacing between 12 inches and 16 inches. Steps are to be located approximately centered on manhole barrel and cone section joints, and in no event closer than 3 inches to the face of the joint where the wall thickness is decreased, in order to protect the tongue and groove joint from potential damage. Steps shall have an impact strength of 300 pounds and pullout strength of 1,500 pounds. Two materials are acceptable:

- a. Cast or extruded aluminum, with epoxy coating
- b. Co-Polymer polypropylene with ½" steel reinforcing rod

Unless otherwise shown on the Plans or in the Standard Details, steps are to be offset 20 to 30 degrees from the manhole inlet pipe to facilitate cleaning equipment.

2.8.9 Manhole Frame and Lid.

- A. Standard Lid: The manhole frame and lid shall be cast iron, weighing a minimum total of 250 pounds, with inside diameter of 24 inches, and shall be equivalent to Castings, Inc. (Grand Junction) MH-250-24. The bearing surface between ring and cover shall be machine finished or ground to assure a non-rocking fit in any position, and to allow interchangeability. Below grade surfaces will be coated with coal tar varnish. The lid shall be marked "SEWER".
- B. Watertight Design: The manhole frame and lid shall be the same construction as the Standard Lid, plus four - ½" hex head, corrosion resistant bolts will fasten lid to frame, with a neoprene gasket between lid and frame.

2.8.10 Flexible Plastic Gasket. The flexible plastic gasket between manhole wall sections shall meet Federal Specifications SS-S-00210 "Sealing Compound, Preformed Plastic for Pipe Joints" and shall be equal to 'Ramnek' or Rub'R-Nek. It shall be installed in accordance with the manufacturer's instructions, which may include application of a primer to the concrete surface. Install two strips of gaskets at each joint, one on each horizontal surface of the tongue and groove joint.

2.8.11 Drop Manhole Construction. Drop piping for drop manholes shall utilize the same fittings and pipe material as used in the sewer line. Drop fittings and pipe are to be encased in concrete flow fill as shown on the Plans or Standard Details. A minimum of 8 inches granular material shall be used for all subgrades under drop manholes.

2.8.12 Manhole Waterproofing. When manhole waterproofing is required by the Project Specifications or on the Plans, the exterior surface of base, riser sections and cone shall be coated with coal tar epoxy or concrete sealant ConSeal CS55, Armacoating 901 or equal.

2.8.13 Drop Manhole Corrosion Protection. When manhole corrosion protection is required by the Project Specifications or on the Plans, the interior surface of the manhole walls and base shall be coated with Tnemec or Sherwin-Williams coating system, designed for the degree of exposure expected in each specific location as follows:

Light Exposure:

Tnemec 446-413, Tnemec Tar or approved equal

Moderate Exposure:

Tnemec 435 or Sherwin Williams Cor-Cote SC or approved equal. At Contractor's option Tnemec Series 120 Vinester can be used provided adequate ventilation and respiration equipment is provided during the application process per the Manufacturer's recommendations.

Extreme Exposure:

Tnemec Series 434 Perma Shield and Tnemec Series 435 Permaglaze or approved equal.

The Engineer will determine the degree of exposure expected at each location.

If the concrete substrate of new manholes or existing manhole has any pitting, bug holing, etc., the concrete surface shall be prepared and coated with Tnemec Series 218 "Mortar Clad" (or equal) per the Manufacturer's recommendations. If concrete substrate is acceptably smooth, but damp, Tnemec "Epoxoprime Series 201" primer (or equal) shall be applied per the Manufacturer's recommendations.

All coatings shall be applied in strict accordance to manufacture's recommendations, and to NACE, and SSPC requirements. All coating applications are to be completed inside in a temperature controlled environment. After the manhole is installed and backfilled, all surfaces shall be tested with an electric holiday detector. The voltage and specific methods of testing is to be as specified by the Engineer but not be less than as recommended by the manufacturer of the lining material. An alternative to setting test voltages in the field is to use the formula developed by the National Association of Corrosion Engineers International (NACE) and incorporated into several Standards. The formula for thin film coatings applied to 30 mils (.76 mm) thickness and less is $V = 525 \text{ times the square root of "T"}$ where "T" is the coating thickness in mils (ie; a coating of 25 mils (.64 mm) thick would equate to an inspection voltage of approximately 2,625 volts). For thicker applied coatings the formula changes to $V = 1,250 \text{ times the square root of T}$ (i.e.; a coating of 125 mils (3.175 mm) thick would equate to an inspection voltage of approximately 14,000 volts). All pinholes and/or holidays shall be marked, repaired and retested. Repairs to the coating wherever damage has occurred, are to be installed in conformance with the instructions and recommendations of the coating

manufacturer to provide a complete and watertight manhole, resistant to hydrogen sulfide gas corrosion. No visible pin holes or other irregularities will be permitted in the final coating.

2.8.14 T-Lock Plastic Lined Corrosion Protection. Manholes requiring corrosion protection through T Lock Plastic Lining shall meet the following requirements.

2.8.14.1 T-Lock Material and Installation. Manholes shall be provided with an interior plastic lining, white in color that shall conform to the following:

1. Premolded Plastic Sheet Linings shall be Amer-Plate "T-Lock", not less than 0.065-inch thick, as manufactured by Ameron, Corrosion Control Division, Brea, CA or equal.
2. Joint and Welding Strip shall be Amer-Plate "T-Lock" or equal.

Precast vertical manhole barrel sections and flat lid slabs (or approved cone section) shall be completely lined. The entire circumference of the manholes shall be covered with plastic lining with the longitudinal edges of the lining joined with a 4-inch wide joint strip and welding strips. Welding shall provide a continuous joint equal in corrosion resistance and impermeability to the liner material. The manhole opening through the flat top lid slab (or cone) shall also be lined by returning the plastic liner under the manhole cover frame using an angle strip in combination with adhesive or mastic.

All work in connection with the installation of the plastic lining in precast manhole sections is to be performed in strict conformance with the lining manufacturer's recommendation. Liner sheets are to be fastened securely in the forms for the manhole sections before reinforcing steel or concrete is placed.

Care shall be taken in handling and transporting plastic lined manhole sections to prevent damage to the liner. No interior hooks or other interior lifting device is to be used in handling the manhole sections. All handling requiring lifting or suspension is to be done by use of exterior slings.

The joint between barrel sections will require field welding a joint strip of T-Lock material to provide a continuous and gas tight seal between the concrete and T-Lock system. The manhole joints will require a bed of grout to be placed on the inside of each barrel joint prior to placement of the next barrel section or flat lid slab (or cone). The grout is to be carefully pointed before it has reached its initial set for the full circumference of the manhole section. This will provide for a grout backing of the joint strip. The grout should be finished flush with the interior walls of the manholes. Grout will not be allowed to extend into the manhole section beyond a straight line connecting the surfaces of the manhole barrel sections or flat lid slab (or cone). Grout used to seal manhole joints should be "Rapid Set" or equivalent and applied per the manufacturers recommendations. Care should also be taken to clean the T-Lock surface of any excess grout that is deposited into the manhole from the joint grouting procedure by use of trowels and clean cloths. In addition to the barrel joint grouting, 'Rub-R-Nek' material is to be placed along the outer edge of the manhole barrel joint prior to placement of subsequent barrel sections or the flat lid slab (or cone) to ensure a watertight seal.

The 'Rub-R-Nek' will need to be kept warm prior to placement to ensure compression of the 'Rub-R-Nek' in the shortest possible time frame.

The T-Lock joint strip is not to be installed until the joint grout has cured and reached sufficient strength to prevent the manhole barrel section above the joint from settlement (minimum of 8 hours). All grout and other foreign material is to be cleaned from the T-Lock surface prior to installing joint strips at each manhole joint. The joint strip shall be 4 inches wide and is to be centered over the manhole barrel joint. Two 1-inch wide welding strips are to be welded to the joint strip and T-Lock liner to permanently secure the joint strip. The 4-inch joint strip should overlap the lining of each joint no less than one inch. Welding at the barrel joints is to be in accordance with the manufacturers recommendations by persons qualified and trained in this type of welding and material. When joints between T-Lock and dissimilar materials are necessary at the flat lid slab (or cone) opening and manhole ring, the 4-inch joint strip is to be secured to the T-Lock lining by welding and to exposed steel or concrete with an adhesive compound (Manufacturers 19Y Adhesive or equivalent). A detail of a typical T-Lock lined manhole showing the special provisions specified herein is shown on the Standard Details or the Plans.

2.8.14.2 Manhole Base Coating. Upon completion of the manhole, the concrete base is to be coated with Chem Bloc H₂S 434, and Chem Gel 435 epoxy system as manufactured by TNEMEC. Chem Gel 435 is to be used to coat concrete inverts that will be in contact with sewage. Chem Bloc H₂S 434 is to be used on all other concrete surfaces of the manhole base. This coating system requires that the concrete be completely cured prior to application and shall be applied following manufacturers' instructions. Chem Bloc H₂S 434 is to be applied at 1/8-inch (0.125") minimum total thickness. After the resin has cured, the joint between the PVC liner and epoxy coating is to be sealed using Sikaflex 1A. The joint between the sewer pipe and epoxy coating is also to be sealed with Sikaflex 1A. If a second coat of Chem Bloc H₂S 434 is required after first coat has cured, it will be necessary to wash the resin surface with acetone and dry the surface using clean rags. The area is to then be scuff sanded using #36 to #60 grit production sand paper.

2.8.14.3 Welding Certification. Because of the technical nature of completing the field welding of T-lock material, all field personnel performing T-Lock welding are to be certified in the T-Lock welding procedure.

2.8.15 Manhole Cleaning. All manholes shall be thoroughly cleaned of all debris and foreign matter of any kind prior to final inspections and acceptance.

2.9 SERVICE LINES

2.9.1 General. This section specifies material requirements and installation practices for gravity flow, sewer service lines. Service lines are laterals 4 and 6 inches in diameter connecting a lot or building to the main line. The service line installation will consist of the main line tap and the service pipe to the limits shown on the Plans.

2.9.2 Materials. Service lines and fittings shall be one of the following materials:

<u>Pipe</u>	<u>Reference Standard</u>
PVC	ASTM D3034, SDR-35
Ductile Iron Pipe	Same as Paragraph 2.2.3

PVC service line material shall be subject to the same quality requirements of mainline piping. For curved or bowed pipe, maximum allowable offset distance between a straight line from ends of pipe to the pipe belly is as follows:

<u>Pipe Diameter</u>	<u>Maximum 14' Joints</u>	<u>Offset Distance 20' Joints</u>
4"	4.2"	10.8"
6"	2.9"	7.3"

2.9.3 Main Line Connection (Tap). All sewer service pipe shall be joined to the sewer main with a full body wye fitting or saddle. The connection shall be above the spring line of the pipe, with the branch turned upward 45 degrees from a horizontal plane. A sweep 45 degree bend shall be used to provide the transition from the service line grade to the sewer main branch fitting at each tap. (See Standard Details).

Full body main line fittings (rather than saddles) shall be installed on new sewer collection systems unless otherwise shown on the Plans and approved by the Engineer.

The method for attaching saddle fittings to an existing sewer main shall be approved by the Engineer and inspected by the District. (approved methods include adhesive, solvent weld or clamps). Holes in the main line shall be cut round to match the service connection with a hand or power saw (or drill) or coring; chiseled holes are not permitted. The service line or wye should not extend beyond the inside wall of the sewer main. For concrete or vitrified clay pipe, an insert-a-tee tap fitting is allowed upon approval of the Engineer.

2.9.4 Connection Between PVC Service Line Pipe and Dissimilar Pipe. At locations where connections are necessary between new PVC service lines and existing service lines of dissimilar materials such as concrete or vitrified clay pipe, the connection shall be made with either flexible "calder" type couplings with stainless steel straps encased in concrete, or shall be made with solid sleeve "Mission Couplings."

2.9.5 PVC to PVC Pipe Connections. At locations where connections are necessary between PVC pipes that cannot be made with normal bell and spigot joints, the connection shall be made with SDR-35 PVC repair (closure) couplings. Flexible or "calder" type couplings on new sewer lines that connect to existing PVC pipe are not acceptable.

2.9.6 Sewer Service Line Installations. In addition to these specifications, all service line installation work shall conform to applicable portions of the Uniform Plumbing Code, and/or any other local plumbing code in effect.

Pipe shall be laid in accordance with the details on the Plans or in the Standard Details. Sewer and water service lines must be a minimum of 10 feet apart horizontally, and water wells and sewer service lines must be a minimum of 50 feet apart horizontally or concrete encasement of the sewer line or an impervious and structural sewer such as SDR-26 PVC or ductile iron pipe will be required. All joints shall be watertight and jointing of dissimilar materials (i.e., clay pipe to PVC pipe) shall be done by means of a "Fernco" type flexible coupling or other approved method and the joint encased in concrete to prevent settlement or lateral displacement of the joint. The minimum pipe size shall not be less than 4 inches.

Service pipe shall be laid on a straight line at a minimum grade of $\frac{1}{4}$ inch per linear foot (2' per 100') in accordance with the Uniform Plumbing Code, latest edition, whenever slope is available. Where it is impractical to maintain $\frac{1}{4}$ inch per foot slope, the service pipe may be installed at a grade of $\frac{1}{8}$ inch per lineal foot (1' per 100') with the Engineer's prior approval. The alignment of service lines shall be established by the Engineer.

The maximum deflection permissible at any one fitting or any combination of adjacent fittings shall not exceed 45 degrees, unless otherwise approved.

A joint effort between the District, Engineer and Contractor will be necessary to determine the location of the main line and service line connections and the depths of the service lines.

Service lines shall be constructed in accordance with the provisions of these Specifications and the International Plumbing Code with all joints and workmanship equal to that of the sewer main. No service lines will be hooked up for active service until after the main line is tested and accepted. This includes tests for deflection, infiltration, and alignment to ensure proper grade and alignment.

Where service lines are stubbed out to the right-of-way and ended for future connection, the end of the pipe shall be plugged and marked with a 4 foot long 4x4 board buried vertically above the end of the pipe and extending to 4" above ground surface. The ends of the service lines shall be capped with watertight plugs braced to withstand test pressures. The marker board shall be painted green.

2.9.7 Site Restoration. Where the service line is installed on private property, site restoration will comply strictly with Section 6.

2.9.8 Cleanouts. Cleanouts shall be required in the service line under the following conditions:

1. When service lines are extended up to the building, cleanouts shall be placed at the junction of the building drain and building sewer immediately outside the building (required only if there is no cleanout already on the building sewer).
2. Additional cleanouts shall be placed at each aggregate change of direction 45 degrees and greater and at intervals of 100 feet or less on straight runs.

Cleanouts shall be constructed in accordance with the Standard Details. No surface load shall be transmitted to the main, wye, or riser pipe.

2.9.9 Two Service Collection System. In the event two or more services are connected into one service lateral, and the number of services connected into one service lateral has been approved by the Engineer, the minimum pipe size shall be 6 inches with a minimum slope of $\frac{1}{4}$ inch per foot (2' per 100').

2.9.10 Direct Manhole Connections. Service lines shall not enter manholes direct unless otherwise specified on the Plans.

TABLE 2-1

Specified Test Duration for A Maximum 0.5 PSIG Pressure Drop for
Size and Length of Pipe Indicated:

Pipe Dia.	<u>Specification Time for Length (L) Shown (min.:sec.)</u>							
(in)	100'	150'	200'	250'	300'	350'	400'	450'
8	3:47	3:47	3:47	3:47	3:48	4:26	5:04	5:42
10	4:43	4:43	4:43	4:57	5:56	6:55	7:54	8:54
12	5:40	5:40	5:42	7:08	8:33	9:58	11:24	12:50
15	7:05	7:05	8:54	11:08	13:21	15:35	17:48	20:02
18	8:30	9:37	12:49	16:01	19:14	22:26	25:38	28:51
21	9:55	13:05	17:27	21:49	26:11	30:32	34:54	39:16
24	11:24	17:57	22:48	28:30	34:11	39:53	45:35	51:17
27	14:25	21:38	28:51	36:04	43:16	50:30	57:42	64:54
30	17:48	26:43	35:37	44:31	53:25	62:19	71:13	80:07

Safety: The air test may be dangerous if proper precautions are not taken. All plugs must be sufficiently braced to prevent blowouts and the pipeline must be completely vented before attempting to remove the plugs.

TABLE 2-2

Specified Test Duration for A Maximum 1.0 PSIG Pressure Drop for
Size and Length of Pipe Indicated

Pipe Dia. (in)	<u>Specification Time for Length (L) Shown (min:sec)</u>							
	100'	150'	200'	250'	300'	350'	400'	450'
4	3:46	3:46	3:46	3:46	3:46	3:46	3:46	3:46
6	5:40	5:40	5:40	5:40	5:40	5:40	5:42	6:24
8	7:34	7:34	7:34	7:34	7:36	8:52	10:08	11:24
10	9:26	9:26	9:26	9:53	11:52	13:51	15:49	17:48
12	11:20	11:20	11:24	14:15	17:05	19:56	22:47	25:38
15	14:10	14:10	17:48	22:15	26:42	31:09	35:36	40:04
18	17:00	19:13	25:38	32:03	38:27	44:42	51:16	57:41
21	19:50	26:10	34:54	43:37	52:21	61:00	69:48	78:31
24	22:47	34:11	45:34	56:58	68:22	79:46	91:10	102:33

Safety: The air test may be dangerous if proper precautions are not taken. All plugs must be sufficiently braced to prevent blowouts and the pipeline must be completely vented before attempting to remove the plugs.

ORCHARD MESA SANITATION DISTRICT
STANDARD SPECIFICATIONS

SECTION 3
GRAVEL SURFACING AND SUB-BASE

3.1 DESCRIPTION

This section includes General Specifications for furnishing and placing one or more courses of aggregate and additives, if required, on a prepared surface in accordance with the lines, grades and typical cross sections shown on the Plans or established in the Field.

3.1.2 Related Standard Specifications. Corresponding Standard Specifications of the City of Grand Junction shall apply except where modified herein.

3.1.3 Related Project Specifications. Specific Project Specifications will apply if provided on individual projects.

3.2 CONSTRUCTION REQUIREMENTS

3.2.1 Preparation of Subgrade. The subgrade shall be completed in accordance with Section 1.8 and approved in writing by the Engineer before placing base or surface course.

3.2.2 Mixing and Placing. After the aggregate for each layer has been placed, it shall be mixed at the required moisture content until the mixture is uniform throughout.

The aggregate shall be spread in a uniform layer, with no segregation of size, and to a loose depth that shall have the required thickness when compacted.

If the required compacted depth of any aggregate base or surface course exceeds 6 inches, it shall be placed in two or more layers of approximately equal thickness. The maximum compacted thickness of any one layer shall not exceed 6 inches.

Hauling equipment shall be dispersed over the surface of the previously constructed layer to minimize rutting or uneven compaction.

3.2.3 Compaction. The aggregate shall be compacted to 95 percent of optimum density as determined by ASTM D-698 or ASTM D-1557 (see Plans for test required), and shall be compacted by a smooth drum roller or rubber tired roller. Compaction using loaded dumptrucks will not be allowed.

The surface of each layer shall be bladed during the compaction operations to remove irregularities and produce a smooth, even surface. In-place density will be determined by the Engineer.

3.2.4 Thickness Requirements. The minimum thickness of the compacted aggregate shall not vary more than ½-inch from the thickness shown on the Plans. The compacted thickness shall not be less than the specified thickness.

3.3 MATERIAL REQUIREMENT

3.3.1 Quality Requirement. Aggregate for surface course shall be crushed stone, crushed slag, crushed gravel or natural gravel, suitably hard and durable, free from organic matter, mica, clay lumps, and other deleterious material, and which, when placed and compacted, will result in a firm, dense, unyielding foundation. It shall conform to all the quality requirements of AASHTO M-147, except as otherwise noted in the following table:

Crushed Aggregate Quality Requirements
For Base or Surface Courses

<u>Description</u>	<u>AASHTO Test Method</u>	<u>Requirement</u>	
		<u>Base</u>	<u>Surfacing</u>
Percent Wear	T 96	50 max.	50 max.
Durability Index, Coarse and Fine	T 210	35 min.	35 min.
Liquid Limit	T 89	25 max.	35 max.
Plasticity Index	T 90	6 max.	2-9
Dust Ratio:			
% Passing No. 200	T 11	2/3 max.	2/3 max.
% Passing No. 40	T 27		

When crushed gravel is used, at least 50 percent by weight of the particles retained on the No. 4 sieve shall have at least one fractured face. Naturally fractured faces may be included in the 50 percent requirement, provided the roughness and angularity produce strength characteristics equivalent to mechanically fractured faces.

3.3.2 Grading Requirements. The aggregate shall meet one of the following grading requirements:

CLASSIFICATION TABLE FOR AGGREGATE BASE COURSE

<u>Sieve</u> design- nation	<u>Percentage by Weight Passing Square Mesh Sieves</u>						
	<u>LL not greater than 35</u>			<u>LL not greater than 30</u>			
	Class 1	Class 2	Class 3	Class 4	Class 5	Class 6	Class 7
4 inch	-	100	-	-	-	-	-
3 inch	-	95-100	-	-	-	-	-
2½ inch	100	-	-	-	-	-	-
2 inch	95-100	-	-	100	-	-	-
1½ inch		-	-	90-100	100	-	-
1 inch		-	-	-	95-100	-	100
¾ inch		-	-	50-90	-	100	-
No. 4	30-65	-	-	30-50	30-70	30-65	-
No. 8		-	-	-	-	25-55	20-85
No. 200	3-15	3-15	20 max.	3-12	3-15	3-12	5-15

ORCHARD MESA SANITATION DISTRICT
STANDARD SPECIFICATIONS

SECTION 4
CONCRETE AND REINFORCEMENT: MATERIALS AND
CONSTRUCTION REQUIREMENTS

4.1 GENERAL

The work required by this section of the Specifications shall include all labor, equipment and materials necessary to complete all concrete structures or other concrete members as shown on the Plans or specified herein.

4.1.1 Related Standards. All structural concrete shall conform to ACI 301, latest edition, "Specifications For Structural Concrete For Buildings," except as herein amended and supplemented. ACI 301 is made by reference a part of this Specification and it shall be the responsibility of the Contractor to refer to this standard and conform to its requirements unless noted otherwise herein.

4.1.2 Related Standard Specifications. Corresponding Standard Specifications of the City of Grand Junction shall apply except where modified herein.

4.1.3 Related Project Specifications. Specific Project Specifications will apply if provided on individual projects.

4.2 MATERIALS

4.2.1 Portland Cement. The Portland Cement shall be Type I or II (IA or IIA) and shall conform to ASTM Designation C150. The C3A content shall not exceed 5%. Copies of certified test results shall be submitted to the Engineer upon request.

4.2.2 Aggregate. The aggregate for the concrete masonry shall conform to the requirements of ASTM Designation C33 as amended to date. Maximum size aggregate shall be in accordance with ACI 301, but in no case larger than 3/4".

4.2.3 Water. The water for the concrete masonry shall be clean and free from oil, acid, alkali, chlorides, organic matter or other deleterious substances.

4.2.4 Air-Entraining Admixtures. Admixture used for entraining air in the concrete shall be of an approved type and subject to a performance test to be invoked at the option of the Engineer. The air-entrained agent shall be used in strict accordance with the manufacturer's instruction. Air entrainment admixtures shall be used for all concrete and shall be in accordance with Table 3.4.1 of ACI 301. Entrained air shall be 6% plus or minus 1%.

4.2.5 Reinforcing Steel. Reinforcing steel shall conform to ASTM Specifications A615-72 and shall be Grade 60, except ties and dowels, which are to be field bent, which shall be Grade 40. Welded wire fabric shall conform to ASTM Specifications A185 and is designated as load carrying reinforcement.

4.2.6 Metal Accessories. The metal accessories shall include all spacers, chairs, ties and other devices necessary for properly placing, supporting and fastening reinforcement in place. Form ties shall be of the type designed to break off inside the wall. The void shall be hammer packed with patching mortar using an approved bonding agent. Reinforcement shall be wired together at intersection or as directed by the Engineer. The method of supporting single and double layers of welded wire fabric in slab-on-grade shall be approved by the Engineer.

4.2.7 Fiber Reinforcing. Synthetic fibers for concrete shall be polypropylene, collated, fibrillated fibers having high resistance to salt and acid and low thermal and electrical conductivity. Fibers shall be thoroughly mixed with the concrete at a minimum rate of $\frac{3}{4}$ pound per cubic yard.

4.2.8 Water Stops. Water stops shall be used on all structures holding water, at construction joints, or where indicated on the Drawings. Water stops shall be copper, or PVC, as shown on the Plans, size 6" x 3/16" or as shown on the Plans. Joints shall be soldered, brazed or welded (metal) or vulcanized or cemented (PVC). All concrete form ties used for structures that hold water shall have factory installed waterseals.

4.2.9 Pozzolanic Additive. "Fly Ash" shall conform to ASTM C-168 Class UF, shall be added to the mix according to ASTM C-494-71. The particular Class F Fly Ash used will be limited to that with a Loss On Ignition factor (L.O.I., carbon content) not to exceed 1.0% maximum or a Fineness factor (percent retained on #325 sieve) exceeding 30%. The aforementioned physical characteristics, as well as all other compliance requirements with the Fly Ash standard, ASTM C-168, must be guaranteed by the Distributor of the Fly Ash, the Concrete Producer, and the Contractor. Where cement Types II, II Modified, or Type V are specified for sulfate resistance, Class C Fly Ash will not be allowed in lieu of Class F.

4.2.10 Bonding Agent. Bonding agent shall be used whenever new concrete is placed on hardened concrete. Acceptable bonding agents are Weldcrete (Larson Products Co.); Tamms Industries Liquid Bonding Agent, Concesive 1001-LpL (Adhesive Engineering Co.) or equivalents.

4.2.11 Chemical Admixtures. The Contractor may use accelerators, water reducing agents, set-retarding agents, water-reducing agents, or super plasticizers and other chemical admixtures, if specified in the Project Specifications or approved by the Engineer. All admixtures shall meet the requirements of ASTM C-494, "Standard Specifications for Chemical Admixtures for Concrete".

4.2.12 Non-Shrink Cement-Based Grout. This specification describes non-shrink cement-based grout to be used wherever shown or implied on the drawings or called for in the Project Specifications. Non-shrink grout shall be furnished factory premixed so that only water is added at the job site. The manufacturer's instructions must be printed on the outside of each bag.

4.2.12.1 Grout Mixture Materials.

1. Water. Potable water shall be used in mixing grout. Use the minimum water necessary for proper installation.
2. Non-Shrink Cement-Based Non-Metallic Grout. The Contractor shall submit information verifying that the grout exhibits the following physical characteristics:

The grout must show no shrinkage in accordance with ASTM C-827, ASTM C-1107, and/or the grout must show no shrinkage under Corps of Engineers CRD-C-621 and CRD-588.

3. Acceptable Manufacturers for Normal Non-Shrink Grout Applications. Acceptable products for grout installations that are at least ½ inch thick include:

US Grout "Five Star Grout"
Master Builders "Master Flow 713 Grout" or "Set Non-Shrink Grout"
L&M Construction Chemicals "Crystex"
Burke "Non-Ferrous, Non-Shrink Grout"
Quickrete "Non-Shrink Construction Grout"
CTS "Rapid Set Non-Shrink Multi-Purpose Grout Cement All"

For applications that require less than ½ inch grout thickness, such as concrete repairs, facing or feather-edging, the following manufacturers and products are acceptable:

CTS "Rapid Set Non-Shrink Multi-Purpose Grout Cement All"
Burke "Burke Acrylic Patch"

4. Special Purpose Non-Shrink Grout. Non-shrink grouts used in special applications shown on the Plans, such as special purpose grouts for chemical resistance, vibration, impact or temperature extremes, or non-expansive qualities shall be as described in the Project Specifications.

4.2.12.2 Grout Installation.

1. Preparation. Concrete surfaces are to be roughened and clean and free of concrete laitance, grease, oils, curing agents, dirt, dust or other contaminants. Surface of concrete shall be presoaked for 24 hours prior to commencing grouting. Remove any standing water prior to placing grout.
2. Mixing and Placement. Unless otherwise specified or with approval of Engineer, the minimum thickness of grout shall be 1½ inches. Mixing and placement shall be in strict accordance with the manufacturer's instruction so that all spaces and voids are completely filled. Grout shall be mixed either in a mechanical mixer or by use of a paddle-wheel driven by a ½" drill. Do not retemper after initial mixing.

3. Curing. Non-shrink grout shall be protected against rapid loss of moisture by covering with wet rags or polyethylene sheets after finishing is completed. The grout shall be wet cured for at least seven days.
4. Grout Inspection. Grout will be inspected for integrity no earlier than 7 days after placement. Inspection of the grout will be accomplished by the Engineer or Resident Inspector. Finished grout shall be free of voids, cracking or loose material and shall be adequately adhered to its concrete host.

4.2.13 Concrete Flowfill

Flowable fill concrete shall be installed in conformance with the locations and requirements as shown on the Plans.

4.2.13.1 Flowable Fill Backfill. Flowable fill concrete backfill shall consist of the following materials and mix proportions:

<u>MATERIAL</u>	<u>STANDARD</u>	<u>PER CUBIC YARD OF CONCRETE</u>
Cement	ASTM C-150	42 lbs.
Sand	ASTM C-33	1845 lbs.
Size #57 Aggregate	ASTM C-33	1700 lbs.
*Air Entraining Agent	ASTM C-260	5.0 oz.
Water	ASTM C-94	325 lbs. (39.0 gal.)

*NOTE: Air entraining agent may be used to increase flowability.

The above weights are based upon aggregates in a saturated, surface dry condition. Batch plant corrections must be made for moisture in aggregates.

DESIGN PHYSICAL PROPERTIES:

Slump Obtained - 6-8 inches
28-Day Compressive Strength - 100 psi

4.2.13.2 Flowfill Placement. After all pipe and structures have been placed and partially backfilled, and the work approved in place, the area shall be backfilled with flowfill concrete to the elevation specified. The flowfill concrete shall be rodded or vibrated as necessary to assure voids will not be present in the flowfill concrete or around or under the pipe and structures.

Flowfill concrete shall be allowed sufficient time to cure prior to allowing any structures or other fill being placed on the flowfill surface without observable deformation.

4.3 CONCRETE PROPORTIONS

For a specified compressive strength, water-cement ratios shall be in accordance with Table B in Section 4.12. If a specific compressive strength is not specified on the Plans or Project Specifications, then the minimum compressive strength at 28 days shall be 3000 psi. Testing shall be in accordance with ASTM C39, the slump of the mixed concrete shall be in accordance with the requirements of ACI 301. Minimum cement content shall be 4.5 sacks per cubic yard of concrete unless otherwise specified on the Plans or Project Specifications.

No mixing water in excess of the amount called for shall be added to the concrete during mixing or hauling or after arrival at the delivery point. The Engineer shall have authority to reject, in total, any batch which exceeds the allowable slump or water content.

The consistency of the concrete mix shall be determined by the slump cone test. The Contractor shall use the least slump possible consistent with workability for proper placing of the specified strength classification of concrete.

4.4 MATERIALS TESTS

The use of testing services shall in no way relieve the Contractor of the responsibility to furnish materials and construction in full compliance with the Contract Documents.

The Contractor shall submit to the Engineer the concrete materials and the concrete mix designs proposed for use with a written request for approval. This submittal shall include the results of all testing performed to qualify the materials and to establish the mix designs. No concrete shall be placed in the work until the Contractor has received such approval in writing. The Plans or Project Specifications will specify a minimum compressive strength, a water-cement ratio and slump range as the basis for the mix design.

All of the materials used in the completion of the concrete structures or other concrete members shall be subject to tests at an independent testing laboratory if required by the Engineer.

A slump test will be taken by the Engineer on every batch. In addition, the Contractor shall assist the Engineer in preparing a minimum of two concrete cylinders for testing, if so requested by the Engineer. The Owner shall bear costs of testing. Contractor shall provide and maintain for the sole use of the testing agency, adequate facilities for safe storage and proper curing of concrete test specimens on the project site for the first 24 hours as required by "Method of Making and Curing Concrete Test Specimens in the Field" (ASTM C-31).

4.5 READY-MIX CONCRETE

Ready-mix concrete may be used at the option of the Contractor. If the Contractor selects a commercial source, the concrete shall meet the requirements of this section. The mixing plant or transit mixer shall be subject to approval of the Engineer. Each batch shall be accompanied by a certificate showing the quantities and type of cement, the amount of air-entraining admixture, any chemical admixtures, the amount of water, and the amount of fine and coarse aggregate contained in the batch. Copies of the certificates shall be delivered to the Engineer.

The mixer shall be equipped with a water-regulating device which shall accurately measure the water. Concrete transported in truck mixer, agitator, or other transportation device shall be discharged at the job within one and one-half hours after the cement has been added to the water or the aggregates, unless an admixture has been used to retard the set of the concrete, in which case the manufacturer's instructions shall be followed. At no time shall the concrete exceed 90° F. on arrival at the job site. Addition of water shall be allowed to initially adjust to the specified slump provided such addition does not exceed the limits of the specified maximum water-cement ratio. Any later addition of water shall be prohibited. The maximum volume of mixed concrete transported in an agitator shall be in accordance with the specified rating, and in no case shall this volume be exceeded. The concrete shall be handled and mixed in accordance with the requirements of ASTM Designation C94.

4.6 WATERTIGHT CONCRETE

The Contractor shall conduct his operations in such a manner and use necessary materials or processes so as to insure watertight concrete; no leakage will be allowed through the walls. All concrete used in walls and slabs against earth, and in all exterior exposed concrete work or tanks or channels containing water, shall be made watertight. All form ties for watertight concrete shall have factory installed water seals and cone retainers. If required by the Project Specifications, a pozzolanic additive shall be used (Section 4.2.9, above). The water-cement plus pozzolanic ratio shall be less than 0.50 by weight. To test a tank or structure for leakage, if requested by the Engineer, the Contractor shall clean, disinfect (if required) and fill the tank or structure with water to its maximum level. The water shall be allowed to remain 24 hours with all associated valves and appurtenances tightly closed. During this 24-hour period, there shall be no measurable loss in water surface elevation. If this test fails, the Contractor shall dewater the tank or structure, make such repairs to achieve a watertight tank or structure, clean, disinfect (if required), and retest. Tests and repairs shall be repeated until the tank or structure is accepted by the Engineer.

4.7 FORMS

4.7.1 General. Forms shall be so constructed that the finished concrete will conform to the shapes, lines, grades and dimensions indicated on the drawings. The forms shall be substantially constructed and properly braced and tied to maintain shape and position and insure safety to workmen. The forms shall be sufficiently tight to prevent leakage of mortar and shall not deflect under the weight of the wet concrete or construction loads.

4.7.2 Materials and Construction. Forms may be constructed of wood, metal or other material approved by the Engineer. Wood forms shall be dressed and matched boards 1-inch or 2-inch nominal thickness and not more than 10 inches wide. Plywood forms shall be Commercial Standard Douglas Fir, moisture-resistant or equal, and not less than 5-ply and at least 9/16-inch thick. Metal forms if used, shall be such that will produce surfaces equal to those produced by wood forms. Forms shall be given a coat of approved liquid form oil. In all cases, care shall be used to remove all excess oil and grease. Cleanout and inspection openings shall be provided at the bottom of all wall forms to provide for adequate inspection and cleaning of surfaces of hardened concrete against which fresh concrete is to be placed.

4.7.3 Removing Forms. Forms shall not be disturbed until the concrete has hardened sufficiently to develop bond and shear strengths adequate to permit their safe removal. The removal of forms shall be carried out at such times and in such manner as will insure that no damage will occur to the structure, and the Contractor shall be responsible for all his actions pertaining to the removal of forms. In no case shall the minimum removal time be less than the following schedule:

Vertical side forms on walls	-	3 days
Horizontal forms under beams and decks when forms are reshored at the 1/3rd span points	-	9 days
Horizontal forms under beams and decks when forms and shoring are completely removed	-	24 days

4.7.4 Special Form Material. When special form materials are necessary to achieve architectural effects or for other reasons, the special forming will be indicated on the drawings.

4.8 PLACING CONCRETE

4.8.1 General. The Contractor shall not place any concrete until all spaces or areas to receive concrete have been checked and approved by the Engineer. All sleeves, inserts, anchors, and embedded items required for adjoining work or for its support shall be accurately placed and securely anchored prior to placing concrete. The Engineer shall be notified in advance to allow time for inspection of the forms, reinforcing steel, and excavations before concrete is placed. No concrete shall be placed in the absence of the Engineer except with his consent.

Water, ice, frost and any loose soil or debris shall be removed from excavations and forms before concrete is deposited.

4.8.2 Conveying. Concrete shall be conveyed immediately after mixing from the mixer to the forms by methods which shall prevent the possibility of segregation or separation of the aggregates.

4.8.3 Depositing. The concrete shall be deposited in a manner to bring the construction up level (normally 1- to 2-foot thick horizontal layers for walls) and, during the process, agitated with a vibrator of an approved type so as to produce a compact concrete of maximum density with all voids filled to obtain a smooth unbroken surface free from coarse aggregate or exposed honeycomb spaces when the forms are removed. The lower layer which is to be integrated with fresh concrete shall be plastic when the new layer is placed. Concrete shall be deposited in an approved manner to minimize segregation. No honeycomb work will be accepted.

4.8.4 Placing on Hardened Concrete. Special care shall be taken to remove all laitance from concrete surfaces before placing fresh concrete on or against the surface. For concrete that has set, the surface shall be thoroughly roughened, dampened, and, whenever possible, covered with

a grout coat of neat cement. The fresh concrete shall be placed before the grout has attained initial set.

4.8.5 Joints. Location of construction and expansion joints shall be as shown on the drawings or as approved by the Engineer. Construction joints not indicated on the Plans shall be so made and located as to cause the least impairment of the strength of the structure. Construction joint surfaces shall be treated as described above in paragraph "Placing on Hardened Concrete." At least twelve hours must elapse after depositing concrete in columns or walls before depositing in beams or slabs supported thereon.

4.8.6 Repair and Patching. All tie-rod holes shall be filled and all honeycombs or other defective concrete shall be repaired in accordance with the provisions of ACI 301. Surface defects, including tie holes, shall be repaired immediately after form removal. Surfaces shall be clean, rough and dry prior to preparing the surface for repairs. Before repairs commence, the method and materials proposed for use shall be approved by the Engineer.

Remove all damaged, loosened, or unbonded portions of defective concrete with chipping hammers or other approved equipment. Holes and cracks shall be undercut or dove-tailed. Feather edges should be avoided.

Before the patching concrete is applied, the surrounding concrete shall be kept wet for several hours. The area should be damp when grout is applied, but not wet with free moisture. Shallow patches can be filled with a stiff mortar similar to that used in the concrete in layers not more than ½ inch thick, with each layer given a scratch finish to improve bond with the subsequent layer, and the final layer finished to match the surrounding concrete. Deep patches (greater than 3 inches) can be filled with concrete held in place by forms. Such deep patches shall be reinforced and doweled to the hardened concrete.

4.8.7 Placing in Cold Weather. Cold weather concreting shall be performed in accordance with ACI-306. Unless otherwise approved by the Engineer, concrete shall be mixed and placed only when the temperature is at least 40 deg. F. and rising. For placing concrete at lower temperatures on approval from the Engineer, materials shall be heated and mixed as previously specified. Means shall be provided for maintaining the concrete at a temperature of at least 50 deg. F. for 72 hours after placement. Methods of heating materials and protecting concrete shall be approved by the Engineer.

4.8.8 Vibrating Concrete. All concrete shall be vibrated, according to ACI-301.

4.9 FINISH

4.9.1 Surfaces Other Than Slabs. All exposed edges and surfaces shall be straight, smooth and free from hollows. Exposed edges shall be beveled or rounded as directed. Voids or other defects disclosed upon removal of forms shall be corrected at the Contractor's expense as required. Form marks shall be removed by rubbing down or other approved means. Patching shall be carefully done by experienced workmen and in a manner to match the adjacent concrete.

4.9.2 Floor Slabs. Slab surfaces shall be finished by tamping the concrete with suitable tools to force the coarse aggregate down from the surface, screeding with straight edges, and floating to the required finish level. While the concrete is still green, but sufficiently hardened to bear a man's weight without imprint, the surface shall be steel troweled to a uniform smooth surface, free from tool marks. Walks and other exterior slab surfaces subject to foot traffic shall be given an approved broom finish after troweling.

4.9.3 Bottoms of Tanks. Floors of tanks shall have a floated finish unless a topping is to be provided. Initial finish of the floor where a topping is to be installed shall be a scratched finish. Topping shall be placed where indicated and to the dimensions shown on the Plans. The surface of the topping shall be shaped to fit and shall provide close tolerances with the equipment scrapers. The equipment shall be installed and used to check the elevation and contour of the topping. The use of the equipment for spreading or shaping the topping will not be permitted; however, final screeding to fill low spots will be permitted provided excessive loads are not put on the equipment. Finish of the topping shall be a troweled finish. All workmanship and materials for the finish and topping shall be in accordance with ACI 301.

4.10 PROTECTION AND CURING. Immediately after placing or finishing, concrete shall be protected against physical damage, freezing and loss of surface moisture for not less than 72 hours. Protection from loss of moisture shall be provided by applying membrane curing compounds, by moist curing methods, or by application of impervious coverings, as approved or as directed by the Engineer. Membrane curing compounds shall not be used on surfaces which are to receive additional concrete or paint. Impervious coverings shall not be used to cure fresh concrete when the ambient temperature exceeds 90° F. unless approved in advance by the Engineer. Methods of protection against freezing shall be adequate to meet the conditions encountered and shall be subject to approval of the Engineer. Protection and curing time shall be extended beyond the 72-hour period when directed by the Engineer.

4.11 PRECAST CONCRETE. Precast concrete used for manholes, vaults, pipe and similar structures shall conform with requirements of ASTM C478. Reinforced concrete, Portland cement, air entrainment, aggregate, water and steel bars and wire mesh shall be as specified herein. Concrete shall have a minimum 28-day compressive strength of 4000 psi unless otherwise noted on the Plans or specified in the Project Specifications. The handling and placement of concrete shall be by methods that will prevent segregation of concrete materials and the displacement of reinforcing steel from its proper position in the form. Precast sections shall be steam cured or water cured for a sufficient length of time so that the concrete develops its specified compressive strength at 28 days or less. Finished sections shall be substantially free of fractures, large or deep cracks, surface roughness, pits, air holes, honey-combing, laitance, laminations, spalling or damaged ends. Manufacturers of precast concrete shall submit certification of conformance with specified standards, and shall provide test results to demonstrate strength requirements. Precast concrete sections delivered to the job site shall be subject to rejection on account of failure to conform to the specified requirements or for damage incurred during transport.

4.12 TABLES FOR CONTROL OF CONCRETE MIXTURES.

TABLE A
TOTAL AIR CONTENT FOR VARIOUS SIZES OF COARSE AGGREGATE FOR NORMAL WEIGHT CONCRETE (Table 3.4.1 - ACI 301)

<u>Nominal maximum size of coarse aggregate(in.)</u>	<u>*Size Number</u>	<u>Total air content, percent by volume</u>
3/8	8	6 - 10
1/2	7	5 - 9
3/4	67	4 - 8
1	57	3.5-6.5
1 1/2	467	3 - 6
2	357	2.5-5.5
3	-	1.5-4.5

*Per ASTM C33, Table 2 Grading Requirements for Coarse Aggregates

TABLE B

<u>CONCRETE CLASSES</u> with 28-day Field Compressive Strength & Brief Description	<u>MINIMUM CONCRETE SPECIFICATIONS</u>				
	<u>Cement (lbs./C.Y.) (minimum)</u>	<u>Max. Water/ Cement Ratio (lbs.H₂O/lb. of cement)</u>	<u>Air Content % Range (Total)</u>	<u>Max. Slump (inches)</u>	<u>Fine Aggreg. (Max. % of Total Aggregate)</u>
A-Large Aggregate 3000 Psi	565	0.50	4-8	4	45%
B-3/4" Aggregate 3000 Psi	565	0.53	5-8	4	50%
BZ-3/4" Aggregate 4000 Psi	610	0.48	-	8	50%

TABLE C
CONCRETE TEMPERATURE AT DELIVERY
(Section 7.6 - ACI 301)

<u>Air Temperature deg. F.</u>	<u>Minimum Concrete Temperature, Deg. F.</u>	
	<u>For sections with least dimension less than 12 in.</u>	<u>For sections with least dimension 12 in. or greater</u>
30 to 45	60	50
0 to 30	65	55
Below 0	70	60

ORCHARD MESA SANITATION DISTRICT
STANDARD SPECIFICATIONS

SECTION 5
PREPARATION OF CONSTRUCTION AREAS

5.1 SCOPE

5.1.1 General. This section includes General Standard Specifications regarding preparation of the construction area prior to construction of permanent improvements. The Contractor shall provide all labor, equipment and materials necessary for Site Preparation Work as herein described, and as shown on the Plans.

5.1.2 Work Items. The work items to be covered by this specification include the following:

- A. Clearing and grubbing
- B. Topsoil removal and storage
- C. Removal of existing structures
- D. Temporary construction facilities

5.1.3 Related Standard Specifications. Corresponding Standard Specifications of the City of Grand Junction shall apply except where modified herein.

5.1.4 Related Project Specifications. Specific Project Specifications will apply if provided on individual projects.

5.2 DESIGNATION OF WORK AND NON-WORK AREAS

Areas to be subjected to Site Preparation Work shall be specifically designated on the Plans or in the Project Specifications; areas to be preserved shall also be designated. If the Contractor should damage or disturb any area or object which is to be preserved, the Contractor shall make restoration, at his own expense, to the satisfaction of the Engineer and Owner.

5.3 CLEARING AND GRUBBING

5.3.1 Description. Clearing shall mean the removal and disposal of all trees, stumps, brush, shrubs, grass, crops, weed and other vegetable matter to a level of 2 inches above the ground. In addition, all debris, trash and organic material on the ground shall be removed and disposed of. Grubbing shall mean the removal and disposal of all roots, stumps, sod and other protruding objects to a minimum depth of 6 inches, and to a greater depth if so designated on the Plans. The term 'clearing and grubbing' shall include both of the work items listed above.

The limits of clearing and/or grubbing shall be as designated on the Plans or in the Project Specifications, or as directed by the Engineer in the field. All areas which are to be excavated shall be subjected to both clearing and grubbing. Foundation areas beneath certain embankments (specific locations will be indicated on the Plans or Project Specifications) shall

also be subject to both clearing and grubbing.

Except in areas to be excavated, stump holes and other holes from which obstructions are removed shall be backfilled with suitable material and compacted, if required by the Engineer.

5.3.2 Disposal of Materials and Debris. All materials which are salvageable for construction uses or firewood shall be turned over to the Owner. The Plans or Project Specifications shall define which materials are to be salvaged. All other materials are to be disposed of either by burning, burial, chipping, or by hauling to designated locations where the materials will either be placed in piles or scattered.

5.4 TOPSOIL REMOVAL AND STORAGE

Where indicated on the Plans or directed by the Engineer, topsoil shall be carefully stripped and stored in an area approved by the Engineer. Topsoil may include the natural grasses, but shrubs, brush, trees and stumps shall be removed. The depth of topsoil removal will be determined by the Engineer in the field.

5.5 REMOVAL OF EXISTING STRUCTURES

5.5.1 Description. The Contractor shall raze, remove and dispose of all buildings and foundations, fences, structures, abandoned pipelines and any other obstructions which have been specifically designated to be removed as stated on the Plans or in the Project Specifications. In addition, the Plans and Project Specifications may designate certain materials to be salvaged and stockpiled for later use on the Project.

5.5.2 Salvage. All salvageable material shown on the Plans shall be removed without necessary damage, and sections or pieces which may be readily transported shall be stored by the Contractor as directed. Contractor shall be held responsible for the safekeeping of all salvageable materials during the period of the Contract until they are received by the Owner. Contractor shall make good or replace, at his own expense, any such materials damaged, stolen or otherwise lost prior to receipt by the Owner.

5.5.3 Disposal. Unusable, perishable material shall be destroyed. Non-perishable material may be disposed of outside the limits of the Project at a location selected by the Contractor. The Contractor shall make all necessary arrangements with property owners of disposal sites.

5.5.4 Removal of Portions of Structures. Where portions of structures are to be removed, the remaining portions shall be prepared to fit new construction. The work shall be done in accordance with plan details, and in such a manner that materials to be left in place shall be protected from damage. All damage to portions of structure to remain in place shall be repaired by the Contractor at his expense. Where required, concrete shall be sawed in order to preserve salvageable pieces. Reinforcing steel projecting from the remaining structure shall be cleaned and aligned to provide bond with new extension. Dowels as required by plans are to be securely grouted with approved grout.

5.5.5 Pipe Removal or Disposal. All salvageable pipe shall be carefully removed and cleaned, and every precaution taken to avoid breaking or damaging the pipe. The ends of

concrete or masonry culverts or sewers that are to be left in place shall be plugged with suitable concrete or masonry culverts or sewers that are to be left in place shall be plugged with suitable material. The ends of CMP culverts shall be crushed. Culvert and sewer ends are to be sufficiently filled or crushed to prevent future settlement of embankments or backfill.

5.5.6 Removal of Roadway Appurtenances. Traffic signals and related materials shall include all attachment hardware and other incidental materials, such as, but not limited to, mast, arms and spanwire.

Concrete adhering to sign posts shall be removed.

Sign islands shall be considered part of the removal item and shall be removed to one foot below the surrounding ground.

5.5.7 Removal of Pavements, Sidewalks, Curbs, Etc. Pavements, sidewalks, curbs, gutter, etc., designated for removal, shall be broken into pieces and used for riprap on the project, or:

- (A) Broken into riprap-sized pieces and stockpiled at designated locations.
- (B) Disposed of as directed.

Old concrete construction and asphalt pavement that abuts new concrete construction, edges of pavement, sidewalks, curbs, etc. to be left in place shall be cut to a true line with a vertical face. Sawing is the required process. Minimum depth of saw cut in concrete shall be 2-inches. With permission of the Engineer, concrete or asphalt may be cut with a cutting wheel, jack hammer, or similar impact or pressure device.

5.5.8 Removal of Bridges, Culverts and Other Drainage Structures. Bridges, culverts and other drainage structures in use by traffic shall not be removed until satisfactory arrangements have been made to accommodate traffic.

The substructures of existing structures shall be removed down to the natural stream bottom and those parts outside of the stream bed shall be removed to a point one foot below natural ground surface, unless otherwise shown on the Plans or detailed in the Project Specifications. Structures that lie wholly or in part within the limits of a new structure shall be removed as necessary to accommodate the construction of the proposed structure.

Specified steel and wood bridges shall be carefully dismantled without unnecessary damage. Steel members to be salvaged shall be match marked with waterproof paint. All salvaged material shall be stored as specified in Section 5.5.2.

5.5.9 Existing Pipe and Drainage Systems. Live sewers connected to removed manholes, catch basins and inlets shall be properly reconnected and satisfactory bypass service shall be maintained during such operations. Holes resulting from removal of manholes, catch basins and inlets shall be backfilled and compacted.

5.5.10 Temporary Restoration. Where required for convenience and safety of pedestrians and vehicles, excavations caused by removal of existing structures shall be temporarily backfilled or protective barriers and warning signs shall be erected.

5.5.11 Items to be Reset. All poles, posts, signs, planters, walkways, pipes, meter boxes and similar items so designed on the Plans and/or designated in the field by the Engineer to be removed for construction and reset after construction shall be carefully removed and stored in a safe location.

5.6 TRAFFIC CONTROL

5.6.1 General.

Traffic control shall consist of traffic control devices, flagging and temporary access facilities for vehicles and pedestrians.

The Contractor shall provide and maintain all necessary traffic controls to protect and guide traffic for all work in the construction area.

The application of traffic control measures shall be based primarily upon the conditions existing at the time such measures are deemed necessary. The Contractor shall provide and erect necessary and adequate devices prior to starting work that would interrupt normal traffic flow. The devices shall be removed when no longer required.

5.6.2 Traffic Control and Warning Signs.

- (A) Temporary traffic control devices shall be used to guide traffic through construction areas. They include traffic cones to channelize traffic, portable barricades for warning, vertical panel channelizing devices to divert traffic, and lighting devices between the hours of sunset and sunrise.
- (B) Advance warning devices shall be used to alert the motorist of an obstruction in the roadway. They include diamond-shaped signs, flags, and flasher-type high level warning devices mounted 8-feet above the roadway.
- (C) Existing traffic signs and street name signs shall be maintained, erect, clean and in full view of the intended traffic by the Contractor until such time as construction renders them obsolete. Signs and posts that must be removed shall be removed without damage, stored and reinstalled as directed by the Engineer.
- (D) Construction on the roadway, alley, or refuse collection easement that might interfere with mail delivery or with normal refuse collection shall not be initiated until the Contractor has made arrangements with the party or parties responsible for refuse pickup and mail, in order that mail delivery or refuse collection service can be maintained.

(E) Special traffic regulations will be defined in the Project Specifications.

5.7 TEMPORARY CONSTRUCTION FACILITIES

Unless otherwise designated on the Plans or in the Project Specifications, the Contractor shall be responsible for providing all temporary construction facilities such as fences around the construction area, electrical power, water for domestic and construction purposes, pumps for controlling ground water and similar items.

Contractor shall also provide sanitary facilities and enclosures in accordance with applicable laws and regulations. Sanitary facilities shall be maintained a minimum of once per week.

ORCHARD MESA SANITATION DISTRICT
GENERAL STANDARD SPECIFICATIONS

SECTION 6
SITE RESTORATION AND RECLAMATION

6.1 SCOPE

This section includes General Standard Specifications regarding restoration of the construction area and any adjacent disturbed areas after completion of the project, and for seeding and mulching for both adjacent disturbed areas, and areas which are to be a permanent part of the finished project. The Contractor shall provide all labor, equipment and materials necessary for restoration and seeding of the construction area as herein described and as shown on the Plans.

The work items to be covered by this specification include the following:

1. Site Restoration:
 - a. Cleanup of debris, trash and other waste products associated with construction.
 - b. Site rehabilitation, primarily restoration of the ground surface.
 - c. Restoration of existing structures and ground covers.

2. Reclamation:
 - a. Topsoil placement
 - b. Seeding
 - c. Mulching

There are two categories of areas which may require site restoration and landscaping work:

- (1) Areas within the designated Construction Limits, which are initially intended to be part of the project being built (berms, roads, parking areas, back slopes, etc.), for which the Plans and Project Specifications provide specific requirements for grading and surface treatment.

- (2) Areas outside the Construction Limits, which are advertently and/or inadvertently disturbed through use for storage, vehicular traffic, and similar items.

The Construction Limits include all the facilities within the boundaries of the Project being built. Site restoration and landscaping procedures are similar for both areas.

6.1.2 Related Standard Specifications. Corresponding Standard Specifications of the City of Grand Junction shall apply except where modified herein.

6.1.3 Related Project Specifications. Specific Project Specifications will apply if provided on individual projects.

6.2 CLEANUP

After completion of the work, the construction area shall be left clean and neat with all trash and debris removed from the site. Oil spills will be cleaned up, and all excess construction materials, including gravel, sand, asphalt and similar items, shall be removed from the site. Any temporary structures used during the construction, such as power poles, fences and water taps, will also be removed.

6.3 SITE PROTECTION AND REHABILITATION

6.3.1 Erosion Prevention. The Contractor shall conduct his construction operations in a manner to minimize erosion at the construction site and will construct such temporary and permanent facilities at the site as are needed to reduce erosion. Where necessary, or when directed by the Engineer, the Contractor shall provide water bars (low rounded ridges of dirt) or ditches constructed around the contour of the slope. Rocks, logs, hay bales and similar items may be necessary at the outlet of the ditches to prevent erosion. The Contractor shall also refrain from stockpiling dirt and construction materials and equipment in existing water courses.

6.3.2 Surface Grading. Any surface that is part of the construction project shall be graded to the finish grade as shown on the Plans. Any ground surface outside the Construction Limits, which has been subject to disturbance as part of the construction operation, shall be restored to its original grade. All areas disturbed by construction operations shall be left free draining.

6.3.3 Restoration of Disturbed Surfaces. All areas within and outside the Construction Limits which have been subject to disturbance shall be restored to original condition, including storage areas used for equipment and materials and similar uses. If the topsoil has been removed, it shall be replaced to its approximate original thickness. The topsoil shall be loosened in areas that have become compacted by traffic or equipment. Roadways created or constructed by the Contractor shall be scarified unless otherwise directed by the Owner. Where necessary, the disturbed area shall be reseeded, or if necessary, the area shall be re-sodded. Any damaged trees or shrubs shall be replaced or trimmed, and irrigation ditches and drainage courses shall be restored to their original condition.

Restoration requirements with Construction Limits on the project facilities are shown on the Plans.

6.4 RESTORATION OF STRUCTURES

If any existing structure within or without the Construction Limits has been disturbed during construction (and that structure is not specifically designated to be modified), then the structure shall be restored to a condition equal to that before the work began and to the satisfaction of the Engineer. Structures shall be taken to mean any paving, curbing, sidewalks, gutters, fences, powerlines, buildings, pipelines, trees, shrubs and similar items which are removed during the progress of construction, either purposefully or inadvertently.

6.5 SEEDING

6.5.1 General. Seeding and mulching work shall consist of the establishment or reestablishment of ground covers or crops, grasses and/or forbs through a process of seed bed preparation, spreading and sowing seeds, adding fertilizers, watering, and mulching, where required.

6.5.2 Seeding Seasons. Areas that will not be irrigated during the growing season shall be seeded only during the spring and fall seeding seasons, which are as follows:

Zone	Spring Seeding	Fall Seeding
Below 6000'	Spring thaw to June 15th	September 15th until consistent ground freeze
6000' to 7000'	Spring thaw to June 20th	September 1st until consistent ground freeze
7000' to 8000'	Spring thaw to July 15th	August 15th until consistent ground freeze
Above 8000'	Spring thaw to consistent ground freeze	

"Spring thaw" shall be defined as the earliest date in a new calendar year in which seed can be buried ½ inch into the surface soil (topsoil) thru normal drill seeding methods.

"Consistent ground freeze" shall be defined as that time during the fall months in which the surface soil (topsoil), due to freeze conditions, prevents burying the seed ½ inch thru normal drill seeding operations. At no time shall seed be sown, drilled or otherwise planted when the surface soil or topsoil is in a frozen or crusted state.

If seeding is done at any other season, the Contractor must apply the seed at a rate twice the normal application rate used, and shall provide irrigation until the vegetation is established. Seed shall not be applied during windy weather or when the ground is frozen or excessively wet, or otherwise untillable.

In the event weather conditions are inappropriate for seeding, the Contractor shall notify the Engineer in writing, and the work may be suspended until such time that the weather conditions are favorable for seed application.

6.5.3 Quality and Type of Seed. All seed shall be furnished in unopened bags or containers labeled to show supplier, seed name, lot number, net weight, percent weed seed, and guaranteed percent purity and germination. It shall be equal in quality to standards for "certified seed", when applicable, of the state in which it is to be sown. The seed shall be free from noxious weed seeds such as Russian Thistle, bind weed, Johnson grass and leafy spurge. Seed which has become wet, moldy or otherwise damaged in transit or in storage will not be acceptable.

The seed mix to be used will be listed on the Plans or in the Project Specifications, or shall be of the type that will match the existing ground cover. The quantity of seed shall be sufficient to replace ground covers on disturbed areas inside and outside the construction area.

6.5.4 Methods and Procedures.

- A. Seedbed Preparation - Prior to seeding, the ground surface shall be cultivated to a minimum depth of 4 inches to provide a suitable seedbed. Stones or rocks greater than 3 inches shall be removed from the prepared surface. The seedbed shall be free from frozen material, excessive moisture, wheel ruts, compacted clods of soil or other conditions that would inhibit germination and continued growth of vegetation. When seeding is to occur on slopes, all equipment should be operated on the contour of the slope.
- B. Application - Seed may be applied either by mechanical power- drawn drills to a depth of at least ¼-inch, followed by farm harrows and/or packer wheels, as appropriate, or by broadcast type seeders, after which the soil surface shall be raked or dragged so that the seed is covered to a depth of at least 1/4 inch. Seed shall be spread uniformly at a rate as specified in the Plans or Standard Specifications, or as recommended by the manufacturer.
- C. Fertilizer - When called for on the Plans or the Project Specifications, fertilizer of the type specified shall be applied uniformly at the rate specified and tilled into the top 2 inches of soil. The following chart shows acceptable commercial fertilizers:

<u>Material</u>	Minimum		
	<u>% Available Nutrient by Weight</u>		
	<u>N</u>	<u>P</u>	<u>K</u>
	<u>Nitrogen</u>	<u>Phosphorus</u>	<u>Potassium</u>
Ammonium Nitrate	33	0	0
Ammonium Sulfate	20	0	0
Urea	45	0	0
Urea formaldehyde	38	0	0
Diammonium Phosphate	18	46	0
Triple Superphosphate	0	46	0
Potash (Muriate of Potassium)	0	0	60

Fertilizer shall be uniform in composition, dry and free flowing and shall be delivered to the site in unopened containers, each bearing the manufacturer's guaranteed analysis.

- D. Irrigation - The seeded area shall be irrigated as necessary. Periodic watering shall continue as necessary after seeding until the vegetation is established.

When directed by the Plans or Project Specifications or if requested by the Contractor, seeding may be accomplished by hydroseeding whereby seed, water, fertilizer and/or mulch can be applied in one step.

6.6 MULCHING

6.6.1 General. Mulching involves the spread of straw, hay, or wood cellulose fiber or similar material, over a prepared seed bed for the purpose of protecting the seed bed from wind and water erosion, rapid evaporation of water, frost and cold weather, and rainfall and hail damage. Mulching shall be done immediately upon completion of seeding unless otherwise required by the Plans or the Project Specifications.

6.6.2 Materials. Mulching materials shall consist of the following:

- A. Straw of oats, barley, wheat or rye, or hay of clean field or marsh grass, free of seeds of noxious weeds, which has not been excessively decomposed or dried.
- B. Wood cellulose fiber, color dyed to allow visual metering and which has the properties of becoming evenly dispersed in water and which will form a water-like ground cover which readily absorbs water and allows infiltration.
- C. Barn or stable manure which shall be nontoxic, reasonably free of refuse, well rotted and free of noxious weed seeds.

6.6.3 Spreading of Mulch. The rate of mulch application shall be two tons per acre unless otherwise specified in the Plans and/or the Project Specifications. Seeded areas shall be mulched within 24 hours after seeding. Hay or straw mulch shall be crimped in with a crimper or other approved equipment. On slopes steeper than 2:1, burlap or other blanketing materials, properly anchored and secured, may be used in lieu of other mulching procedures.

Cellulose fiber or an approved equal can be added to the hydroseed slurry as mulch. Manure mulch shall be spread with a manure spreader.

When asphalt is used as a binder for mulch, it shall be applied at the rate of 0.2 gallons per square yard by approved spraying equipment.

6.7 ACCEPTANCE OF RESTORED AREAS

All clean-up, restoration of structures, seeding and landscape work shall be subject to the Engineer and Owner's acceptance. In the event seeding does not establish uniform vegetation over at least 50% of areas seeded within one growing season, the Owner may require the Contractor to re-seed the areas at the Contractor's expense during the warranty and performance period, or the Owner may arrange to correct the Work at the expense of the Contractor. In the event seed and mulch are windblown, do not receive adequate care and watering, become disturbed by subsequent construction activities or is otherwise inhibited from becoming established, the Owner shall not be obligated to make payment, either initial or final, for the bid item to which the work pertains. At the Owner's discretion, payment may be made contingent on re-seeding by the Contractor under warranty, plus an extended warranty (if necessary) to include one complete growing season after completing warranty re-seeding.

6.8 ACCEPTANCE OF REVEGETATION

Acceptable revegetation shall mean that the ground surface of the reclaimed area supports a vegetative cover (percent cover aerial projection) at least equal to the vegetative cover present prior to disturbance, and that the vegetative cover is composed of plant species considered to be at least as desirable, from a range management or agricultural perspective, as the vegetative composition prior to disturbance.

ORCHARD MESA SANITATION DISTRICT
GENERAL STANDARD SPECIFICATIONS

SECTION 7
GENERAL ELECTRICAL SPECIFICATIONS

7.1 SCOPE

This section includes General Standard Specifications regarding approved materials and procedures for installing electrical systems.

7.1.1 Related Standard Specifications. Corresponding Standard Specifications of Mesa County Building Codes shall apply except where modified herein.

7.1.2 Related Project Specifications. Specific Project Specifications will apply if provided on individual projects.

7.2 GENERAL REQUIREMENTS

7.2.1 Codes, Regulations and Standards. All work shall be in strict accordance with local governing laws, ordinances and regulations, National Electric Code and rules and regulations of local power company. All materials shall bear the Underwriters' Laboratories, Inc. label provided a standard has been established for the material in question. All equipment shall be equal to or exceed minimum requirements of NEMA, AIEE, and/or Underwriter's Laboratories, Inc.

7.2.2 Permits and Fees. Contractor shall obtain and pay for all local fees, permits and services of inspection authorities required by work hereunder.

7.2.3 Construction Drawings. The drawings are diagrammatic and indicate general arrangement of electrical work. Locations are approximate and shall be subject to minor modifications as directed by the Engineer. The Contractor shall be responsible for exact fitting of all materials, equipment, etc., in buildings. All dimensions shall be verified on the job.

7.2.4 Coordination. Contractor shall so order progress of his work so as to conform to progress of work of other trades and shall cooperate fully with local utility companies with respect to their services. All outages shall be fully coordinated with the Owner and other Contractors.

7.2.5 Cutting and Patching. Cutting, patching, and drilling will be kept to a minimum. Any such work required for installation, support, or anchorage shall be accomplished so as not to damage the structure, and shall be patched and repaired to the satisfaction of the Engineer.

7.2.6 Delivery and Storage. The Contractor shall make his own provisions for delivery and safe storage of his materials and shall assume full responsibility for condition and/or safekeeping of materials furnished by others upon acceptance of same.

7.2.7 Inspections and Tests. Work shall be subject to inspection by the Engineer at all times and in the event of questionable work, his decisions shall be final. After electrical installation is completed and at such times as the Engineer may direct, the Contractor shall conduct an operating test for approval. Installation shall be demonstrated to be in accordance with requirements of this specification. Any defect revealed shall be corrected promptly and tests reconducted.

7.2.8 As-Built Drawings. The Contractor shall maintain on the job an up-to-date set of working drawings and specifications, marked up to show electrical systems as installed. These drawings and specifications shall be available for inspection by the Engineer or his representative. Upon completion of the work, the Electrical Contractor shall provide the Owner with one set of As- Built drawings and marked-up specifications, certified accurate by endorsement.

7.2.9 Shop Drawings. The Contractor shall furnish four (4) copies of shop drawings and material lists, as herein called for, to Engineer prior to commencement of work. Material lists shall include catalog cuts, diagrams and other descriptive material. Shop drawings shall be submitted for all panelboards, distribution equipment, and special controllers (alternators). Material lists shall be submitted for all lighting fixtures. The Contractor shall revise and resubmit shop drawings and material lists as required for approval. A complete typewritten list of all equipment to be furnished shall be provided.

7.3 EQUIPMENT AND MATERIALS

7.3.1 Directory Cards, Nameplates and Labels. Provide labels and neatly-typed directory cards for all panelboards. Label all mechanical equipment disconnects and starters, etc., with raised-letter tape. Directory cards, nameplates, and labels shall indicate the general area and type of electrical load served by each circuit.

7.3.2 Junction and Pull Boxes. Construct junction or pull boxes not over 150 cubic inches in size standard outlet boxes. Construct junction or pull boxes over 150 cubic inches in size the same as cabinets with covers of the same gauge metal and secured by screws or bolts. Removable covers must be accessible at all times.

7.3.3 Cabinets. All cabinets shall be of sheet steel, of standard make, and shall bear the manufacturer's nameplate or stamp and the Underwriter's Laboratories, Inc. inspection label. Provide each cabinet door with a catch and lock set into panel. All locks shall be keyed alike.

Fronts for cabinets shall consist of sheet steel panels with a hinged door.

All cabinets shall include suitable devices for securing, supporting and adjusting panelboard interiors and fronts. Cabinets shall be arranged to provide a wiring gutter not less than that specified in Article 373-6(a) of the National Electrical Code.

7.3.4 Wires and Cables.

7.3.4.1 General. Provide a complete system of conductors in raceway systems. All wiring shall be routed through an approved raceway regardless of voltage application. Unless shown otherwise, minimum wire size shall be No. 12, except for control or signal circuits which may be No. 14.

Branch circuits whose length from panel to first outlet exceeds 75 feet for 120-volt circuits shall not be smaller than No. 10. All wire shall be copper, insulated for 600 volts. All control cable shall be multi-colored stranded copper equal to General Electric S1-58415. Conductor insulation shall be of the type recognized by the National Electrical Code as approved for its particular application, unless otherwise specified or noted. All feeders and all branch circuit wire in buildings shall have Type THW or RHW insulation.

Color code by line or phase per Article 210-5 of the National Electrical Code. All wiring for control systems to be coded in accordance with wiring diagrams furnished with the equipment.

Insulation resistance to ground shall not be less than that approved by the National Electrical Code. Eliminate splices wherever possible; where necessary, splice in readily-accessible pull, junction or outlet box.

Splices and connections shall be made as follows:

- A. Connect No. 8 and smaller wire by twisting tight and applying properly-insulated pressure or wire nut connections.
- B. Connect No. 6 and larger wire to panels and apparatus with properly-sized, solderless, approved lugs or connectors.

All terminating fitting, connectors, etc., shall be a type suitable for the specific cable furnished. All fittings shall be made up tight. All splices and terminations shall be re-checked and made mechanically and electrically tight during a 15-day period immediately prior to final acceptance of the work.

7.3.4.2 Buried Control Cable. Buried control cable shall be suitable for direct burial as determined by the National Electrical Code, IPCEA and UL. Conductors within cable assembly shall be in the quantities and sizes (AWG) as noted on the drawings. See installation specification.

- A. Cable assembly shall be UL and National Electrical Code type XHHW. Insulation over individual conductors shall be chemically cross-linked polyethylene rated 600 volts and comply with IPCEA S-66-524. Color coding shall be as described above and per National Electrical Code, Section 210-5.
- B. Conductors shall be assembled together with fillers, binder tape and a corrugated aluminum sheath overall, all in accordance with UL 44, Table 36.

- C. A 50 mil PVC jacket shall be applied overall. Jacket shall comply with IPCEA S-66-524.

7.3.5 Wiring Devices. Provide the following brown-colored devices where indicated on the Drawings. Equivalent, specification-grade devices shall be as manufactured by Hubbel,

Arrow-Hart & Hageman, Bryant, Slater, General Electric, or as approved. All devices shall have screw-type terminals.

1. Receptacles:
 - a. Grounding-type duplex throughout: Slater 5252-BR.
 - b. Duplex weatherproof: Slater M3780-FS and 5252-BR.
 - c. Special outlets: As indicated on Drawings.
 - d. GFI duplex: Leviton #6598.
2. Lights: As specified on drawings.
3. Switches: A.C. tumbler quiet-type, Slater 700-BR series, full-rated for either inductive or incandescent loads.

7.3.6 Device Plates. Provide a device plate for each outlet to suite the device installed. Plates shall be by Slater (No. 421 for single-pole switches). All metal finish device plates shall have rounded edge, "streamline" design.

7.3.7 Circuit Breaker Load Centers. The circuit breaker load center bus assembly and breakers shall be enclosed in a steel cabinet. Fronts shall include doors and have flush, stainless steel, cylinder tumbler-type locks with catches and spring-loaded door pulls. All circuit breaker load center locks shall be keyed alike. A circuit directory frame and card with a clear plastic covering shall be provided on the inside of the door. The directory shall be typed to identify the load fed by each circuit.

Circuit breakers shall be quick-made, quick-break, thermal- magnetic, and have common trip on all multipole breakers.

Bus bar connections to the branch circuit breakers shall be the "distributed phase" type. Three-phase, four-wire bussing shall be such that any three adjacent single-pole breakers are individually connected to each of the three different phases in such a manner that two or three-pole breakers can be installed at any location.

Equipment ratings shall be as indicated on the individual panelboard schedules.

Circuit breaker load centers shall be a Square D Type QO with plug-on breakers, or equal by G.E., Westinghouse, Cutler-Hammer, or Gould/ITE.

7.3.8 Safety Switches. Provide safety switches for all polyphase mechanical equipment, switches shall be furnished in NEMA 1 general purpose enclosures unless NEMA 3R (rainproof) is required or indicated on the Plans. Covers on NEMA 1 enclosures shall be attached with pin type hinges. Rainproof covers shall be securable in the open position.

Switches shall have a quick-make and quick-break operating handle and mechanism which shall be an integral part of the box, not the cover. Switches shall have a dual cover interlock to prevent unauthorized opening of the switch door in the "ON" position or closing of the switch mechanism with the door open. Handle position shall indicate if the switch is "ON" or "OFF". All switches shall have switch blades which are fully visible in the "OFF" position when the door is open.

Switch ratings shall be as indicated on the Plans, or as required for the equipment served.

Safety switches shall be square D, heavy duty type, or equal by G.E., Westinghouse, Cutler-Hammer, or Gould/ITE.

7.3.9 Main Distribution Panel. Furnish and install a main distribution panelboard as indicated in the 1-line diagram and where shown on the Plans. Panelboard shall be equipped with thermal-magnetic, molded case circuit breakers of frame and trip ratings as shown on the 1-line diagram.

Bussing Assembly and Temperature Rise. Panelboard bus structure and main lugs or main breaker shall have current ratings as shown on the 1-line diagram. Such ratings shall be established by heat rise tests with maximum hot spot temperature on any connector or bus bar not to exceed 50° C. rise above ambient. Heat rise tests shall be conducted in accordance with Underwriters Laboratories Standard UL 67. The use of conductor dimensions will not be accepted in lieu of actual heat tests.

Circuit Breakers. Circuit breakers shall be equipped with individually insulated, braced and protected connectors. The front faces of all circuit breakers shall be flush with each other. Large, permanent, individual circuit numbers shall be affixed to each breaker in a uniform position. Tripped indication shall be clearly shown by the breaker handle taking a position between "ON" and "OFF". Provisions for additional breakers shall be such that no additional connectors will be required to add breakers.

Integrated Equipment Short Circuit Rating. Each panelboard, as a complete unit, shall have a short circuit current rating equal to or greater than the integrated equipment rating shown on the panelboard schedule or on the Plans. This rating shall be established by testing with the overcurrent devices mounted in the panelboard. The short circuit tests on the overcurrent devices and on the panelboard structure shall be made simultaneously by connecting the fault to each overcurrent device with the panelboard connected to its rated voltage source. Method of testing shall be per Underwriters Laboratories Standard UL 67. The source shall be capable of supplying the specified panelboard short circuit current or greater. Testing of panelboard overcurrent devices for short circuit rating only while individually mounted is not acceptable. Also, testing of the bus structure by applying a fixed fault to the bus structure alone is not acceptable. Panelboards shall be marked with their maximum short circuit current rating at the

supply voltage and shall be UL listed.

Cabinet. Panelboard assembly shall be enclosed in a steel cabinet. The rigidity and gauge of steel to be as specified in UL Standard 50 for cabinets. The size of wiring gutters shall be in accordance with UL Standard 67. Cabinets to be equipped with latch and tumbler-type lock on door of trim. Doors over 48" long shall be equipped with three-point latch and vault lock. All locks shall be keyed alike. End walls shall be removable. Fronts shall be of code gauge steel. Gray baked enamel finish electro-deposited over cleaned phosphatized steel.

Safety Barriers. The panelboard interior assembly shall be dead front with panelboard front removed. Main lugs or main breakers shall have barriers on five sides. The barrier in front of the main lugs shall be hinged to a fixed part of the interior. The end of the bus structure opposite the mains shall have barriers.

UL Listing. Panelboards shall be listed by Underwriters Laboratories and shall bear the UL label. When required, panelboards shall be suitable for use as service equipment. Panelboards shall be I-LINE panelboards from Square D. Main distribution panel shall be Square D I-LINE or equal by G.E., Westinghouse or ITE.

7.4 MECHANICAL EQUIPMENT WIRING AND CONNECTIONS

Unless otherwise indicated, all mechanical equipment motors and controls shall be furnished, set in place and wired by the Contractor. Provide for each motor, 1/3 horsepower and below, a horsepower-rated disconnect switch and thermal overload protection unless integrally provided with the motor. Switches for single-phase motors shall be Allen-Bradley Bulletin 600 or equal. Size heater units for approximately 115 percent full load motor current.

All disconnects and starters for motors ½ horsepower and larger shall be of the combination type unless otherwise noted.

Provide equipment connections in accordance with "Raceway Systems" section. Provide Type S rubber-jacketed cord, 600-volt, heavy-duty service, of code sizes and lengths as required. See "Grounding" section.

Where outlets are indicated for miscellaneous equipment requiring electrical power or control, provide wire, conduit, etc., and make all connections to same, unless otherwise indicated. Provide all power circuits, wiring, conduit, outlets, etc., and provide final electrical connections to all equipment.

7.5 SYSTEMS

7.5.1 Grounding. All service equipment, conduit systems, supports, cabinets, equipment, fixtures, etc., and the grounded circuit conductor shall be properly grounded in accordance with the latest issue of the National Electrical Code. Provide bonding jumpers, grounding bushings, clamps, etc., for complete grounding.

Provide a green grounding jumper from the ground screw to a box grounding screw or clip for all grounding-type devices. Use insulated wire.

7.5.2 Raceway Systems. Provide raceways of type as required below for all raceway systems. Where nonmetallic raceways are utilized, the Contractor shall provide sizes as required to conform with the full requirements of the National Electrical Code with the grounding conductor considered as an insulated additional conductors.

Install all raceways exposed, except where otherwise shown. Space supports for exposed raceways not more than seven (7) feet apart, parallel or perpendicular to walls and structural members, and with neat right-angle turns and symmetrical bends. Provide for waterproofing for all conduits, outlets, fittings, etc., which penetrate the roof by use of flashing and counterflashing or pitch pockets. See "Grounding" section.

Provide the following types of raceways for each particular application or location:
(Requirements are minimum standards.)

1. Rigid galvanized steel conduit for all locations:
 - 1) Exposed to weather or installed in concrete.
 - 2) Exposed from floor to a point at least 5 feet above floor.
2. Provide rigid, Schedule 40, PVC plastic conduit for locations:
 - 1) Directly embedded in earth, gravel, cinders, etc.
 - 2) In or directly below concrete slab-on-grade.
3. Provide short extensions of flexible metallic conduit for make-up of motor or equipment connections.
4. Provide flexible watertight conduit for equipment connections at locations exposed to weather or at interior locations subject to moisture.

7.5.3 Supports and Hangers. Support and align all raceways, cabinets, boxes, fixtures, etc., in an approved manner and as herein specified. Support raceways on approved types of wall brackets, ceiling trapeze hangers, or malleable iron straps. Plumbers perforated straps not permitted as means of support. Secure all supporting methods by means of toggle bolts in hollow masonry, expansion bolts in solid masonry, concrete preset inserts or expansion bolts in concrete, machine screws, bolts or welding on metal surfaces, and wood screws on wood construction.

7.6 INSTALLATION OF BURIED CABLE

Cable shall be installed to connect remote electrical equipment as shown on the Plans, and/or as described in the Project Specifications. Either of two methods for burial of cable will be indicated:

1. Placement within pipe trenches in accordance with the standard electrical detail.
2. Placement in a separate trench with minimum burial of 42", unless a separate depth is indicated on the Plans or Specifications.

A four-inch layer of bedding sand (100% passing the ¼" screen) shall be placed above and below all direct burial cables. If a protective cable conduit is specified on the Plans or in the Project Specifications, the sand bedding will not be required. In all cases, place a 12" wide, 6 mil polyethylene yellow plastic marker 12" above the cable for its entire buried length.

Markers, consisting of steel fence posts, 6 foot long, with an attached warning sign, "WARNING-UNDERGROUND CABLE", shall be placed at locations to be selected by the Engineer. Signs shall be of metal plate, 4"x6", with letters ½" high, neatly painted in a durable red paint. The number of markers required for the Project shall be indicated on the Plans.

ORCHARD MESA SANITATION DISTRICT
GENERAL STANDARD SPECIFICATIONS

SECTION 8
WATERPROOFING AND PROTECTIVE COATINGS

8.1 SCOPE

8.1.1 General. This section includes General Standard Specifications regarding coatings used for waterproofing and corrosion protection. Contractor shall provide all labor, equipment and materials necessary in the proper application of coatings.

8.1.2 Work Items. The work items to be covered by this Specification include the following:

1. Product descriptions.
2. Product specifications.
3. General surface preparation.
4. Application techniques.
5. Special requirements.

8.1.3 Related Standard Specifications. Corresponding Standard Specifications of the City of Grand Junction shall apply except where modified herein.

8.1.4 Related Project Specifications. Specific Project Specifications will apply if provided on individual projects.

8.2 CEMENTITIOUS WATERPROOFING.

8.2.1 Product Description. This shall be a Portland cement based crystalline coating for waterproofing concrete and masonry. The coating material must be capable of waterproofing both negative and positive sides of the substrate and be capable of penetrating into the capillaries of the surface. Acceptable products are Hey'Di K11, Vandex Cementitious waterproofing, or approved equal.

8.2.2 Product Specifications. The coating shall meet the following specifications:

- a. Adhesion per ASTM C-952, a minimum of 175 psi.
- b. Tensile strength per ASTM C-190, a minimum of 300 psi at 100% RH, and a minimum of 100 psi at 50% RH.
- c. Flexure strength per ASTM C-580, a minimum of 450 psi.
- d. Permeability per CRD-48-73, a minimum of 2.5×10^{-10} cm/sec per coat, tested at water pressures of 200 psi.

8.2.3 General Surface Preparation. Surfaces must be clean, structurally sound, and free of all contaminants, including curing compounds, foreign release agents, dust, dirt, oil, old coatings, and paint.

New concrete and masonry surfaces should be cured 7 days. Provide an absorptive surface on all substrates, including smooth, precast and formed concrete.

Remove form marks and other protrusions. Concrete honey comb, cavities, joints, cracks, voids, tie holes, and other defects, must be opened and routed to sound material. Rout broken and uneven brick or block to sound material.

8.2.4 Application Techniques. Moisture must be present in the surface to start the crystallization process. Dampen the wall with potable water before application. Surface must be damp but leak-free, with no running or standing water.

- a. Brush Application. Apply with a bristle brush, working the coating slurry into the surface to fill all pores and voids. the final brush strokes should be in one direction to produce an even texture and finish. The coating shall be applied per the manufacturer's specifications with a minimum of 0.25 lb./sq.ft. each coat. Follow manufacturer's specifications for drying time between coats.

Prior to subsequent coats, dampen the first coat, mix and apply the second coat in the same manner as the first coat, except that finish brush strokes are at right angles to the finish strokes of the previous coat. The second coat shall be applied at the rate of manufacturer's specifications, or a minimum of 0.25 lb./sq.ft. The second coat must dry and cure per the manufacturer's specifications.

- b. Spray Application. the coating shall be applied with air operated spray equipment capable of spraying cementitious materials. Use a 1/8 in. nozzle. For concrete surfaces, apply in one even coat at the rate specified by the manufacturer or a minimum of 0.5 lb./sq.ft. For concrete masonry surfaces, apply in two coats, each at the rate specified by the manufacturer or a minimum of 0.25 lb./sq.ft. Before initial set of the first coat, backbrush the surface with a cement mason's brush or broom to fill voids and insure uniform surface coverage. Cure the first coat for the time period specified by the manufacturer. Prior to application of the second coat, dampen the surface. Backbrushing is not required on the second coat. Drying and cure time shall be per manufacturer's specifications.

8.2.5 Special Requirements.

- a. Cementitious waterproofing shall not be applied where ambient temperatures cannot be maintained at least 40 deg. F. for 48 hours.
- b. When ambient temperatures are above 90 deg., the surface shall be fully saturated with water for a minimum of 15 minutes prior to application of the coating.
- c. Do not use on traffic-bearing surfaces.

- d. Provide a minimum of 7 days cure time prior to exposing to free standing water or backfilling.

8.3 COAL TAR EPOXY

8.3.1 Product Description. Coal tar epoxy is a low odor chemical and corrosion resistant coating. Acceptable materials are Tnemec brand 46H-413 Hi-Build Tneme-tar, Porter 7080 Tarsert Maxi-Build, or, in lieu of coal tar epoxy, Porter BC12 System 2000 epoxy, or approved equal.

8.3.2 Product Specifications. Coting shall be applied in more than one coat, with a total minimum dry film thickness of 30 mils. Manufacturer's minimum and maximum coat thicknesses shall be followed. Solids by volume must be a minimum of 70%. No priming is required on concrete surfaces; however, steel shall be primed per manufacturer's specifications prior to application of the first coat. Curing time and recoating time shall be per manufacturer's specifications. The coating shall meet or exceed criteria for the following tests:

- a. Abrasion - For 1,000 cycles of the CS-17 Wheel, 1000 grams load:
 - 1. No more than 170 mg loss in Federal Test Method Standard #141, test method 6192; or
 - 2. No more than 275 mg loss in ASTM 4060 test.
- b. Adhesion to steel - not less than 600 psi, average of 3 trials, with a testing method of the Elcometer Adhesion Tester (0-1000 psi), per ASTM D-4541, or a rating of at least 10 on ASTM 0-1654 test.
- c. Adhesion to concrete - not less than 250 psi, average of 3 trials. Method - Elcometer Adhesion Tester (1-1000 psi), per ASTM D-4541.
- d. Vapor Transmission - No more than .20 perms per ASTM E96.
- e. Impact - not less than 20 in./lbs. average with a test method of ASTM G14-72 (reverse impact), or 10 in./lbs. average with a test method of ASTM D-2794.
- f. Salt spray (fog) - no blistering, cracking, softening or delimitation of film, no more than 1/16 rust creepage at scribe and no more than 2% rusting at edges after 1500 hrs. exposure, with a test method of ASTM B 117-72.

8.3.3 General Surface Preparation. Surfaces shall be prepared per manufacturer's specifications.

8.3.4 Application Techniques.

- a. Air or Airless Spray. Manufacturer's specifications shall be followed.

- b. Brush. Brushing is recommended on small areas only. Ladle material on and use flat side of brush to spread. Do not brush out to thin film as with conventional coatings.
- c. Roller. Use short-nap, mohair (rug type) cover - not recommended for Tnemec 46H-413.

8.3.5 Special Requirements. Ambient temperatures must be at least 50°F with a maximum of 120°F. The surface should be dry and at least 5°F above the dew point. Coating will not cure below minimum surface temperatures. Also, coating shall not be immersed or backfilled within 7 days of application, except Porter BC 12, which may be immersed and backfilled within 24 hours.

STANDARD NOTES

Standard Sanitary Sewer Notes Required for OMSD Submittals:

Required Notes. The following notes are required on every sheet of the submittal. Additional notes may be required by the District Engineer for items specific to each sewer line extension.

1. All sewer line construction shall conform to Orchard Mesa Sanitation District's Standards and Specifications.
2. All materials and workmanship shall be subject to inspection by the District. The District reserves the right to accept or reject any materials and workmanship that does not conform to its Standards and Specifications.
3. The Contractor shall have one signed copy of the Plans and a copy of the District's Standards and Specifications at the job site at all times.
4. All sanitary sewer pipe shall be PVC SDR-35 unless otherwise specified. All pipe joints shall be 13 foot joints unless otherwise approved by the District Engineer.
5. All sewer mains shall be laid to grade utilizing a pipe laser.
6. All service line connections to the new main shall be accomplished with full body wyes or tees. Tapping saddles will not be allowed.
7. All trenches shall be compacted to 95% as determined by AASHTO T-99. Contractor shall be required to perform all necessary compaction tests through a certified soils lab. A copy of the compaction test results shall be provided to the District during the course of the project.
8. A minimum 10-foot separation shall be maintained at all times between waterlines and sewer lines (except at specified crossings).
9. All sanitary sewer services to be 4" PVC SDR 35 unless otherwise specified.
10. Sewer service stub-outs shall extend 14 feet beyond the property line and shall be glue-capped and marked with a 2x4 post painted green.
11. The Contractor shall notify the District at least 48 hours prior to commencement of construction.
12. Manholes shall be constructed as shown on the Orchard Mesa Sanitation District Standard Sanitary Sewer Detail sheet. At the District's direction, the Contractor shall field vacuum test manholes to ensure that they are of watertight construction and that manholes have not been damaged during installation.
13. No service lines shall be connected directly into manholes.

14. Manhole cone and flat top sections shall be positioned such that the manhole ring and cover are offset 20 degrees to 30 degrees from the upstream main sewer line into the manhole. Manhole steps shall be installed in vertical alignment with the ring and cover.
15. Steel paving rings are not allowed for grade adjustment unless otherwise approved by the District.
16. The Contractor is responsible for all required sewer line testing to be completed in the presence of the District Engineer or their representative. Final testing is to be accomplished only after all other infrastructure has been installed. This includes waterlines, gas lines, electric lines, etc. Testing will be performed after all compaction of street subgrade and prior to street paving. Final lamping will also be accomplished after paving is completed to insure that the line is clean. These tests will be the basis for issuing Initial Acceptance of the sewer line extension.

OPTIONAL NOTES

Standard Sanitary Sewer Notes Required for OMSD Submittals:

Optional Notes if Applicable to Project

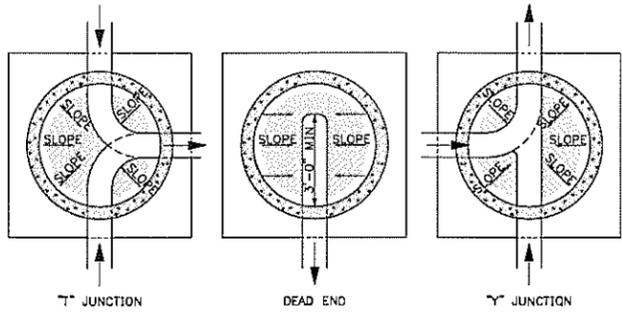
17. The Contractor shall excavate a depth of 14 inches below the flow line of the existing sewer main and provide wedges or other approved support of the existing sewer line. After the existing sewer line has been adequately supported, the top half of the pipe should be cut out to springline and notched to accommodate the new invert-in. The Contractor may elect to pour the new base and invert prior to cutting the existing sewer line to accommodate the new invert. The Contractor shall exhibit care so as not to float or sag the existing pipe when constructing manhole base.

The Contractor shall also be responsible for controlling all live sewage flow and shall not allow debris from the cutting or other work to enter the existing sewer main while work is being completed.

The invert-in elevation shall be raised as necessary so that sewage flows in the existing sewer main will not back up into the subdivision sewer line extension during peak flow events based on actual observations of the peak flow depth after the top half of the existing sewer line is removed. The Engineer shall notify the District of any adjustments necessary in the invert elevation.

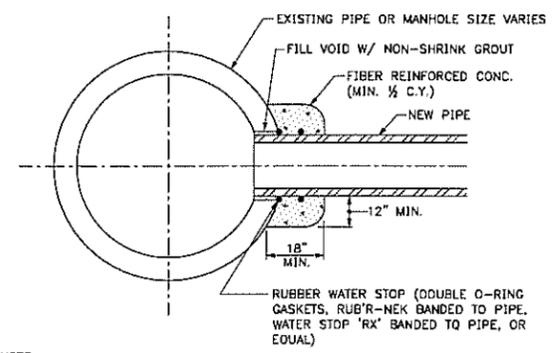
19. When connecting to existing manholes, it is necessary to core drill the existing manhole wall and base and provide a "PSX" positive seal gasket to accommodate the new invert-in. The manhole base and wall is to be grouted to provide a water tight seal and the invert grouted as necessary to provide for a smooth invert channel. All grout used on the invert channel should be suitable for feathering applications and installed per the manufacturer's recommendation.
20. The Contractor is to connect to the existing manhole by removing the existing stub out and installing a full pipe joint into the manhole utilizing the existing PSX pipe boot. The pipe boot is to be grouted to provide a watertight seal, and the invert grouted as necessary to provide for a smooth invert channel. All grout used on the invert channel shall be suitable for feathering applications and installed per the manufactures recommendations.
21. Because of the shallow sewer lines, flat top lids for shallow manholes should not be installed until all street subbase preparation has been completed. This will help facilitate lamping and testing of the proposed sewer mains. Manholes should be temporarily covered with steel plates or other material to prevent debris from entering the manhole during subgrade and subbase preparation.
22. For shallow manholes using flat top lid slabs, cast in place bases shall be used with a 1-foot barrel section placed on the base. Precast bases can be used only if total height of base section is 24-inches or less.
22. The invert channel for dead-end manholes shall be a minimum 3/4 of the length through the manhole base to facilitate testing and access for the District's maintenance equipment.

STANDARD DETAILS



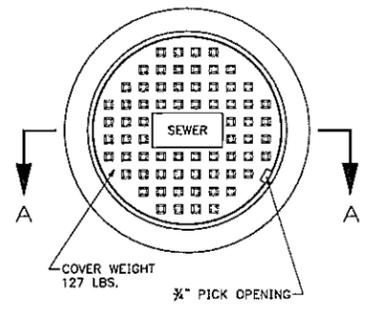
INVERTS SHALL BE FORMED TO PROVIDE A 24" MINIMUM APPROACH IN LINE WITH EACH PIPE FOR MAINTENANCE EQUIPMENT.

SECTION B-B

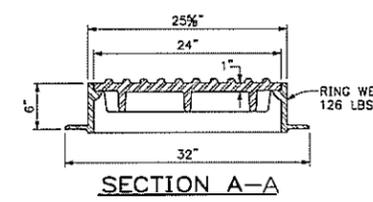


NOTE: IF THE HOLE IN THE EXISTING PIPE OR MANHOLE IS CORED, THE CONNECTION CAN BE MADE BY INSTALLING A FLEXIBLE PIPE TO MANHOLE CONNECTOR ("BOOT") AND THE CONCRETE ENCASEMENT ELIMINATED.

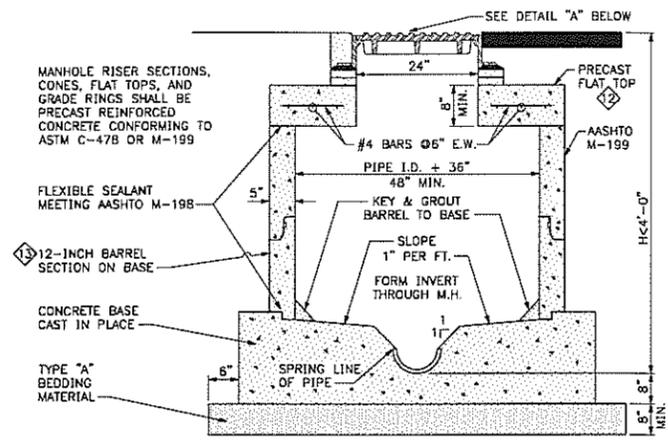
CONNECTION TO EXISTING MANHOLE OR INLET BOX



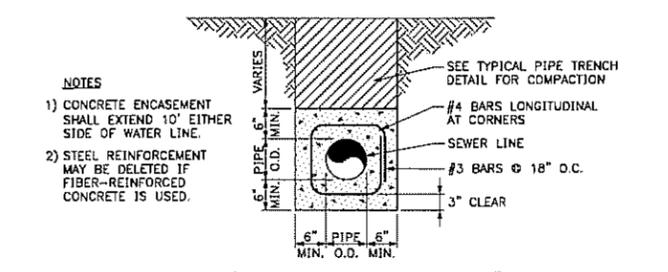
STANDARD CAST IRON MANHOLE RING & COVER



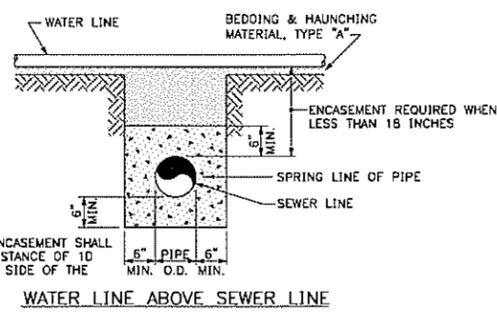
SECTION A-A



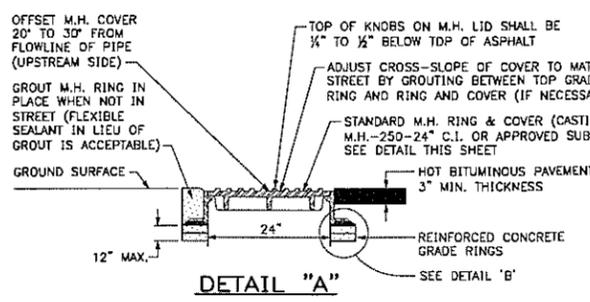
STANDARD SHALLOW MANHOLE CAST-IN-PLACE BASE



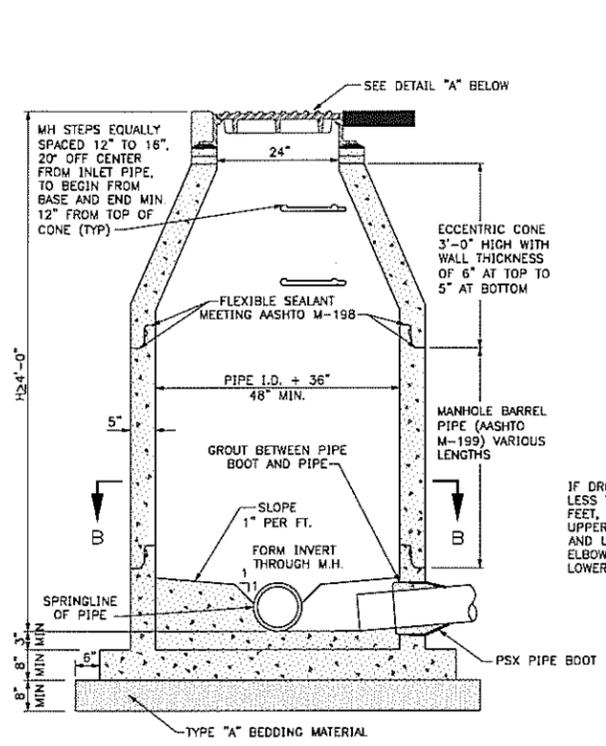
WATER LINE BELOW SEWER LINE



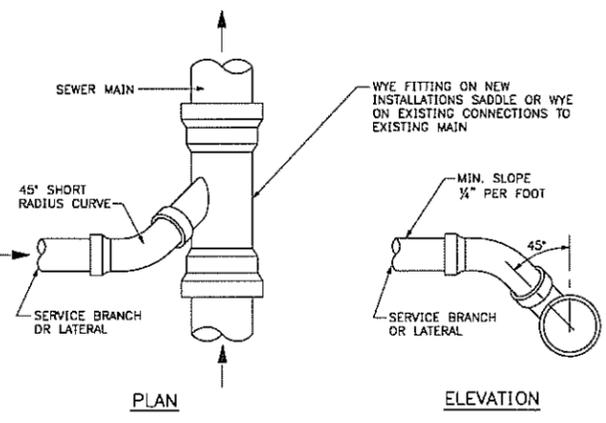
CONCRETE ENCASEMENT DETAIL



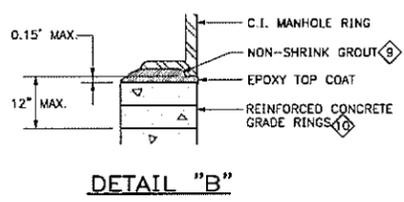
DETAIL "A"



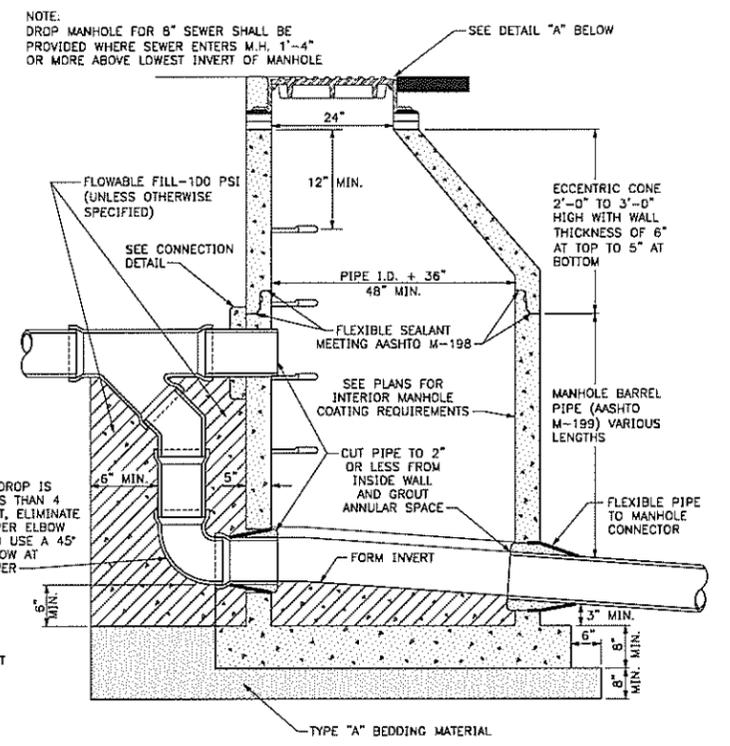
STANDARD MANHOLE WITH PRE-CAST BASE



TYPICAL SERVICE "Y" CONNECTION

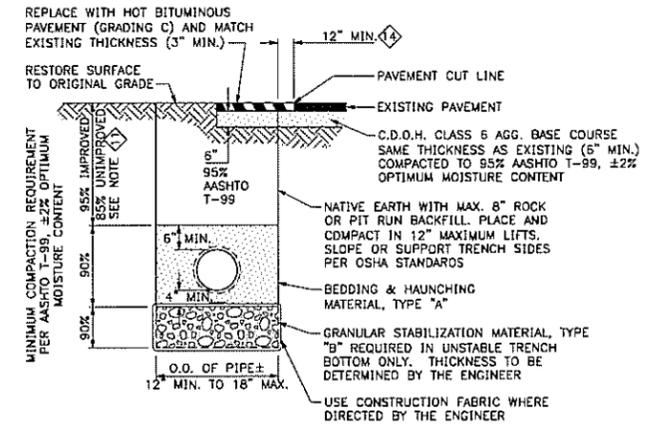


DETAIL "B"



DROP MANHOLE PRECAST BASE

NOTE: PRECAST BASE AND FLEXIBLE PIPE CONNECTORS ARE TO BE USED FOR ALL STANDARD AND DROP MANHOLE TYPES UNLESS OTHERWISE APPROVED BY THE ENGINEER.



TYPICAL TRENCH DETAIL

SIEVE SIZE	PERCENT BY WEIGHT PASSING SQUARE MESH SIEVES		
	PIPE BEDDING & HAUNCHING MATERIAL (TYPE A)	GRANULAR STABILIZATION MATERIAL (SCREENED OR CRUSHED ROCK TYPE B)	PIT RUN AGGREGATE (TO BE USED WHERE SPECIFIED OR DIRECTED BY THE ENGINEER)
8 INCH	---	---	---
2 INCH	---	100	---
3/4 INCH	100	---	---
NO 200	20 MAX	15 MAX	20 MAX

ALL BACKFILL MATERIAL SHALL BE PLACED FULL WIDTH IN 12" MAX. LIFTS AND COMPACTED TO THE MIN. RELATIVE DENSITIES SHOWN.

GENERAL NOTES

- Concrete shall be Colorado Division of Highways Class "B" (Section 601.02).
- All cement used in mortar, concrete bases, grade rings, riser sections, cones, and flat tops, for sanitary sewer manholes, shall be Type II or modified Type II Portland Cement with less than 5% tricalcium aluminate.
- Manhole riser sections, cones, flat tops, and grade rings shall be precast reinforced concrete conforming to ASTM C-478 or AASHTO M-199.
- Backfill around manholes and other structures shall be placed in 8-inch max. lifts and compacted to 95% AASHTO T-99 unless otherwise specified.
- All work shall be in accordance with approved plans and District specifications.
- Manhole cone and flat top sections shall be positioned such that the manhole ring and cover are offset 20 degrees to 30 degrees from the upstream main sewer line into the manhole.
- Manhole steps shall be installed in vertical alignment with the ring and cover.
- Refer to Plans or Specifications for any manhole waterproofing and/or corrosion protection that may be required for the project.
- Manhole ring and cover can be set to finished grade, using non-shrink grout to adjust rim elevation. Grout shall not exceed 0.15 ft. thickness and shall have a finish coat of epoxy applied to all grout surfaces exposed to the interior of the manhole. Epoxy top coat requirement may be deleted provided non-shrink grout is installed in accordance with manufacturers recommendations and instructions and is acceptable to the Engineer.
- Precast concrete grade rings are to be used for grade adjustment on all new manholes. Paving rings are not allowed for grade adjustment unless otherwise approved by the District Engineer.
- Minimum trench compaction requirements:
 - 95% in all areas of public or street right-of-ways including trenches beneath pavement, gradebed areas, borrow ditches, and open space.
 - 85% or to match existing (whichever is greater) in unimproved or landscaped areas, fields, or private easements that are not within road or street right-of-ways.
- Flat top slabs are allowed only when the shortest precast eccentric cone is too tall or as required by the Plans.
- For shallow manholes using flat top slabs, cast in place bases shall be used with a 1-foot barrel section placed on the base. Precast bases can be used only if total height of base section is 24-inches or less.
- See Plans for lap asphalt width and T-Lock patch requirements.

SCALE: HORIZONTAL N.T.S.
VERTICAL N.T.S.

REVISIONS	DATE
REVIEW/UPDATED	04-2009

WestWater Engineering
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Grand Junction, CO 81505
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ORCHARD MESA SANITATION DISTRICT
SANITARY SEWER DETAILS

Design by:	Drafted by:	Date:	Project No.:	Sheet
	WWE			of