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BEFORE THE ARIZONA CORPORATION COMMISSION

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COMMISSIONERS
JEFF HATCH-MILLER - CHAIRMAN
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BARRY WONG

IN THE MATTER OF THE APPLICATION OF CAVE CREEK WATER COMPANY FOR APPROVAL OF AN EXTENSION OF THEIR CERTIFICATE OF CONVENIENCE AND NECESSITY TO INCLUDE PARCEL NO. 216-29-002A.	DOCKET NO. W-01452A-05-0082
IN THE MATTER OF THE APPLICATION OF CAVE CREEK WATER COMPANY FOR APPROVAL OF AN EXTENSION OF THEIR CERTIFICATE OF CONVENIENCE AND NECESSITY TO INCLUDE PARCEL NO. 211-99-006.	DOCKET NO. W-01452A-04-0810

Cave Creek Water Company ("Cave Creek"), through undersigned counsel, hereby files a Line Extension Agreement between Cave Creek and the Co-Family Trustees of the Derald D. Ulmer 2002 Trust.

RESPECTFULLY SUBMITTED this 27th day of October 2006.

ROSHKA DEWULF & PATTEN PLC

By _____

Michael W. Patten
Timothy J. Sabo
One Arizona Center
400 East Van Buren Street, Suite 800
Phoenix, Arizona 85004
Attorneys for Cave Creek Water Company

Original and 15 copies of the foregoing filed this 27th day of October 2006 with:

Docket Control
Arizona Corporation Commission
1200 West Washington Street
Phoenix, Arizona 85007

Copy of the foregoing hand-delivered/mailed this 27th day of October 2005 to:

Kristin Magin
Salmon, Lewis & Weldon, P.L.C.
2850 East Camelback Road, Suite 200
Phoenix, Arizona 85016

Mr. Stephen J. Anthony
Sacks Tierney, P.A.
4250 North Drinkwater Boulevard, 4th Floor
Scottsdale, Arizona 85251

Marc Stern, Esq.
Administrative Law Judge
Hearing Division
Arizona Corporation Commission
1200 West Washington Street
Phoenix, Arizona 85007

Christopher C. Kempley, Esq.
Chief Counsel, Legal Division
Arizona Corporation Commission
1200 West Washington Street
Phoenix, Arizona 85007

Ernest G. Johnson
Director, Utilities Division
Arizona Corporation Commission
1200 West Washington Street
Phoenix, Arizona 85007

By Mary Spoolitz

ROSHKA DEWULF & PATTEN, PLC
ONE ARIZONA CENTER
400 EAST VAN BUREN STREET - SUITE 800
PHOENIX, ARIZONA 85004
TELEPHONE NO 602-256-6100
FACSIMILE 602-256-6800

CAVE CREEK WATER CO.
INDEX TO LINE EXTENSION AGREEMENT

CAVE CREEK WATER CO.
LINE EXTENSION AGREEMENT

THIS AGREEMENT is made this 25th day of October, 2006, by and between CAVE CREEK WATER CO., an Arizona corporation ("Company") and Michael D. Crew, Ricky D. Ulmer, Cynthia L. Ulmer-Lux, David D. Ulmer and Tamera L. Tomlin, as the Family Co-Trustees of the Derald D. Ulmer 2002 Trust ("Applicant").

A. Company holds a Certificate of Convenience and Necessity from the Arizona Corporation Commission ("ACC") to provide water service to the Black Mountain Vistas subdivision and which is more specifically described on EXHIBIT A attached hereto and incorporated herein by this reference (the "Property").

B. Applicant owns and intends to develop five (5) residential lots on the Property and has requested Company to provide water service to the Property.

C. Certain Water-Related Facilities (as hereinafter defined) must be designed, constructed, installed and connected to Company's system in order to permit Company to deliver water service to the Property.

D. Applicant is willing and able to finance, design, install and construct said Water-Related Facilities, subject to Company's approval of such design and construction.

NOW, THEREFORE, in consideration of the mutual covenants herein contained, and as a predicate to the Property receiving water service, the parties hereby agree as follows:

1. Facilities to be Constructed: This Agreement governs the construction, installation and financing of the Water-Related Facilities set forth in those certain engineering plans for project #108026, dated July 25, 2006, drafted by Pinnacle Engineering, Inc., Sheet Nos. 1 to 5, attached hereto and incorporated herein by this reference as Exhibit B (the "Plans"), as modified in final engineering plans approved by Company, the ACC, the Arizona Department of Environmental Quality ("ADEQ") or its delegate, the Maricopa County Environmental Services Department ("MCESD") and/or such other governmental agency, if any, having authority to review and approve the engineering plans. Such modifications shall be deemed to amend the Plans and are incorporated herein by reference. No other or further amendments of the Plans shall be permitted without written authorization of Company. The facilities to be constructed pursuant to the Plans and all easements, rights-of-way or other real property rights or interests allowing the construction, operation, maintenance, repair, replacement and upgrading of such facilities, are hereinafter referred to as the "Water-Related Facilities". Any additional lines, or water facilities necessary to provide adequate water service to the Property, or any portion thereof, are beyond the scope of this Agreement and Company shall have no responsibility therefor unless otherwise agreed by Company expressly and in writing.

2. Applicant to Construct and Pay: Applicant shall design, construct and install the Water-Related Facilities and shall pay all of the costs related thereto and/or arising

directly or indirectly from this Agreement or any undertaking in the performance thereof, including, but not limited to, the costs of acquiring any necessary easements, rights-of-way or other rights necessary to construct, operate, maintain, repair, replace and upgrade the Water-Related Facilities, engineering, computer modeling analysis, materials, labor, transportation, equipment, known or unknown, surcharges, regulatory fees, necessary permits, easements, inspections, administrative overhead, attorney's fees, approvals, testing, correction, insurance and bonds, present or future regulatory fees, special assessments, excise charges, taxes, including a gross-up for income tax impacts relating to receipt of the Water-Related Facilities but expressly excluding property taxes.

3. Time of Payment: Applicant, prior to Company's acceptance of the Water-Related Facilities, shall pay all costs incurred by Applicant in the performance of this Agreement. Upon execution of this Agreement, Applicant shall pay Company ten percent (10%) of the Estimate Cost (as defined in Paragraph 4) of construction, as determined by Paragraph 4 hereof, up to a maximum of fifteen thousand dollars ($15,000.00) as and for Company's cost of engineering, computer modeling analysis, inspection, administrative overhead, and attorneys' fees incurred in connection with this Agreement. All other costs payable by Applicant to Company hereunder shall be due and payable the later of: (a) prior to Company's acceptance of the Water-Related Facilities, or (b) within fifteen (15) days of receiving a bill therefore. Interest shall accrue on any unpaid balance at the rate of 1.5% per month. All sums paid by the Applicant pursuant to this Paragraph 3 and supported by documentation as required by Paragraph 5 shall be deemed advances-in-aid-of-construction refundable as set forth in Paragraph 6 hereof.

4. Actual Cost Shall Govern: The estimated total cost of the Water-Related Facilities is fifty-three thousand five hundred thirty-two dollars and 50/100 ($53,532.50) as shown in itemized form on Exhibit C ("Estimated Cost"). Applicant acknowledges the estimate is non-binding and hereby agrees to pay the actual cost of the Water-Related Facilities. Company shall calculate, and Applicant shall pay, the estimated income tax impact for any portion of the Water-Related Facilities treated as income for income tax purposes (e.g. service lines and meters serving individual lots) (herein referred to as the "gross-up"); provided, however, if the estimated gross-up differs from the actual amount thereof, (a) Company, within ninety (90) days after filing the applicable tax return, shall refund any portion of the gross-up collected in excess of the increase in tax liability of Company arising from receipt of the Water-Related Facilities or (b) within ninety (90) days after receiving Company's invoice therefor, Applicant shall pay to Company any additional amount necessary to fully compensate Company for the actual increase in Company's tax liability arising from receipt of the Water-Related Facilities.

5. Documentation: Applicant shall, as a condition of acceptance of the Water-Related Facilities and not later than sixty (60) days after completing construction, furnish Company with:

(a) copies of all bills, invoices and other statements of expenses incurred by Applicant, covering all costs of materials, equipment, supplies, construction and installation of the Water-Related Facilities;

(b) lien waivers and releases from all contractors, subcontractors and vendors for materials, labor, equipment, supplies and construction included in Water-Related Facilities;

(c) receipts specifying exact amounts evidencing payments in full by Applicant to all contractors, subcontractors or vendors for all materials, equipment, supplies, labor and other costs of construction of the Water-Related Facilities;

(d) "as-built" drawings (hardcopy and electronic copy in AutoCAD format referenced to the following coordinate system: NAD83 HARN State Plane Central Arizona 0202 feet international) certified as to correctness by an engineer registered in the State of Arizona and approved by Company, and showing the location and respective sizes of Water-Related Facilities;

(e) all easements, bills of sale, deeds, subordinations, title insurance policies and other evidences of ownership, and/or right to construct, operate, maintain, repair, replace and upgrade the Water-Related Facilities as deemed necessary and in a form satisfactory to Company; and

(f) an environmental assessment of any real property on which the Water-Related Facilities are located, if requested by Company.

6. Return of Advance: The cost of construction and installation of Water-Related Facilities advanced by Applicant pursuant to this Agreement and evidenced by invoices furnished to Company pursuant to Paragraph 5 hereof, is subject to refund by Company to Applicant. Company shall make refunds annually on or before August 31 of each year for the preceding July 1 through June 30 period. The amount to be refunded annually shall be ten percent (10%) of total gross annual revenues from water sales to each bona fide customer whose service line is connected to main lines covered by this Agreement (excluding all gross receipts collected as sales taxes, franchise fees and/or any other assessment, fee, tax or charge imposed by a state, federal or local governmental body or pursuant to a cost adjustment mechanism approved by the ACC) derived from the provision of water to each customer located on the Property who is served from water mains installed by Applicant pursuant to this Agreement. Refunds shall be payable for a period of ten (10) years commencing from the later of (1) the date of Company's acceptance of the Water-Related Facilities, or (2) the first day of the month following 180 days from the execution of this Agreement. In no event shall the funds paid hereunder exceed the total amounts paid by Applicant as advances-in-aid-of-construction pursuant to this Agreement. Any balance remaining at the end of the ten (10) year period shall become nonrefundable unless the refund period is extended from year to year at the sole option of Company. No interest shall be paid on any amount advanced by Applicant pursuant to this Agreement.

7. Company's Right of First Refusal: Before selling or transferring the refund obligation of Company under this Agreement, Applicant shall first give Company, and its

heirs, successors and assigns, reasonable opportunity to purchase the same at the same price and upon the same terms as contained in any bona fide offer which Applicant has received from any third person or persons which Applicant may desire to accept.

8. Governmental Approvals: Prior to purchasing materials for or commencing construction of the Water-Related Facilities, Applicant shall pay for and provide to Company all requisite use permits, construction permits, including approvals to construct drinking water facilities, ACC approval of this Agreement, zoning and other governmental approvals and other approvals and permits of any kind required and necessary to install, construct, operate and maintain the Water-Related Facilities. Applicant acknowledges that this Agreement must be accompanied by the Certificate of Approval to Construct issued by the Maricopa County Environmental Services Department for submission to the ACC for approval.

9. Provision and Use of Easements: Applicant shall, at no cost to Company and in a form acceptable to Company, furnish Company any and all easements and rights-of-way reasonably necessary to insure the proper provision of utility service by Company, as determined in the sole discretion of Company, including the rights to construct, operate, maintain, repair, replace and upgrade the Water-Related Facilities. In addition, Company shall have the right to use any of the existing or future dedications, easements, or recorded rights-of-way on the Property in furtherance of the proper provision of utility service by Company.

10. Provision and Use of Wellsites, Booster Sites and Storage Tank Sites: Applicant agrees, at no cost to Company and in a form acceptable to Company, to establish and convey to Company the wellsite(s), booster site(s), and storage tank site(s) that Company, in its sole discretion, deems necessary for the proper provision of utility service by Company. It is understood Company shall have the right to reject any site offered or permit condition which Company and/or Company's engineers, in their sole discretion, do not feel appropriate or suitable for Company's needs and, in such circumstance, Applicant shall be obligated to establish and convey a replacement site therefore suitable to Company, at no cost to Company. Conveyance of such site(s) must be by warranty deed acceptable to Company and free and clear of all liens and encumbrances whatsoever.

11. Obligation to Commence: Applicant shall promptly commence construction of the Water-Related Facilities and shall complete construction no later than two years from the date of this Agreement. Should construction not promptly commence, or if Applicant fails to pursue completion within the such time period, or such longer period as mutually agreed to in writing, Company may cancel this Agreement upon ten (10) days written notice to Applicant. In the event the Agreement is canceled, neither party hereto shall have any further obligations to the other hereunder, except that Applicant shall be responsible and pay to Company an amount equal to the costs actually incurred by Company, including, but not limited to, engineering and legal fees and costs incurred in the preparation of this Agreement. Any advances Company has received in excess of the actual costs paid or incurred by Company shall be refunded to Applicant.

12. Company's Right to Stop Work: If Applicant materially fails to perform in accordance with this Agreement, Company, by a written order signed by a duly designated

representative of Company, may order Applicant to stop work, and Applicant shall stop construction and installation of the Water-Related Facilities, or any portion thereof designated in such order, until the cause for such order has been eliminated.

13. Contractor's License: Unless another classification is appropriate, all construction, installation and connection of Water-Related Facilities shall be done by a contractor approved by Company and having a valid contractor's license issued by the State of Arizona Registrar of Contractors encompassing the work to be performed (usually a Class A, A-12 or A-I6 license).

14. Construction Standards: The size, design, type and quality of the Water-Related Facilities shall be in accordance with good utility practices, the requirements of Company (as identified by Company in writing on or before the date of this Agreement or as attached hereto as Exhibit D or otherwise approved by Company in writing), the rules, regulations, orders and requirements of the ACC, ADEQ and any other public agency having jurisdiction thereover, including, but not limited to, traffic control, compaction, safety, pavement removal and replacement, sloping, shielding, shoring, OSHA regulations and Arizona Department of Health Services Bulletins No. 8 and No. 10. Arizona Administrative Code R14-2-406(M) requires that all line-extension agreements shall be filed and approved by the Utilities Division of the ACC. Applicant shall submit the Certificate of Approval to Construct from MCESD to Company promptly upon receipt of the Certificate of Approval to Construct. Additionally, all of said plans and specifications shall meet or exceed the standards and specifications of the Maricopa Association of Governments, and shall be approved in writing by Company before being submitted to ADEQ, or its designee, or the ACC for approval. Applicant will be solely responsible to design and construct the Water-Related Facilities with sufficient capacity to accommodate the water service requirement of the Property, including fire flow requirements imposed by a governmental entity, without adversely impacting water service to other customers of Company. Upon the request of Company, the Water-Related Facilities or any portion thereof, shall be oversized, provided Company shall be responsible for and pay the incremental increase in costs and expenses related to the oversizing.

15. Inspection and Testing: Applicant shall comply with the inspection and testing requirements of Company and any governmental agency having jurisdiction over the construction, installation and connection of the Water-Related Facilities. Any inspection or testing requirement imposed by Company shall be reasonable and shall not cause Applicant unwarranted delays in the ordinary course of construction. Unless otherwise agreed, Applicant shall notify Company or Company's designated engineer that Water-Related Facilities are ready for inspection and/or testing, prior to covering or otherwise limiting access to the facility and when inspection or testing is otherwise required. Company, or its designated engineer shall make an initial inspection of the facility within forty-eight (48) hours after being so notified, excluding weekends and holidays. Inspection or testing by Company shall in no way relieve Applicant of responsibility to obtain any required governmental approvals of the work or relieve or limit Applicant's responsibility and liability for construction and installation of Water-Related Facilities in accordance with the terms of this Agreement; provided, however, if Applicant requires or otherwise obtains a performance bond acceptable to Company, Applicant may require

Company to proceed solely against the bond to remedy defects and deficiencies in construction, materials and workmanship.

16. Acceptance of Facilities: Water-Related Facilities will not be deemed accepted by Company unless (a) accepted in writing by Company or (b) documentation of conveyance has been delivered to and accepted by Company. Company shall not unreasonably refuse to accept the Water-Related Facilities when offered by Applicant; provided, however, Company has no obligation to accept Water-Related Facilities, or any portion thereof if not in compliance with any requirement of the provisions of Exhibit D or any other provision of this Agreement, including, but not limited to, if: (i) not constructed in conformance with the Plans, (ii) determined to be unsatisfactory in any material respect upon inspection or testing, (iii) not paid for in full, (iv) liened or encumbered in any way, (v) not located on Company property, easement or right-of-way, or (vi) not supported by proper documentation. Within sixty (60) days of Applicant tendering the Water-Related Facilities for acceptance, Company shall provide written notification of any defects and items left to be completed. Applicant shall promptly correct all defects and complete all items so identified.

17. Temporary Use of Facilities: Applicant irrevocably consents to Company's use of all or any portion of the Water-Related Facilities, without cost to Company, prior to acceptance thereof in accordance with Paragraph 16. Any water service provided by Company to the Property prior to acceptance of the Water-Related Facilities as provided herein is provided on a temporary basis only, subject to termination by Company on ten (10) days written notice that temporary service will no longer be available until Applicant meets all conditions precedent to acceptance of the Water-Related Facilities.

18. Risk of Loss: All risk of loss shall be with Applicant until acceptance by Company of the Water-Related Facilities in accordance with Paragraph 16. Applicant shall repair or cause to be repaired promptly, at no cost to Company, all damage to the Water-Related Facilities caused by construction operations until all construction under this Agreement has been completed and accepted by Company.

19. Performance Bond and Labor and Material (Payment) Bond: Upon Company's request, Applicant shall provide Company with Performance and Payment Bonds for 100% of the Estimated Cost set forth on Exhibit C. Each Bond shall be executed by a Surety holding a Certificate of Authority to transact surety business in the State of Arizona issued by the Director of the Department of Insurance. The Bond shall be written or countersigned by an authorized representative of the Surety who is either a resident of the State of Arizona or whose principal office is maintained in the State of Arizona. The Bond shall have attached thereto a certified copy of the Power of Attorney for the signing official. The bonding company shall be rated "Best Rated A" or better by the A.M. Best Company and shall be otherwise acceptable to Company.

20. Title to Property: The Water-Related Facilities constructed pursuant to this Agreement shall become upon acceptance thereof by Company in accordance with Paragraph 16, and shall remain, the sole property of Company, whether or not Applicant provides any written document of transfer to Company. Upon such acceptance, Applicant shall

not have any further right, title, ownership or ownership interest in the Water-Related Facilities whatsoever, except for the right to receive refunds of the particular advance-in-aid-of-construction pursuant to the method hereinafter described. However, Applicant shall furnish any document pertaining to ownership and title as may be requested by Company including documents which evidence or confirm transfer of possession to Company of good and merchantable title to the Water-Related Facilities, easements or other real property rights or interests, free and clear of liens.

21. Warranty: Unless otherwise provided in Exhibit B, Applicant warrants to Company that all materials and equipment furnished under this Agreement will be new, and that the Water-Related Facilities will be of good quality, free from faults and defects. Applicant further guarantees the Water-Related Facilities for a period of two (2) years from the date of their acceptance by Company (the "Guarantee Period"). Should any portion of the Water-Related Facilities need replacement or repair within the Guarantee Period, Applicant shall replace such portion of the Water-Related Facilities on a lien-free basis at no cost to Company. Notwithstanding the foregoing, in the event Applicant is unable to obtain a warranty of least two (2) years from a contractor and Applicant provides sufficient written evidence to Company (as determined in Company's reasonable discretion) of Applicant's inability to obtain such a warranty after its commercially reasonable efforts to do so, the Guarantee Period shall be reduced to a period of one (1) year from the date of their acceptance by Company. If Applicant fails within a reasonable time to replace or repair any portion of the Water-Related Facilities deemed to be needed, Company may cause said Water-Related Facilities to be replaced or repaired and Applicant agrees to pay all costs incurred therein; provided, however, if Applicant has obtained a performance bond which has been accepted by Company, Applicant may require Company to first proceed against the bond to remedy defects and deficiencies in construction, materials and workmanship. Any portion of the Water-Related Facilities not conforming to this Agreement, including substitutions not properly approved and authorized, may be considered defective. If required by Company, Applicant shall furnish satisfactory evidence as to the kind and quality of materials and equipment used on the Water-Related Facilities.

22. Insurance: Applicant shall secure and maintain until acceptance of the Water-Related Facilities, the following insurance in the name of Applicant, naming Company as additional insured with respect to claims which may arise out of or result from Applicant's acts, operations or negligence or those of its subcontractors, or anyone directly or indirectly employed by any of them including officers, employees, agents or representatives for matters related to this Agreement. The coverage shall be provided on an "occurrence" basis rather than a "claims made" basis, shall be provided without offset against Company's existing insurance and provide for a minimum of thirty (30) days notice to Company prior to cancellation, reduction in coverage or other substantial modification. Applicant shall provide a Certificate of Insurance, which sets forth the following minimum amounts and types of coverage:

TYPE OF COVERAGE	AMOUNT NO LESS THAN
Workers' Compensation	Statutory Requirements
Employers Workers'	$100,000 each accident

Compensation Liability	$100,000 disease each employee $500,000 disease aggregate
Commercial General Liability (including contractual liability for this Contract;	$1,000,000 per occurrence $2,000,000 aggregate combined single limit
broad form property damage; completed operations; and explosion, collapse and underground coverage)	
Vehicle Liability (including Owned, hired and non-owned coverages)	$1,000,000 combined single limit

Applicant shall submit to Company proof of the required insurance prior to commencing construction of the Water-Related Facilities pursuant to this Agreement and/or at such other time(s) as deemed appropriate by Company. Applicant shall obtain the above-described insurance from insurance companies which are duly authorized to issue such policies in the State of Arizona, "Best Rated A" or better by the A.M. Best Company, and otherwise acceptable to Company. Applicant shall maintain such insurance coverage until all the work has been completed and the Water-Related Facilities have been accepted by Company.

Company shall not be obligated to review any of the Applicant's Certificates of Insurance, insurance policies or endorsements or to advise Applicant of any deficiencies in such documents and any receipt of copies or review by Company of such documents shall not relieve Applicant from or be deemed a waiver of Company's right to insist on strict fulfillment of Applicant's obligations under this Paragraph.

23. Protection of Persons and Property: Applicant and its employees, officers, agents, contractors, subcontractors, heirs and assigns shall adopt every practical means and comply with all laws, ordinances and regulations in order to minimize interferences to traffic, and to avoid inconveniences, discomfort, loss, damage and injury to persons and property, including the provision of adequate dust control measures during the construction, installation or connection of the Water-Related Facilities. All obstruction to traffic shall be guarded. Neither Applicant nor any subcontractor shall trespass upon private property. Applicant shall protect against injury or damage to pipes, sewer conduits, electrical conduits, lawns, gardens, shrubbery, trees, fences, or other structures or property, public and/or private, encountered in the performance of this Agreement. Applicant shall be responsible and liable for any injury or damage to persons or property, directly or indirectly, resulting from the actions or inactions of Applicant, its officers, directors, agents, employees and representatives, including contractors completing the Water-Related Facilities; excepting injury or damage arising from the acts of public enemy, inevitable accidents, fire, explosions, strikes, riots, war or any other act or thing reasonably beyond its control or incident to interruptions necessary for repairs or changes in Company's production, storage, transmission or distribution facilities.

24. Indemnification: Applicant shall indemnify and hold harmless Company, its officers, directors, members, agents and employees from and against claims or expenses, including penalties and assessments and attorney's fees to which they or any of them may be subjected by reason of injury or death of any person, or loss or damage to any property occurring prior to Company's acceptance of the Water-Related Facilities in accordance with Paragraph 16, or contributed to or caused by the active or passive negligence of Applicant, its agents, servants, employees, contractors or subcontractors in the execution of Applicant's obligations under this Agreement or in connection therewith. In case any suit or other proceeding shall be brought on account thereof, Applicant will assume the defense at Applicant's own expense and will pay all judgments rendered therein. The provisions of this Paragraph shall survive termination of this Agreement.

25. Water Service: Upon Applicant complying fully with this Agreement, including receiving Company's acceptance of the Water-Related Facilities in accordance with Paragraph 16, complying fully with any other agreements between the parties and obtaining all requisite governmental approvals to sell lots within the Property, Company agrees to offer domestic water service to the Property pursuant to the terms and conditions of the Agreement between the parties dated June 22, 2006. Water service shall be offered in accordance with Company's Articles of Incorporation, By-laws, rules and regulations, and under the tariffs and rules and regulations approved by or of the ACC, ADWR, ADEQ or any other applicable regulatory agency, as amended from time to time. This Agreement shall not preclude Company from requiring applications for water service to be executed and complied with prior to the actual delivery of water service to individual lots within the Property.

Applicant is requesting retail potable water service to the Property for domestic use only. **Company does not hereby agree to furnish water for industrial, lake, irrigation (excluding residential landscaping), golf course or any other non-domestic purpose, but may do so if so agreed by Company in a separate written agreement. COMPANY EXPRESSLY DISCLAIMS ANY RESPONSIBILITY OR OBLIGATION TO PROVIDE WATER AT A SPECIFIC PRESSURE OR GALLONS-PER-MINUTE FLOW RATE AT ANY FIRE STANDPIPE, OR FIRE HYDRANT, OR FOR FIRE PROTECTION SERVICE. IN THE EVENT FIRE PROTECTION SERVICE IS INTERRUPTED, IRREGULAR, DEFECTIVE, OR FAILS FROM CAUSES BEYOND COMPANY'S CONTROL OR THROUGH ORDINARY NEGLIGENCE OF ITS EMPLOYEES, SERVANTS OR AGENTS, COMPANY WILL NOT BE LIABLE FOR ANY INJURIES OR DAMAGES ARISING THEREFROM, AND APPLICANT, ITS SUCCESSORS AND ASSIGNS, INCLUDING FUTURE OWNERS OF THE PROPERTY, OR ANY PORTION THEREOF, SHALL DEFEND, INDEMNIFY AND HOLD COMPANY HARMLESS AGAINST ANY AND ALL LIABILITY, LOSS, DAMAGE OR EXPENSE OF COMPANY ARISING THEREFROM.**

Company shall have no obligation whatsoever to provide service to the Property or any portion thereof unless and until: Applicant has paid the full cost of the Water-Related Facilities as required hereunder; Applicant has secured all governmental approvals required hereunder or as a condition to the sale and/or occupancy of the subdivided lots; construction of

the Water-Related Facilities has been completed and accepted by Company; and Applicant has paid all fees, charges, and deposits authorized to be charged by the ACC including, but not limited to, meter and service lines which are not a part of the Water-Related Facilities covered by this Agreement.

26. Conservation Requirement: To the extent Applicant contracts for or constructs residences or other water consuming facilities on the Property, Applicant shall make its best efforts to ensure that construction of said residences and facilities incorporates the latest technologies in water conservation consistent with the economic investment therein and limits water using features. Applicant shall take all steps necessary, including restricting outside lawns and vegetation through recorded covenants, conditions and restrictions, to limit total water usage on the Property, and on individual lots and facilities within the Property (a) to levels at or below the gallons per capita per day standard recognized by ADWR for Company and (b) in accordance with any other water use standard applicable to Company and set by law, regulation, order or tariff.

27. Non-Agents: It is agreed that Company is not an agent for Applicant and shall not incur any costs or expenses on behalf of Applicant and that Applicant is not an agent of Company and shall not incur any costs or expenses on behalf of Company.

28. Communication: Communications hereunder shall be sent to Applicant addressed as follows:

Rick Ulmer
c/o Gresham Transfer
P.O. Box 699
Fairview, OR 97024
Fax: (503) 695-5755

With a copy to:

David Gulino
4413 N. Saddlebag Trail, Suite 5
Scottsdale, AZ 85251
Fax: (480) 946-5041

or to such other addresses or addressees as Applicant may advise Company in writing, and to Company at:

Cave Creek Water Co.
c/o Cindy Liles
21410 N. 19th Ave., Suite 201
Phoenix, AZ 85027
Facsimile: (623) 580-9659

with a copy to:

Salmon, Lewis & Weldon, P.L.C.
c/o Kristin D. Magin, Esq.
2850 E. Camelback Rd., Ste. 200
Phoenix, Arizona 85016
Facsimile: (602) 801-9070

or to such other addresses or addressees as Company may advise Applicant in writing. All notices shall be in writing and shall be delivered by hand-delivery, or by deposit with an overnight express delivery service, or by deposit with the U.S. Postal Service, certified mail, return receipt requested, or by facsimile delivery, and shall be deemed given and received upon receipt, if hand-delivered, or one business day after deposit with an overnight express delivery service, or three business days after mailing, if mailed by certified mail, returned receipt requested, or the same day if delivery by facsimile or one business day after delivery by facsimile after 5 pm MST.

29. Assignability: This Agreement shall be binding upon and inure to the benefit of the parties hereto and their respective legal representatives, successors and assigns and either party may record the Agreement with the County Recorder's office in the county where the Property is located. However, Applicant shall not assign its rights, obligations and interest in this Agreement without the prior written consent of Company and any attempted assignment without such consent shall be void and of no effect. It shall not be unreasonable for Company to withhold its consent if the proposed assignee does not own the Property.

30. Covenant Running With the Land: The parties intend the duties and obligations imposed on Applicant by Paragraphs 9 and 26 of this Agreement to be a covenant running with the Property and they shall run with the Property and be the obligation of and be binding upon all holders of any legal or equitable interest in the Property.

31. Rights and Remedies: The duties and obligations imposed by this Agreement and the rights and remedies available hereunder shall be in addition to and not a limitation of any duties, obligations, rights and remedies otherwise imposed or available at law or equity. No action or failure to act by Company or Applicant shall constitute a waiver of any right or duty afforded any of them under the Agreement, nor shall any action or failure to act constitute an approval of or acquiescence in any breach, except as may be specifically agreed in writing.

32. Litigation: Should litigation be necessary to enforce any term or provision of this Agreement, or to collect any damage claimed or portion of the amount payable under this Agreement, then all litigation and collection expenses, witness fees, court costs, and attorneys' fees shall be paid to the prevailing party. Nothing herein shall preclude non-binding arbitration if the parties so elect in the event of a dispute hereunder.

33. Entire Agreement/Time of the Essence/Waiver: This Agreement together with the water service agreement sets forth the full and entire agreement of the parties and supersedes any and all prior or contemporaneous agreements, understandings, representations and statements, oral or written, with respect to the subject matter hereof, including any draft

attached to the water service agreement. This Agreement may only be altered, amended or supplemented in writing. This Agreement shall be governed by the laws of the State of Arizona. Time is of the essence in performing all obligations hereunder. Waiver of a breach of any term, condition or covenant of this Agreement by any party shall be limited to the particular instance and shall not be deemed to waive future breaches of the other party of the same or other terms, conditions or covenants.

34. Counterparts: This Agreement may be executed in any number of counterparts, and all such counterparts shall be deemed to constitute one and the same instrument, and each of said counterparts shall be deemed an original hereof.

35. Effective Date: This Agreement shall have no force or effect whatsoever and shall not be binding upon Company or Applicant until such time as it is executed by all parties and actually approved by the ACC and/or the Utilities Division thereof.

36. Authority to Execute: Applicant represents and warrants that the statements in recitals B and D are accurate and complete, and each party warrants and represents that it has lawful authority to execute this Agreement and to perform all acts required hereunder and that the person signing on behalf of such party has the full right, power and authority to enter into this Agreement on behalf of such party, and to carry out such party's obligations hereunder.

[Signature page follows]

IN WITNESS WHEREOF, the parties hereto have executed this Agreement as of the date and year first written above.

CAVE CREEK WATER CO.,
an Arizona corporation

By: _____
Name: Cindy M. Liles
Its: SVP & CFO

RICKY D. ULMER, as Family Co-Trustee of the Derald D. Ulmer 2002 Trust

By: _____
Name: Ricky D. Ulmer, Family Co-Trustee

CYNTHIA L. ULMER-LUX, as Family Co-Trustee of the Derald D. Ulmer 2002 Trust

By: _____
Name: Cynthia L. Ulmer-Lux, Family Co-Trustee

DAVID D. ULMER, as Family Co-Trustee of the Derald D. Ulmer 2002 Trust

By: _____
Name: David D. Ulmer, Family Co-Trustee

TAMERA L. TOMLIN, as Family Co-Trustee of the Derald D. Ulmer 2002 Trust

By: _____
Name: Tamera L. Tomlin, Family Co-Trustee

MICHAEL D. CREW, as Family Co-Trustee of the Derald D. Ulmer 2002 Trust

By: _____
Name: Michael D. Crew, Family Co-Trustee

ACKNOWLEDGMENTS

STATE OF ARIZONA)
) ss.
COUNTY OF Maricopa)

On this 26 day of October, 2006, before me, the undersigned, a Notary Public, personally appeared Cindy Miles who acknowledged ~~himself~~/herself to be the CFO & SVP of the Cave Creek Water Co., an Arizona corporation, and that ~~he~~/she as such, being authorized so to do, executed the foregoing instrument for the purposes therein contained.

IN WITNESS WHEREOF, I have hereunto set my hand and official seal.

Notary Public

My Commission Expires:

4/18/2009

Jeanne L Critchfield
Notary Public - Arizona
Maricopa County
My Commission Expires
April 18, 2009

STATE OF Oregon)
) ss.
COUNTY OF Clackamas)

On this 18th day of October, 2006, before me, the undersigned, a Notary Public, personally appeared Michael D Crew who acknowledged himself to be the Family Co-Trustee, of the Derald D. Ulmer 2002 Trust, and that he as such, being authorized so to do, executed the foregoing instrument for the purposes therein contained.

IN WITNESS WHEREOF, I have hereunto set my hand and official seal.

Notary Public

My Commission Expires:

02-16-2010

OFFICIAL SEAL
MEGAN E LENTS
NOTARY PUBLIC-OREGON
COMMISSION NO. 402599
MY COMMISSION EXPIRES FEBRUARY 16, 2010

STATE OF Oregon)
) ss.
COUNTY OF Clackamas)

On this 18th day of October, 2006, before me, the undersigned, a Notary Public, personally appeared Rick Ulmer who acknowledged himself to be the Family Co-Trustee, of the Derald D. Ulmer 2002 Trust, and that he as such, being authorized so to do, executed the foregoing instrument for the purposes therein contained.

IN WITNESS WHEREOF, I have hereunto set my hand and official seal.

Megan E. Lents
Notary Public

My Commission Expires:

02-16-2010

OFFICIAL SEAL
MEGAN E LENTS
NOTARY PUBLIC-OREGON
COMMISSION NO. 402599
MY COMMISSION EXPIRES FEBRUARY 16, 2010

STATE OF OREGON)
) ss.
COUNTY OF MULTNOMAH)

On this 18 day of OCTOBER, 2006, before me, the undersigned, a Notary Public, personally appeared DAVID D. ULMER who acknowledged himself to be the Family Co-Trustee, of the Derald D. Ulmer 2002 Trust, and that he as such, being authorized so to do, executed the foregoing instrument for the purposes therein contained.

IN WITNESS WHEREOF, I have hereunto set my hand and official seal.

James W. Hendricks
Notary Public

My Commission Expires:

11-5-08

OFFICIAL SEAL
JAMES W. HENDRICKS
NOTARY PUBLIC-OREGON
COMMISSION NO. 386368
MY COMMISSION EXPIRES NOVEMBER 5, 2008

STATE OF OREGON)
) ss.
COUNTY OF MULTNOMAH)

On this 18 day of OCTOBER, 2006, before me, the undersigned, a Notary Public, personally appeared CYNTHIA L. Ulmer-Lux who acknowledged himself to be the Family Co-Trustee, of the Derald D. Ulmer 2002 Trust, and that he as such, being authorized so to do, executed the foregoing instrument for the purposes therein contained.

IN WITNESS WHEREOF, I have hereunto set my hand and official seal.

Notary Public

My Commission Expires:

11-5-08

OFFICIAL SEAL
JAMES W. HENDRICKS
NOTARY PUBLIC-OREGON
COMMISSION NO. 386368
MY COMMISSION EXPIRES NOVEMBER 5, 2008

STATE OF OREGON)
) ss.
COUNTY OF MULTNOMAH)

On this 18 day of OCTOBER, 2006, before me, the undersigned, a Notary Public, personally appeared TAMERA L. TOMLIN who acknowledged himself to be the Family Co-Trustee, of the Derald D. Ulmer 2002 Trust, and that he as such, being authorized so to do, executed the foregoing instrument for the purposes therein contained.

IN WITNESS WHEREOF, I have hereunto set my hand and official seal.

Notary Public

My Commission Expires:

11-5-08

OFFICIAL SEAL
JAMES W. HENDRICKS
NOTARY PUBLIC-OREGON
COMMISSION NO. 386368
MY COMMISSION EXPIRES NOVEMBER 5, 2008

EXHIBIT A
(THE PROPERTY)

LEGAL DESCRIPTION

THAT PART OF THE LITTLE HOPE MINING CLAIM IN THE NORTHWEST QUARTER OF THE NORTHEAST QUARTER AND IN THE SOUTHWEST QUARTER OF THE NORTHEAST QUARTER OF SECTION 4, TOWNSHIP 5 NORTH, RANGE 4 EAST OF THE GILA AND SALT RIVER BASE AND MERIDIAN, MARICOPA COUNTY, ARIZONA, MORE PARTICULARLY DESCRIBED AS FOLLOWS:

COMMENCING AT THE NORTHWEST CORNER OF THE NORTHEAST QUARTER OF THE NORTHEAST QUARTER OF SAID SECTION 4;

THENCE SOUTH 00 DEGREES 07 MINUTES 22 SECONDS EAST (RECORD SOUTH 00 DEGREES 07 MINUTES 48 SECONDS EAST) A DISTANCE OF 494.41 FEET (RECORD 494.48 FEET) TO THE TRUE POINT OF BEGINNING;

THENCE SOUTH 00 DEGREES 07 MINUTES 22 SECONDS EAST (RECORD SOUTH 00 DEGREES 07 MINUTES 48 SECONDS EAST) A DISTANCE OF 1454.39 FEET (RECORD 1454.42 FEET);

THENCE SOUTH 77 DEGREES 30 MINUTES 39 SECONDS WEST (RECORD SOUTH 77 DEGREES 30 MINUTES 35 SECONDS WEST) A DISTANCE OF 26.03 FEET;

THENCE NORTH 20 DEGREES 40 MINUTES 50 SECONDS WEST A DISTANCE OF 1435.12 FEET (RECORD 1435.15 FEET);

THENCE NORTH 77 DEGREES 29 MINUTES 46 SECONDS EAST (RECORD NORTH 77 DEGREES 32 MINUTES EAST) A DISTANCE OF 541.99 FEET TO THE TRUE POINT OF BEGINNING.

EXHIBIT A

EXHIBIT B
(THE PLANS)

EXHIBIT C
ESTIMATED COST

Land Development Services, L.L.C.
4413 North Saddlebag Trail, Suite 5
Scottsdale, Arizona 85251
(480) 946-5020 FAX (480) 946-5041

Black Mountain Vistas

Cost Estimate

Description	Qty	Units	Materials	Labor	Total Materials	Total Labor	Total
8" DIP Waterline	1000	L.F.	$ 25.00	$ 13.00	$ 25,000.00	$ 13,000.00	$ 38,000.00
Fire Hydrants	1	EA.	$ 1,200.00	$ 600.00	$ 1,200.00	$ 600.00	$ 1,800.00
8" Valves	1	EA.	$ 600.00	$ 350.00	$ 600.00	$ 350.00	$ 950.00
Air/Vac Valve	1	EA.	$ 1,000.00	$ 500.00	$ 1,000.00	$ 500.00	$ 1,500.00
Residential Services	5	EA.	$ 400.00	$ 200.00	$ 2,000.00	$ 1,000.00	$ 3,000.00
Curb Stop	2	EA.	$ 475.00	$ 175.00	$ 950.00	$ 350.00	$ 1,300.00
Construction Staking (3%)	1	LS.				$ 1,396.50	$ 1,396.50
Permit Fees (2%)	1	LS.				$ 931.00	$ 931.00
Engineering Fees (8%)	1	LS.				$ 3,724.00	$ 3,724.00
Soils Testing (2%)	1	LS.				$ 931.00	$ 931.00
Total					$ 30,750.00	$ 22,782.50	$ 53,532.50

EXHIBIT D
(COMPANY REQUIREMENTS)

GLOBAL WATER RESOURCES, L.L.C.

STANDARDS FOR THE PLANNING,

DESIGN AND CONSTRUCTION OF

WATER AND WASTEWATER SYSTEMS

March 2005
Rev July 2005

Global Water Resources, L.L.C.
22601 North 19th Avenue, Suite 210
Phoenix, Arizona 85027
Phone: 623.580.9600
Fax: 623.580.9659

DISCLAIMER

1.) The information contained herein is subject to revision and/or modification by GLOBAL WATER RESOURCES, L.L.C. as necessary to insure compliance with all applicable rules and regulations.

2.) The information contained herein is intended as a guide for the landowner, developer, builder, contractor, and engineer. Special circumstances may arise on a project where the information, design guidelines, and criteria may be altered.

3.) Questions, clarifications, and/or comments on the information contained herein are welcome. Please contact GLOBAL WATER RESOURCES, L.L.C.

4.) It is the responsibility of landowner, developer, builder, contractor, and engineer to insure that they have the latest revision of this Manual prior to commencing design.

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GLOBAL WATER RESOURCES, L.L.C.
WATER SYSTEM STANDARDS

I. GENERAL REQUIREMENTS

A. Introduction

This document has been developed as a guideline to provide minimum criteria for the planning, design, and construction of water systems. It is the responsibility of the developer/engineer to comply with the requirements of the Arizona Department of Environmental Quality (ADEQ) in Title 18 of the Arizona Administrative Code (AAC), the Arizona Department of Water Resources (ADWR), and the standards issued by an authority having jurisdiction. In the event of a conflict between the Global Water Resources (GWR) design guidelines discussed herein and any applicable federal, state, county, or local authority, the more stringent requirement shall take precedence.

Technical specifications and standard details shall conform to the current Uniform Standard Specifications for Public Works Construction sponsored and distributed by the Maricopa Association of Governments (MAG), any GWR supplements thereto, and as modified herein.

B. Codes of Practice

All development must be in compliance with current GWR Codes of Practice (COP), which are provided in Appendix A.

C. Submittal Requirements

All improvement projects which involve the GWR water system shall be submitted for GWR review and approval prior to construction. Submittals shall be made in accordance with the policies and procedures established by the local governing authority in which the system is to be constructed. Refer to Appendix D for additional information regarding the process for request and approval of service.

1. Master Plans

A Water Master Plan is required for all proposed developments. Development master plans shall be prepared in accordance with GWR design guidelines and must conform to the GWR Water Master Plan for the region. A minimum of 3 copies shall be submitted to GWR prior to final plan submittal. Hydraulic model output files along with AutoCAD files shall be submitted on a CDR disk with the master plan.

At a minimum, master plans shall include the following:

- A brief description of the project location, site conditions, topographic conditions (on an approved vertical datum), and existing and proposed land use.
- A vicinity map and proposed land use plan which identifies proposed parcel boundaries, street locations, and lotting (if available).
- A description of the water system design criteria utilized.
- A figure which identifies the proposed and existing water system infrastructure, water service area, contour data, and pressure zone boundaries (if applicable).
- Anticipated water demands created by the development, domestic and fire supply.
- A description of the existing and proposed water system.
- A description, location within the project, and timeline of project phasing.
- Verification that adequate pressures and flows are available under anticipated peak demand conditions through the use of a hydraulic model (preferably WaterCAD).
- A figure which labels all junctions and pipes utilized in the hydraulic model. Proposed pipe diameters shall be labeled as well.
- Model output tables for average day, maximum day, peak hour, and maximum day plus fire flow conditions including discharge, velocity, head loss gradient per foot, and residual pressure for both residential and commercial use, if any. Refer to Paragraph A of Section III for requirements.

All master plans shall be signed and sealed by a professional civil engineer registered in the State of Arizona.

2. Construction Drawings

All water mains shall be located to the north or east side of the street. Contact GWR for resolution of any conflicts.

Water main plans shall be at a minimum scale of 1" = 40' and shall include the following information:

- Water main stationing.
- Signature approval block for the appropriate water utility provider on the cover sheet.
- Benchmark and datum information.
- Profiles for water mains 12 inches and larger.
- GWR standard water notes (located in Appendix B).

- Existing and proposed ground elevations at the centerline of the water main.
- Sizing and locations of water service lines and water meters.
- Identification of pipe crossings and proposed separations with ADEQ approved details.
- Identification of existing and proposed utility locations.
- Identification and dimensions of easements and right-of-ways.

All plan documents shall be signed and sealed by a professional civil engineer registered in the State of Arizona.

3. Design Reports

A design report may be required at the discretion of GWR depending on the scale of the project. A report shall be required for all booster pump station projects. Reports shall be signed and sealed by a professional civil engineer registered in the State of Arizona.

D. Meeting Requirements

Mandatory meetings shall include the following:

- A pre-design meeting between the developer, engineer, GWR, and the local governing authority.
- An onsite pre-construction meeting between the contractor, the GWR inspector, and the local governing authority.

The contractor must present all applicable permits prior to or during the pre-construction meeting including, but not limited to, all ADEQ permits and any permits required by the local governing authority.

It shall be responsibility of the developer, engineer, and/or contractor to schedule the pre-design and pre-construction meetings.

Refer to Appendix D for additional information related to meeting requirements.

E. Final Acceptance

Final acceptance of water mains shall be in accordance with GWR Code of Practice GWR-CP-01-008 Acceptance of Underground Facilities, provided in Appendix A.

No new utilities will be accepted by GWR until the following occurs:

- All installed facilities have been inspected, tested, and approved.
- A copy of all test reports, including trench compaction tests, and inspections has been provided to GWR.

- All punchlist items required by the GWR inspector have been addressed.
- Record drawings (as-builts) have been supplied to GWR by the Engineer-of-Record including AutoCAD files.
- A signed ADEQ "Certificate of Approval of Construction" has been provided to GWR.
- Developer has furnished copies of the contract, copies of all checks paid to the Contractor, and UNCONDITIONAL LIEN WAIVERS from the Contractor.
- Any other outstanding issues.

Record drawings (as-builts) to be provided to GWR shall consist of three 11" x 17" hard copy sets of as-built drawings and one electronic set on CDR disk in AutoCAD format with a minimum of two points referenced to the GWR GIS system.

II. WATER SYSTEM INFRASTRUCTURE

A. Wells

GWR will assess existing wells in the development area for inclusion in the utility's potable/raw water inventory.

Well production shall be designed to meet the maximum day water demand with one well out of service. Well sites shall be equipped with a backup power supply sized for a 12 hour run time.

Prior to drilling and installing a well, a "Notice of Intent to Drill" and "Application for a Drilling Permit" must be completed with the ADWR.

Developers shall be responsible for properly abandoning wells in accordance with ADWR requirements. All wells must be abandoned by ADWR licensed well drillers.

B. Booster Pump Station and Storage Facilities

Storage facilities shall be sized to exceed both of the following criteria:

- 30% of the maximum day demand plus a fire flow reserve.
- Average daily demand during the peak month minus firm well production capacity in accordance with AAC R18-5-503.

The minimum fire flow reserve shall be equal to 120,000 gallons (1,000 gpm for 2 hours). The storage requirement shall be increased as required to conform to the fire flow requirements of the local fire authority.

Steel water storage tanks shall meet the requirements of the American Water Works Association D100. Tanks may be equipped with a cathodic protection system at the discretion of GWR. Non-corrosive bedding material shall be required for all tanks. Interior and exterior coating systems and color schemes are subject to approval by GWR.

Booster pumps shall be designed to maintain pressures within the minimum and maximum requirements for both domestic use and fire protection. Specifically, booster stations shall be designed to exceed both of the following criteria with the largest pump out of service (firm capacity):

- Maximum day demand plus fire flow.
- Peak hour demand.

At a minimum, pump stations and storage facilities shall be equipped with the following:

- Variable frequency drives (VFD) with an air conditioned enclosure.
- Backup power supply with a fuel reserve adequate for a 12 hour runtime.
- Disinfection facilities.
- Hydropneumatic tank with a pad mounted air compressor and automatic level control.
- Flow metering with a valved bypass assembly.
- Telemetry and control system integrated to GWR SCADA systems.
- Six foot high perimeter masonry wall with a 12 foot access gate.
- Isolation and silent type check valves for each pump assembly.
- Instrumentation (pressure gauges, flow switches, etc) satisfactory to GWR.

The pump station shall be equipped appropriately to protect the water system from surges and/or water hammer. In addition to hydropneumatic tanks and VFD's, acceptable methods of protection include flow control valves on pump discharges, soft-start motor controllers, and surge anticipator valves.

Acceptable pump types include split case centrifugal and vertical turbine. Pumps speeds shall not be greater than 1800 rpm.

Additional design criteria is provided in ADEQ Engineering Bulletin No. 10, "Guidelines for Construction of Water Systems" and Engineering Bulletin No. 8, "Disinfection of Water Systems".

C. Water Distribution and Transmission Mains

Water mains operate on a grid system and shall be sized as follows:

- 16 inch water mains are required on one mile alignments (typically on section lines). No water services shall be allowed on 16 inch water mains.
- 12 inch water mains are required on half-mile alignments.
- All internal water mains shall be looped 8 inch lines (with the exception of 6 inch fire hydrant connections).
- Fire hydrants shall be located at the end of all permanent dead end water lines. Caps with blowoffs as a substitute for fire hydrants are not acceptable.

Acceptable pipe materials for water main pipe include polyvinyl chloride (PVC) and ductile iron pipe (DIP). Proposals for alternate pipe materials may be considered by GWR and shall be submitted in writing by the Engineer. The minimum pressure class of PVC pipe shall be AWWA C-900 DR 14 Class 200 (12 inches in diameter and less) or AWWA C-905 DR 25 Class 165 (larger than 12 inches in diameter). In no case shall the pressure class of any water main be less than the following:

Pipe Diameter	Pressure Class
12 inches and smaller	200 psi
14 inches and larger	150 psi

A higher design internal working pressure may be required to account for the occurrence of water hammer.

Joints shall be restrained when necessary in accordance with MAG Standards. At a minimum, restrained joints shall be provided at all bends, tees, reducers, line valves, and dead ends. Concrete thrust blocks as a substitute to restrained joints are not acceptable unless otherwise approved by GWR.

In general, water mains shall be located on the north and east sides of the right-of-way a minimum of 1.5 feet behind the sidewalk. All water mains less than 12 inches in diameter shall have a minimum cover of 3 feet over the top of pipe from finished grade. All water mains 12 inches and larger shall have a minimum cover of 4 feet over the top of pipe from finished grade.

All water lines shall be marked with 3 inch wide detector locating wire and locator tape (blue in color). The tape shall be located within the water main trench approximately 1 foot above the pipe.

Deflection of all water mains shall be within manufacturer's recommendations or an appropriate fitting shall be installed.

In the event that minimum horizontal and/or vertical separation requirements cannot be met between water and sewer, the water main shall be constructed of DIP and both the water and sewer shall be concrete encased in accordance with MAG specifications.

D. Valving

The maximum spacing of water distribution system isolation valves shall be 800 feet. Isolation valves located on transmission mains with no services shall be located no more than 1,500 feet apart. Isolation valving shall also be provided for hydrant branches, wash crossings, railroad crossings, and major highway crossings.

At water main intersections, the minimum number of valves required shall be one less than the total number of water lines. At the discretion of GWR, the total number of valves required may be equal to the total number of water lines.

All valves shall conform to MAG specifications. All 12 inch and smaller isolation valves shall be resilient wedge gate valves. Isolation valves 16 inches and larger shall be either gate valves or butterfly valves.

Valves shall not be located in sidewalks, curbs, or driveways. Contractor shall furnish one valve key of suitable length for all valves prior to final acceptance. Valves greater than 5 feet in depth shall be provided with extensions.

Air release and vacuum/air relief valves shall be provided at all water system high points in accordance with MAG Section 630.6 and shall be constructed in accordance with City of Scottsdale Standard Detail No. 2348.

Pressure reducing valves (PRV) may be required to maintain pressure within acceptable ranges within the distribution system. Sizing of the PRV shall be based on manufacturer's recommendations and anticipated design flow.

E. Fire Hydrants

All fire hydrants shall conform to GWR Detail No. 1 as provided in Appendix C. Refer to the fire hydrant detail for the elevation of the hydrant flange. All hydrants shall be CLOW MEDALLION with a 4 foot bury depth, 5-1/4 inch main valve opening, one 4 inch pumper connection, and two 2-1/2 inch hose connections. No substitutions are allowed.

All hydrant connections shall be constructed of DIP. Hydrants in residential areas shall be installed with the 4 inch pumper nozzle facing the sidewalk or curb.

The spacing of fire hydrants shall not be more than 800 feet unless a shorter distance is required by the local fire authority.

Fire hydrants shall be placed at the end of all dead end lines (with no plans for future extensions) for flushing purposes. Capped dead end lines which will be extended in the future may be tapped with a flushing device per MAG standards in lieu of a fire hydrant.

F. Service Lines

Water service lines shall be Type K soft copper tubing with no splices in the service lines between the main and the meter. Minimum cover for water service lines shall be 30 inches. Branch service tees are not allowed.

Service saddles for PVC water main shall be wide-strap full circle bronze as manufactured by Mueller Model H-13000 or an equal approved by GWR. For a single service, the saddle shall be ¾ inch with a ¾ inch corporation stop. For double services, the saddle shall be 1 inch with a 1 inch corporation stop. Adjacent service saddles shall be a minimum of 6 pipe diameters apart on the main line.

The water meter box specification shall be obtained from GWR. The meter box shall be positioned such that the meter is in the center of the box opening. The top of the meter box shall be level with the top of the box 2 inches above finished grade or 1 inch above the elevation of the adjacent sidewalk. The water meter box shall be installed such that the long axis of the box is perpendicular to the street and the water meter box shall open to the street side to facilitate reading the meter.

Each separate building shall have its own service connection and meter. Backflow prevention assemblies shall be provided for all cross connections in conformance with AAC R18-4-115.

Within Pinal County only, meters shall be sized based on the total fixture count in accordance with the International Plumbing Code (IPC), 2000. For areas outside of Pinal County, contact GWR for requirements. Two methods for sizing meters are provided in the IPC Section 604 and Appendix E. Meter sizing is the responsibility of the builder's engineer.

The following table summarizes the capacity of typical meter sizes:

Water Meter Size	Continuous Flow Capacity	Maximum Flow Capacity
5/8 inch x ¾ inch	15 gpm	20 gpm
¾ inch x ¾ inch	15 gpm	30 gpm
1 inch	25 gpm	50 gpm

A ¾ inch x ¾ inch meter is typically the maximum size recommended for residential use. It shall be the responsibility of the builders engineer to notify GWR when a larger meter is required (i.e. for sprinkled homes). All water meters shall be manufactured by AMCO and shall only be acquired through GWR.

Water service connections shall not be made into water mains 14 inches and larger or into lines designated as transmission mains by GWR.

Any residential or commercial property where the static pressure exceeds 80 psi shall require individual PRV's on the service line. The PRV shall be located on the customer side of the meter and shall not be the responsibility of GWR. The PRV shall require a separate meter box and cover supplied by the builder.

G. Easements

All water mains shall be located within street right-of-way or within a dedicated Public Utility Easement (PUE). All PUE's shall be shown on the final plat.

Dedicated easements shall be a minimum width of 16 feet for water mains less than 12 inches in diameter and shall be a minimum of 20 feet for water mains 12 inches in

diameter and larger. The easement requirements are based on water mains with less than 8 feet of cover. Water mains with greater than 8 feet in cover shall be evaluated on an individual basis by GWR. If parallel water and sewer mains are to be located within the same easement, the easement width shall be based on sewer depth as follows:

Parallel Sewer Depth	Easement Width
Less than 15 feet	25 feet
Greater than 15 feet	35 feet

In no case shall a water main shall be located within 5 feet of a property or easement line or within 10 feet of a building foundation or masonry block wall footing.

Easements shall be free of obstructions and easily accessible to GRW. No permanent structures shall be located within the easement. Trees shall not be planted within 10 feet of any water main. Valves, valve boxes, blowoffs, etc. shall not be located within storm water retention basins.

H. Testing and Disinfection Requirements

Water lines shall be pressure and leakage tested in accordance with MAG Section 610.14. Water lines shall be disinfected per ADEQ Engineering Bulletin No. 8 or AWWA C651-86. Copies of all test result shall be given to the GWR inspector.

III. WATER SYSTEM DESIGN CRITERIA

A. Water Demands

New domestic water systems shall be designed based on the following criteria:

- Demands for residential development shall be equal to:
  - Average day demand = 250 gpd per dwelling unit
  - Maximum day demand = 495 gpd per dwelling unit.
  - Peak hour demand = 841 gpd (0.584 gpm) per dwelling unit.
- The average day demand for commercial facilities shall be based on 0.125 gallons per square foot of building area. For master planning purposes, it shall be assumed that the building area occupies 50% of the total commercial land area to account for open space and parking. Accordingly, the average day demand shall be equal to 2,800 gpd per acre of commercial property. Contact GWR for high water use operations such as restaurants, car washes, etc.
- The average day demand for a school facility shall be based upon 50 gallons per day per student.
- Parks and open space tracts shall be assumed to create an average day water demand equal to 1,800 gpd per acre.

The maximum day flow shall be equal to 1.8 times the average day flow with a 10% allowance. Consequently, the maximum day flow shall be equal to 1.98 times the average day flow. The peak hour flow shall be equal to 1.7 times the maximum day flow.

For preliminary design only, a density of 3.5 dwelling units per acre shall be utilized for single family residential properties without a land use plan. Final design shall be based on the actual density.

B. Pressure Requirements

Working pressures within the distribution system shall be between 40 and 80 psi. System pressure shall not drop below 40 psi at any point within the distribution system during peak hour demand. The minimum allowable pressure under maximum day demand plus fire flow conditions is 20 psi.

C. Fire Flow Requirements

Fire flow requirements shall be in accordance with the local fire department authority. At a minimum, the water system shall be designed to deliver a fire flow of 1,000 gpm for 2 hours without reducing the system to below 20 psi residual pressure.

D. Network Analysis

The network analysis for the distribution system shall be analyzed utilizing a hydraulic model such as WaterCAD. A model shall be constructed to demonstrate that the proposed system meets the design guidelines established by GWR. Flow conditions shall be analyzed for average day, maximum day, peak hour, and maximum day plus fire flow.

Input parameters to the model shall include a Hazen-Williams coefficient (C) equal to 130.

The model output shall demonstrate that the water system meets the following criteria:

- Under the maximum day scenario, the velocity shall not exceed 5 fps and the head loss gradient shall not exceed 6 feet per 1,000 feet of pipe.
- Under the peak hour scenario, the velocity shall not exceed 6 fps and the head loss gradient shall not exceed 8 feet per 1,000 feet of pipe.
- Under the maximum day plus fire flow scenario, the velocity shall not exceed 8 fps.
- All dead-end cul-de-sacs shall be served with a minimum 8 inch diameter line.

GLOBAL WATER RESOURCES, L.L.C.
WASTEWATER SYSTEM STANDARDS

I. GENERAL REQUIREMENTS

A. Introduction

This document has been developed as a guideline to provide minimum criteria for the planning, design, and construction of wastewater collection and pumping systems. It is the responsibility of the developer/engineer to comply with the requirements of the Arizona Department of Environmental Quality (ADEQ) in Title 18 of the Arizona Administrative Code (AAC), and the standards issued by an authority having jurisdiction. In the event of a conflict between the Global Water Resources (GWR) design guidelines discussed herein and any applicable federal, state, county, or local authority, the more stringent requirement shall take precedence.

Technical specifications and standard details shall conform to the current Uniform Standard Specifications for Public Works Construction sponsored and distributed by the Maricopa Association of Governments (MAG), any GWR supplements thereto, and as modified herein.

B. Codes of Practice

All development must be in compliance with current GWR Codes of Practice, which are provided in Appendix A.

C. Submittal Requirements

All improvement projects which involve the GWR sanitary sewer collection system must be submitted for GWR review and approval prior to construction. Submittals shall be made in accordance with the policies and procedures established by the local governing authority in which the system is to be constructed. Refer to Appendix D for additional information regarding the process for request and approval of service.

1. Master Plans

A Wastewater Master Plan is required for all proposed developments. Development master plans shall be prepared in accordance with GWR design guidelines and must conform to GWR Master Wastewater Plan for the region. A minimum of 3 copies shall be submitted to GWR prior to final plan submittal. AutoCAD files shall be submitted on a CDR disk with the master plan.

At a minimum, master plans shall include the following:

- A brief description of the project location, site conditions, topographic conditions (on an approved vertical datum), and existing and proposed land use.
- A vicinity map and proposed land use plan.
- A description of the wastewater system design criteria utilized.
- A map which identifies the proposed wastewater infrastructure and the wastewater service area with contour data, both existing and proposed.
- Anticipated wastewater flows generated within the development.
- A description of the existing and proposed wastewater system.
- A description and timeline of project phasing.
- A spreadsheet which summarizes the upstream and downstream nodes, service acreage, number of dwelling units served, average and peak flows, lengths, slopes, inverts, diameters, ground elevations, pipe capacity, percentage of pipe capacity utilized, and peak daily flow velocity for each sewer segment.

All master plans shall be signed and sealed by a professional civil engineer registered in the State of Arizona.

2. Construction Drawings

Gravity sewer plans shall be at a minimum scale of 1" = 40' and shall include the following information:

- Sewer stationing.
- Signature approval block for the appropriate wastewater utility provider.
- Benchmark and datum information.
- Plan and profile views for water mains 6 inches and larger.
- GWR standard sewer notes (located in Appendix B).
- Existing and proposed ground elevations at the centerline of the sewer.
- Locations of sewer service lines.
- Slope, length, and invert elevation of stubs for future extensions.
- Identification of pipe crossings and proposed separations.
- Identification of existing utility locations.
- Identification and dimensions of easements and right-of-ways.

All plan documents shall be signed and sealed by a professional civil engineer registered in the State of Arizona.

3. Design Reports

A design report may be required at the discretion of GWR depending on the scale of the project. A report shall be required for all proposed lift station projects.

Reports shall be signed and sealed by a professional civil engineer registered in the State of Arizona.

D. Meeting Requirements

Mandatory meetings shall include the following:

- A pre-design meeting between the developer, engineer, GWR, and the local governing authority.
- An onsite pre-construction meeting between the contractor, the GWR inspector, and the local governing authority.

The contractor must present to GWR all applicable permits prior to or during the pre-construction meeting including, but not limited to, all ADEQ permits and any permits required by the local governing authority.

It shall be responsibility of the developer, engineer, and/or contractor to schedule the pre-design and pre-construction meetings.

Refer to Appendix D for additional information related to meeting requirements.

E. Final Acceptance

Final acceptance of gravity sewers, force mains, and manholes shall be in accordance with GWR Code of Practice GWR-CP-01-008 Acceptance of Underground Facilities.

No new utilities will be accepted by GWR until the following occurs:

- All installed facilities have been inspected, tested, and approved.
- A video survey has been completed after paving operations and shall include video of all sewer infrastructure.
- A copy of all test reports, including trench compaction tests, and inspections has been provided to GWR.
- All punchlist items required by the GWR inspector have been addressed.
- Record drawings (as-builts) have been supplied to GWR by the Engineer-of-Record including AutoCAD files.
- A signed ADEQ "Certificate of Approval of Construction" has been provided to GWR.
- Developer has furnished copies of the contract, copies of all checks paid to the Contractor, and UNCONDITIONAL LIEN WAIVERS from the Contractor.
- Any other outstanding issues.

Water meters will NOT be installed to any water service location until the sewer system is accepted by GWR, all easements have been signed and recorded, and the video, mainline and services, approved.

Record drawings (as-builts) to be provided to GWR shall consist of three 11" x 17" hard copy sets of as-built drawings and one electronic set on CDR disk in AutoCAD format with a minimum of two points referenced to the GWR GIS system.

II. SEWER COLLECTION SYSTEMS

A. Sanitary Sewers

In general, all sewer lines in subdivisions shall be located 6 feet south or west of street centerlines. Horizontal curvilinear sewers shall not be allowed for sewers less than 24 inches in diameter. For sewers greater than 24 inches, contact GWR.

All sewers with services shall be installed with a minimum cover of seven (7) feet above the top of pipe to finished grade unless otherwise approved by GWR. The depth shall be sufficient to allow for gravity drainage from the ultimate service area as well as allow for future extensions to adjacent service areas when necessary. The depth of the main sewer line and the side (house) sewers shall be sufficient to avoid conflicts with water service connections and dry utilities.

Acceptable pipe materials for gravity sanitary sewer lines shall include the following:

- Sewers 15 inches in diameter and smaller shall be polyvinyl chloride (PVC) or ductile iron (DIP).
- Sewers larger than 15 inches in diameter shall be PVC, DIP, high density polyethylene (HDPE), or fiberglass reinforced polymer mortar (FRPM).
- All building and house service connections shall be PVC, minimum 4 inches in diameter.

Proposals for alternate pipe materials may be considered by GWR and shall be submitted, in writing, by the engineer.

DIP shall include an approved polyurethane or ceramic epoxy interior lining system with a minimum thickness of 40 mils. Each section of pipe and fitting shall be Holiday tested. Encasement of DIP with a loose type of polyethylene material per MAG standards may be required for corrosive soil environments at the discretion of GWR.

In areas where depth exceeds the allowable capacity of PVC and HDPE pipe, a non-flexible pipe material such as DIP shall be utilized at the discretion of GWR.

Buoyancy and the potential for flotation of sewers shall be considered and prevented with appropriate construction where high groundwater levels are anticipated.

B. Manholes

Manholes shall be installed at the end of each line and at all changes in pipe grade, size, material, and alignment. At changes in pipe alignment, the horizontal angle between two

intersecting sewer lines shall not be less than 90 degrees. Manholes shall also be used in lieu of a wye fitting for service connections 8 inches in diameter and larger.

Maximum sewer lengths between manholes shall be as follows:

Pipe Diameter (in)	Maximum Spacing (ft)
Less than 12	400
12 to 15	500
18 to 36	600
Over 36	800

Cleanouts may be utilized in place of manholes at dead ends when the sewer length is less than 150 feet. Either a manhole or cleanout shall be provided at the end of all line extensions to allow for cleaning. Cleanouts or manholes shall also be provided at the end of all sewer line stubs for future extensions which are greater than one pipe length to allow for testing.

Manholes shall be precast concrete structures in accordance with MAG standards with the exception that manhole steps shall not be provided. Minimum manhole diameters shall be 48 inches for pipe diameters of 8 to 15 inches. Manhole diameters shall be 60 inches for pipe diameters greater than 15 inches or for manholes greater than 10 feet in depth measured from the flow line to the manhole rim. The minimum manhole frame and cover diameter shall be 30 inches for 60 inch manholes.

An approved interior manhole coating system for corrosion protection shall be required for manholes with sewers 15 inches and larger. System shall be approved by GWR prior to installation. T-Loc systems are not acceptable.

Manholes located in washes shall be constructed in accordance with Standard Detail No. 3. The top of sewer pipe located within washes shall be located a minimum of two feet below the scour depth.

C. Design Flows

All sewers shall be designed for peak flow conditions. In the absence of flow data, new domestic sewage systems shall be designed based on the following criteria:

- Residential flows shall be based upon 234 gpd per dwelling unit and a dry peaking factor based upon tributary population in accordance with Table 1 of AAC R-18-9-E301.D.1.a.
- Commercial average day flows shall be based on 0.10 gallons per square foot of building area. For master planning purposes, it shall be assumed that the building area occupies 50% of the total commercial land area to account for open space and parking. Accordingly, the average day flow shall be equal to 2,200 gpd per acre of commercial property. The commercial peak flow shall be equal to 2.0 x average day flow.

- School average day flows shall be based upon 25 gallons per day (10 hour day) per student with a peaking factor of 2.0 x average day flow.
- Open space tracts shall be assumed to generate no wastewater flow.

For preliminary design only, a density of 3.5 dwelling units per acre shall be utilized for single family residential properties without a land use plan. Final design shall be based on the actual density.

D. Hydraulic Design

The minimum allowable slope for an 8 inch sewer shall be equal to 0.0035 ft/ft unless otherwise approved by GWR. For all other sewer sizes, the sewer lines shall be designed and constructed to provide a minimum velocity of 2.0 feet per second (fps) when flowing full. A design Manning's Formula "n" value equal to 0.013 shall be utilized for all pipe materials. Peak design velocities shall be less than 8 fps.

Other than private services, no sewers shall be less than 8 inches in diameter.

The ratio of flow depth in the pipe to the pipe diameter (d/D) shall not exceed 0.75 in peak dry weather flow. Consequently, the maximum sewer design capacity shall be equal to 91% of the full flow capacity at the peak design flow.

Manholes shall have a minimum drop of 0.10 feet across the manhole for all sewers with intersecting angles. When sewers with different diameters enter a manhole, the upstream pipe shall not have its crown lower than the crown of the downstream pipe.

Drop manholes shall be constructed in accordance with MAG standards when the difference between the upstream and downstream sewer inverts is greater than 2 feet. The manhole bottom shall be shaped to prevent solids deposition. Only outside drops shall be acceptable unless the inside manhole diameter is 6 feet or greater.

E. House and Building Service Connections

Residential sewer service connections shall be a minimum of 4 inches in diameter, and commercial service connections shall be a minimum of 6 inches. All service line connections shall be installed in accordance with MAG standards. Taps for future connections shall be marked. Each house or dwelling unit requires a separate sewer service connection.

Service connections 8 inches and larger in diameter shall be installed directly into a manhole. Direct service connections are not allowed for sewers 18 inches and larger and shall be installed into a manhole. No more than three service taps shall be made into any single manhole. Sewer service line inverts shall be a minimum of 6 inches above the crown of the outflow pipe.

Grease, oil, and/or sand interceptors shall be provided for all facilities when determined necessary by GWR. Refer to Paragraph F of Section II "Commercial and Industrial Operations" for additional details.

F. Commercial and Industrial Operations

Codes of Practice (COP) define the requirements for managing wastes discharged into the GWR sanitary sewer collection system from commercial and industrial operations. The COP provide guidance related to discharge regulations, interceptors, sampling, and record keeping and retention. Refer to Appendix A for additional requirements.

As of March 2005, operations regulated by GWR include RV parks, food services, dry cleaning, photographic imaging, and dental care. Contact GWR for the most current list of regulated operations or to determine the requirements of commercial and industrial operations which are currently not regulated by a COP.

Installation and maintenance of grease, oil, and sand interceptors shall be the responsibility of the property owner. The design shall be approved by GWR prior to installation and shall meet the requirements outlined in the COP. Minimum maintenance requirements for interceptors are also provided in the COP.

G. Easements

All sewer lines shall be located within street right-of-way or within a dedicated easement. The easement shall be dedicated to GWR and shall be restricted to GWR utilities only.

Dedicated easements shall be a minimum width of 20 feet wide for sewers less than 15 feet in depth and a minimum of 30 feet wide for sewers greater than 15 feet in depth. Sewer depths shall be measured from finished grade to the flow line. The easement width shall be increased by 5 feet if parallel water and sewer mains are to be located within the same easement.

In no case shall a sewer line shall be located within 10 feet of a property line, easement line, or a masonry block wall footing or within 15 feet of a building foundation.

Dedicated easements shall be free of obstructions and easily accessible to GRW. No permanent structures shall be located within the easement. Trees shall not be planted within 10 feet of any sewer. Easements shall not be located within storm water retention basins.

H. Testing Requirements

Testing shall be performed in accordance with GWR Code of Practice, GWR-CP-01-008.

Deflection testing shall be done on all sewer lines comprised of flexible materials. The entire length of sewer shall be tested for uniform slope. PVC sewer lines shall be low-pressure air tested utilizing ASTM Method F 1417-92.

Water tightness of sewers and manholes shall be determined by exfiltration or low-pressure air testing. Water tightness testing of the sewer line shall be performed to show that leakage does not exceed 200 gpd per inch diameter per mile of pipe. Exfiltration from manholes shall be limited to 0.1 gallons per hour per vertical foot of manhole.

Trench compaction and settlement testing shall be performed in accordance with the recommendations of a registered professional geotechnical engineer in the State of Arizona and as determined necessary by GWR. Test results shall be provided to the GWR inspector and shall be sealed by a registered professional geotechnical engineer in the State of Arizona.

The Contractor shall be responsible for an initial video inspection of the entire sewer line. However, after placement of pavement and prior to development of a punchlist, GWR will videotape the entire sewer system prior to acceptance at GWR's cost.

III. SEWAGE PUMP STATIONS

Sewage pump stations shall be capable of pumping the peak design wastewater flow with the largest pump out of service. Force main velocities shall be between 3 and 6 fps. Force mains shall be identified by placing marking tape one foot above the pipe along its entire length.

Acceptable pipe materials for pressure sewer pipe include PVC and DIP. Proposals for alternate pipe materials may be considered by GWR and shall be submitted in writing. Pressure class of PVC pipe shall be AWWA C-900 DR 14 Class 200 or AWWA C-905 DR 25 Class 165. In no case shall the pressure class of pressured pipe be less than 150 psi.

DIP shall include an approved polyurethane or ceramic epoxy interior lining system with a minimum thickness of 40 mils. Each section of pipe and fitting shall be Holiday tested. Encasement of DIP with a loose type of polyethylene material per MAG standards may be required in corrosive soil environments at the discretion of GWR.

Joints shall be restrained when necessary in accordance with MAG Standards. At a minimum, restrained joints shall be provided at all bends, tees, reducers, and dead ends. Thrust blocks as a substitute to restrained joints are not acceptable.

Isolation valves shall be eccentric type plug valves.

Odor control requirements will be evaluated on an individual project basis and may be required at the discretion of GWR. Odor control requirements apply to both the wetwell and air release valves.

Wetwells shall be lined with an approved coating system for corrosion protection. T-Loc systems are not acceptable.

Pump station equipment shall be protected from flooding and shall be designed to remain operable during a 100-year storm event. All pump stations shall include an automated backup power supply with a fuel reserve adequate for a 12-hour run time.

GLOBAL WATER RESOURCES, L.L.C.
RECLAIMED WATER SYSTEM STANDARDS

I. GENERAL REQUIREMENTS

Contact Global Water Resources for current standards for reclaimed water systems.

APPENDIX A

CODES OF PRACTICE

GLOBAL WATER RESOURCES (GWR)

CODE OF PRACTICE

GWR-CP-01-LST

LIST OF EFECTIVE CODES OF PRACTICE

CODES OF PRACTICE

The following Codes of Practice are enforced by Global Water:

ID Number	Title	Revision/ Status	Office of Primary Interest
GWR-CP-01-LST	List of Effective Codes of Practice	000	Compliance
GWR-CP-01-DEF	Definitions	001	Engineering & Projects
GWR-CP-01-001	RV Park Operations	001	Engineering & Projects
GWR-CP-01-002	Food Service Operations	001	Engineering & Projects
GWR-CP-01-003	Dry Cleaning Operations	001	Engineering & Projects
GWR-CP-01-004	Photographic Imaging Operations	001	Engineering & Projects
GWR-CP-01-005	Dental Operations	001	Engineering & Projects
GWR-CP-01-006	Determination of Capacity Impact of Commercial Units	000	Engineering & Projects
GWR-CP-01-007	Optimizing Landscape Configuration	001	Engineering & Projects
GWR-CP-01-008	Acceptance of Underground Facilities	003	Engineering & Projects
GWR-CP-01-009	Water From Hydrants/Construction Water	DRAFT	Operations
GWR-CP-01-010	On-Call Practices	000	Operations
GWR-CP-01-011	Vehicle Guidelines	001	Operations
GWR-CP-01-012	SCWC Emergency Operations Plan	000	Operations

REVISIONS

Date	Revision Number	Revisions	OPI
25-Mar-04	ORIGINAL (000)		GSS
10-Mar-05	001		SRL

GLOBAL WATER RESOURCES (GWR)

CODE OF PRACTICE

GWR-CP-01-DEF

DEFINITIONS

PROHIBITED WASTE

Prohibited waste means:

Air Contaminant Waste

Any waste other than sanitary waste which, by itself or in combination with another substance, is capable of creating, causing or introducing an air contaminant outside any sewer or sewage facility or is capable of creating, causing or introducing an air contaminant within any sewer or sewage facility which would prevent safe entry by authorized personnel.

Flammable or Explosive Waste

Any waste, which by itself or in combination with another substance, is capable of causing or contributing to an explosion or supporting combustion in any sewer or sewage facility including, but not limited to gasoline, naphtha, propane, diesel, fuel oil, kerosene or alcohol.

Obstructive Waste

Any waste which by itself or in combination with another substance, is capable of obstructing the flow of, or interfering with, the operation or performance of any sewer or sewage facility including, but not limited to: earth, sand, sweepings, gardening or agricultural waste, ash, chemicals, paint, metal, glass, sharps, rags, cloth, tar, asphalt, cement-based products, plastic, wood, waste portions of animals, fish or fowl and solidified fat.

Corrosive Waste

Any waste with corrosive properties which, by itself or in combination with any other substance, may cause damage to any sewer or sewage facility or which may prevent safe entry by authorized personnel.

High Temperature Waste

A high temperature waste is:

a. Any waste which, by itself or in combination with another substance, will create heat in amounts which will interfere with the operation and maintenance of a sewer or sewage facility or with the treatment of waste in a sewage facility;
b. Any waste which will raise the temperature of waste entering any sewage facility to 40 degrees Celsius (104 degrees Fahrenheit) or more;
c. Any non-domestic waste with a temperature of 65 degrees Celsius (150 degrees Fahrenheit) or more.

Biomedical Waste

Any of the following categories of biomedical waste: human anatomical waste, animal waste, untreated microbiological waste, waste sharps and untreated human blood and body fluids.

Miscellaneous Wastes

Any waste, other than sanitary waste, which by itself or in combination with another substance:

a. constitutes or may constitute a significant health or safety hazard to any person;
b. may interfere with any sewer or sewage treatment process;
c. may cause a discharge from a sewage facility to contravene any requirements by or under any ADEQ or AzPDES discharge permit or any other act, or any other law or regulation governing the quality of the discharge, or may cause the discharge to result in a hazard to people, animals, property or vegetation; or
d. may cause biosolids to fail criteria for beneficial land application.

RESTRICTED WASTE

Restricted waste means:

Specified Waste

Any waste which, at the point of discharge into a sewer, contains any contaminant at a concentration in excess of the limits set out below. All concentrations are expressed as total concentrations which includes all forms of the contaminant, whether dissolved or undissolved. The concentration limits apply to both grab and composite samples. Contaminant definitions and methods of analysis are outlined in standard methods.

CONVENTIONAL CONTAMINANTS [mg/L]	
Biochemical Oxygen Demand (BOD)	350
Chemical Oxygen Demand (COD)	700
Oil and Grease[1]	100
Suspended Solids	350

[1] Total oil and grease includes oil and grease (hydrocarbons) (see Organic Contaminants Table)

ORGANIC CONTAMINANTS [mg/L]	
Benzene	0.004
Ethyl Benzene	0.56
Toluene	0.8
Xylenes	8
Polynuclear Aromatic Hydrocarbons (PAH)[2]	0.05
Phenols	1
Oil and Grease (hydrocarbons)	15

INORGANIC CONTAMINANTS [mg/L]	
Antimony	0.0048
Arsenic (As)	0.010
Barium	1.6
Beryllium	0.0032

[2] Note: Polynuclear Aromatic Hydrocarbons (PAH) include:

a. naphthalene benzo(a)anthracene
b. acenaphthylene chrysene
c. acenapthene benzo(b)fluoranthene
d. fluorene benzo(k)fluoranthene
e. phenanthrene benzo(a)pyrene
f. anthracene dibenzo(a,h)anthracene
g. fluoranthene indeno(1,2,3-cd)pyrene
h. pyrene benzo(g,h,i)perylene

INORGANIC CONTAMINANTS [mg/L]	
Cadmium (Cd)	0.004
Chloride (Cl)	1500
Chromium (Cr)	0.08
Cobalt (Co)	5
Copper (Cu)	1
Cyanide (CN)	0.16
Fluoride (F)	3.2
Iron (Fe)	50
Lead (Pb)	0.04
Manganese (Mn)	5
Mercury (Hg)	0.0016
Molybdenum (Mo)	5
Nickel (Ni)	0.08
Selenium (Se)	0.04
Silver (Ag)	0.5
Sulphate (SO_4)	1500
Sulphide (S)	1
Thallium	0.0016
Zinc (Zn)	3

Food Waste

Any non-domestic waste from cooking and handling of food that, at the point of discharge into a sewer, contains particles larger than 0.5 centimeters in any dimension.

Radioactive Waste

Any waste containing radioactive materials that, at the point of discharge into a sewer, exceeds radioactivity limitations as established by regulatory agencies.

pH Waste

Any non-domestic waste which, at the point of discharge into a sewer, has a pH lower than 6 or higher than 9.0, as determined by either a grab or a composite sample.

Dyes and Coloring Material

Dyes or coloring materials which may pass through a sewage facility and discolor the effluent from a sewage facility except where the dye is used by the Sewer Company, or one or more of its agents, as a tracer.

Miscellaneous Restricted Wastes

Any of the following wastes:

a. seawater
b. PCBs
c. chlorinated phenols[3]
d. pesticides
e. tetrachloroethylene

[3] Chlorinated phenols include:

- chlorophenol (ortho, meta, para)
- dichlorophenol (2,3, 2,4-, 2,5-, 2,6-, 3,4-, 3,5-)
- trichlorophenol (2,3,4-, 2,3,5-, 2,3,6-, 2,4,5-, 2,4,6-, 3,4,5-)
- tetrachlorophenol (2,3,4,5-, 2,3,4,6-, 2,3,5,6-)
- pentachlorophenol

REVISIONS

Date	Revision Number	Revisions	OPI
	ORIGINAL (000)		GSS
25-Mar-04	001	Added revisions page	GSS

GLOBAL WATER RESOURCES

CODE OF PRACTICE

GWR-CP-01-001

RV PARK OPERATIONS

APPLICATION

This code of practice for RV park operations defines the requirements for managing waste discharged directly or indirectly into a sewer connected to a sewage facility from RVs, mobile homes, trailers, watercraft and other sources which employ storage, chemical disinfection/stabilization and discharge as a waste disposal mechanism.

This code of practice applies to all RV park operations. Definitions are included in GWR-CP-01-DEF.

DISCHARGE REGULATIONS

An operator of an RV park operation must not discharge waste, which at the point of discharge into a sewer, contains:

a. oil and grease in a concentration that is in excess of 100 milligrams per litre as analyzed in a grab sample;
b. suspended solids in a concentration that is in excess of 350 milligrams per litre as analyzed in a grab sample;
c. 5-day biochemical oxygen demand (BOD_5) in a concentration that is in excess of 350 milligrams per liter in a grab sample;
d. prohibited waste, restricted waste, special waste, stormwater, or uncontaminated water.

If the RV park operation accepts RV customers with the intention of providing sewerage hook-ups, that practice is only acceptable if one of the following conditions is met:

a. If the RV park operation has a dedicated pre-treatment facility, that facility must be used for the disposal of the first discharge of wastewater from any entering RVs. The facility must be maintained as per manufacturer's or engineer's operating instructions. Discharge from that facility which is directed to a sewer connected to a sewerage facility shall be metered such that large slugs of waste are not introduced to the sewer instantaneously. Discharges from such facilities to sewers are limited to 10% of the ADWF (in USGPM) experienced in the sewer.
b. In the absence of a dedicated pre-treatment facility, the RV park operation shall require incoming RVs to certify that, prior to connection to a sewer, that the holding tanks of the RV have been discharged at an approved facility.

RECORD KEEPING AND RETENTION

An operator of an RV park operation must keep a record at the RV park operation of:

a. all disposals of RV waste into a dedicated pre-treatment facility;
b. Pre-treatment facility inspection and maintenance activities including:
    I. the date of inspection or maintenance;
    II. the maintenance conducted; and
    III. the type and quantity of material removed from the facility;
c. Certifications of waste disposal prior to hook up of RVs to sewer services.

The records shall be retained for a period of two years, and shall be available on request.

REVISIONS

Date	Revision Number	Revisions	OPI
	ORIGINAL (000)		GSS
25-Mar-04	001	Added revisions table	GSS

GLOBAL WATER RESOURCES (GWR)

CODE OF PRACTICE

GWR-CP-01-002

FOOD SERVICE OPERATIONS

APPLICATION

This code of practice for Food Service operations defines the requirements for managing waste discharged directly or indirectly into a sewer connected to a sewage facility from restaurants, or other facilities employing food service as a primary or secondary business operation.

This code of practice applies to:

a. operators of a food services operation that adds kitchen equipment that discharges oil and grease;
b. operators of a food services operation that discharges non-domestic waste to sewer that exceeds any of the restricted waste criteria specified in GWR-CP-01-DEF; or
c. any food service operation, as determined by the Engineer of GWR's wastewater operations group.

Definitions are included in GWR-CP-01-DEF.

DISCHARGE REGULATIONS

An operator of a Food Service Operation must not discharge waste, which at the point of discharge into a sewer, contains:

a. oil and grease in a concentration that is in excess of 100 milligrams per liter as analyzed in a grab sample;
b. suspended solids in a concentration that is in excess of 350 milligrams per liter as analyzed in a grab sample;
c. 5-day biochemical oxygen demand (BOD5) in a concentration that is in excess of 350 milligrams per liter in a grab sample;
d. prohibited waste, restricted waste, special waste, stormwater, or uncontaminated water as defined in GWR-CP-01-DEF.

GREASE INTERCEPTORS

Grease interceptors are required to be installed and maintained by the Owner of food service operations within the collection system of GWR facilities. Grease interceptor installations shall conform to the requirements of this code of practice.

Design

The rated flow capacity of each grease interceptor installed in food services establishments shall not be less than the maximum discharge flow from all plumbing fixtures connected to the grease interceptor that will discharge simultaneously.

The rated flow capacity of each grease interceptor must be established using the Plumbing and Drainage Institute standard PDI-G101 or equivalent test as approved by GWR's engineer.

Each grease interceptor must have either:

a. an internal flow control fitting, or
b. a flow control fitting installed on the inlet line[1].

All grease interceptors must be labeled with information containing the rated flow capacity of the unit. The label shall be permanently affixed and visible following installation. Where a permanently affixed and visible label is not possible or practical, manufacturer and installation drawings of the grease interceptor shall be maintained at the site and shall be available for inspection by GWR staff, on request.

Flow Rates

The operator of a food services operation must calculate the maximum discharge flowrate to a grease interceptor by adding together the flowrates from each fixture that will discharge simultaneously using the following method to estimate the flowrate from each fixture:

a. for sinks, calculate the total volume of each sink and assign a drain time of one minute.
b. for exhaust hoods with an automatic cleaning cycle, measure the discharge flowrate or use the manufacturers estimate of peak discharge flowrate during the automatic wash cycle.
c. for floor drains, estimate the flowrate using the following table:

Floor Drain Diameter		Drain Rate		
Millimeters	Inches	L/s	Imperial gpm	US gpm
51	2	1.4	18.3	22
76	3	2.36	31.2	37.5
102	4	2.84	37.5	45

d. for drains on other equipment, use the table in Section (c) or if the drain size is less than 2 inches in diameter either:
   I. measure the discharge flowrate, or
   II. refer to manufacturers estimated peak discharge flowrate, or
   III. use a minimum of 1.4L/s.
e. for automatic dishwashers, measure the discharge flowrate or use the maximum discharge flowrate specified by the dishwasher manufacturer.

Where the rated flow capacity of a grease interceptor is exceeded by the maximum discharge flowrate from all plumbing fixtures that will be discharged simultaneously to the grease interceptor, the operator of a food services operation must:

[1] The flow control fitting must be sized to limit the flow to a rate that is no more than the rated flow capacity of the grease interceptor.

a. install a grease interceptor that has a rated flow capacity equal to or greater than the maximum discharge flowrate from all plumbing fixtures connected to the grease interceptor that will discharge simultaneously; or
b. install additional grease interceptors so that the maximum discharge flowrate from fixtures connected to each grease interceptor that will discharge simultaneously does not exceed the rated flow capacity of the grease interceptor; or
c. have a plan approved by GWR's engineer showing how the discharge of waste will be managed.

Installation

A grease interceptor must be located so that it is readily and easily accessible for inspection and maintenance. A sampling point shall be installed as follows:

a. a sampling tee shall be located either at the outlet of the grease interceptor or downstream of the grease interceptor at a location upstream of any discharge of other waste;
b. the sampling tee shall be not less than 10.2 cm (4 inches) in diameter, and shall be installed so that it opens in a direction at right angles to and vertically above the flow of the sewer pipe; and
c. the sampling tee shall be readily and easily accessible at all times for inspection.

Maintenance

An operator of a food services operation shall maintain all grease interceptors installed in connection with the food services operation in accordance with the manufacturer's recommendations so that the grease interceptors function properly.

An operator of a food services operation must not permit oil and grease to accumulate in a grease interceptor in excess of the lesser of six inches or 25% of the wetted height of the grease interceptor.

An operator of a food services operation shall not dispose of oil and grease from a grease interceptor to a sewer. All cleaning or grease removal shall be accomplished by employing vactor trucks or other means to preclude any grease from entering the collection system.

An operator of a food services operation must not use or permit the use of chemical agents, enzymes, bacteria, solvents, hot water or other agents to facilitate the passage of oil and grease through a grease interceptor without the express written consent of GWR.

Connections to Grease Interceptors

An operator of a food services operation shall have the following fixtures connected to the grease intercept system:

a. sinks used for washing pots, pans, dishes, cutlery and kitchen utensils;
b. drains serving self-cleaning exhaust hoods installed over commercial cooking equipment;
c. drains serving commercial cooking equipment that discharges oil and grease;
d. drains serving a garbage compactor used to compact waste that may contain, or be contaminated with, food waste; or
e. other fixtures that discharge wastewater containing oil and grease.

The following fixtures shall not be connected to a grease interceptor:

a. garburators, potato peelers and similar equipment discharging solids;
b. toilets, urinals and hand sinks;

c. automatic dishwashers[2]

Outdoor Garbage Compactors

An owner of an outdoor garbage compactor installation connected to a sewer must install works as necessary to prevent rainwater from entering the drain connected to the sewer.

SAMPLING

At the request of GWR, the operator of a food services operation shall confirm the operation of any grease interceptor via analytical testing. This testing shall be performed by an accredited laboratory, and paid for by the owner of the grease interceptor.

RECORD KEEPING AND RETENTION

An operator of a food services operation must keep a record at the food services operation of all grease interceptor inspection and maintenance activities including:

a. the date of inspection or maintenance;
b. the maintenance conducted;
c. the type and quantity of material removed from the grease interceptor; and
d. the location of disposal of the material removed from the grease interceptor.

The records shall be retained for a period of two years, and shall be available on request to GWR Staff.

[2] An automatic dishwasher may be connected to a grease interceptor provided that there are no other fixtures connected to the grease interceptor and the grease interceptor is sized to accept the maximum discharge flowrate specified by the dishwasher manufacturer.

REVISIONS

Date	Revision Number	Revisions	OPI
	ORIGINAL (000)		GSS
25-Mar-04	001	Added revisions table	GSS

STANDARD PDI-G101

Testing and Rating Procedure for Grease Interceptors with Appendix of Sizing and Installation Data

ISSUED BY THE PLUMBING AND DRAINAGE INSTITUTE
45 Bristol Drive • Suite 101 • South Easton, MA 02375
Tel: (800) 589-8956 • Fax: (508) 230-3529

Plumbing and Drainage Institute 10/96 15d LIQUID WASTE EQUIPMENT

FOREWORD

The Plumbing and Drainage Institute is comprised of a group of member organizations, each of which is engaged in the manufacture of products for the plumbing industry. The basic aim of PDI is to contribute its combined talents and resources to the further advancement of plumbing engineering and the plumbing industry. This standard is dedicated to those goals.

For nearly a hundred years, grease interceptors have been used in plumbing waste water systems to permit free flow of drainage from sinks and similar equipment and to prevent grease accumulations from clogging connecting piping and sewer lines. In 1883, one Nathaniel T. Whiting of California applied for a patent on a grease trap, which was issued in October of 1884. Whiting's design principle was not unlike that of present day grease interceptors.

For the following fifty years, there were no coordinated efforts to standardize ratings or to establish performance requirements for grease interceptors. Ratings were determined by each manufacturer for its interceptors which were produced in a variety of sizes and types in effort to meet engineer's specifications and satisfy code requirements.

In late 1940 and early 1941, prior to the United States' entry into World War II, grease interceptors were specified for Army posts to meet specifications of the Construction Division, Office of the Quartermaster General. These specifications called for interceptors which proved inadequate; thus it immediately became apparent that a comprehensive engineering and testing program was required in order to properly rate grease interceptors. Apart from prevention of sewage systems clogging, properly rated and sized grease interceptors were essential to the recovery of oils and grease so badly needed for the war effort. As a result, a series of conferences involving the Research Committee of the Plumbing and Drainage Manufacturer's Association (now Plumbing and Drainage Institute), representatives of the Quartermaster General, Surgeon General, Army Corps of Engineers, and others were held to develop a testing program to establish flow rates and grease holding capacity for uniform rating of grease interceptors manufactured at that time. The program that emerged from these conferences included exhaustive laboratory testing of each grease interceptor at the Iowa Institute of Hydraulic Research at the State University. This phase of the program was covered in a comprehensive report issued in August of 1945.

Using the guidelines established in Iowa, the Research Committee continued the testing program at The United States Testing Company, Inc., which culminated with the first issue of this standard in 1949 and certification of applicable grease interceptors.

Since its publication, Standard PDI-GIOI has been widely recognized; it is referenced in most plumbing codes and it is included as the basic testing and rating requirement of Military Specification MIL-T-18361.

Grease interceptors specified by engineers are deemed to be acceptable products when they meet the requirements of this standard.

Standard PDI-GIOI has been reprinted in its original format many times over the years to satisfy the continuing demand for copies. Now, with this reprint, the standard has a new format for ease of reading and is expanded to include this informative foreword plus an appendix of valuable sizing, installation and maintenance data which the Institute feels will be helpful to the industry.

The Plumbing and Drainage Institute currently maintains a grease interceptor testing, rating and certification facility, for interceptors falling within the scope of this standard at the Industrial Testing Laboratories, Inc., in St. Louis, Missouri.

Manufacturers interested in having interceptors tested, rated, and certified in conformance with Standard PDI-GIOI may obtain the details by contacting the Executive Secretary of the Institute at the address on the cover.

This Standard is not intended to be limiting in any way, but rather is intended to provide a uniform measure of performance by Grease Interceptors. The use of this Standard is voluntary and the issuance or existence of this Standard does not in any respect prevent or restrict any member or non-member of The Plumbing and Drainage Institute from manufacturing or supplying products that do not meet the performance criteria contained in the Standard. The data in this publication are based on information believed to be reliable and are offered in good faith but without guarantee. The Plumbing and Drainage Institute and its member companies assume no responsibility or liability for the use of this Standard. No warranty, express or implied, is made of the information contained in this Standard by The Plumbing and Drainage Institute or by any of its member companies.

Testing and Rating Procedure for Grease Interceptors Plumbing and Drainage Institute Standard PDI-G101

1.0 Scope and Purpose

1.1 Realizing the serious need of a standard procedure for the testing and rating of grease intercepting equipment, the Plumbing and Drainage Institute authorized its Research Committee to take the necessary steps to develop such a set of standards. This project would include the design and construction of the testing equipment, preliminary research and testing, the development of a certification test procedure and the development of a standard method of rating the flow capacities and grease retention capacities of grease interceptors.

2.0 Basic Test Method

2.1 The Plumbing and Drainage Institute Standard Testing Procedure for Grease Interceptors is designed to simulate an actual plumbing installation in which the interceptor is subjected to severe operational conditions.

2.2 The test is based on the use of a variable capacity double compartment sink installed on a floor level which is ten (10) feet (3.05m) above the bottom of the interceptor. The sink is connected to the interceptor by means of two (2) inch waste piping. A vented flow control or equal device is installed at the top of the waste riser between the sink and the interceptor. The effluent from the interceptor discharges into a skimming tank, the top of which is located below the outlet of the interceptor. Complete details on the design of the testing equipment and its installation, and the test procedure are outlined hereinafter.

3.0 Construction of Test Equipment

3.1 Test Sink

The sink used in the tests shall have the following inside dimensions: eight (8) feet (2.44m) in length; two (2) feet (0.60m) in width; twelve and one-half (12½) inches (0.32m) in depth. The sink shall be constructed of galvanized sheet metal and shall have two (2) compartments, each four (4) feet (1.22m) in length. The sink shall have steel angle rim, reinforcement, and legs. The legs shall be of proper length so that the rim of the sink will be three (3) feet (0.91m) above the floor. The sink legs shall be braced with steel angles or flat bars.

3.1.1 Sink Waste Connections

Each sink compartment is to be fitted with a one and one-half (1½) inch (38mm) standard sink waste connection with flange, crossbars, threaded or slip joint tailpiece, and locknut. The waste connections are to be located on opposite sides of the center partition in the corner formed by the side of the sink and the center partition.

3.1.2 Water Level Gauges

Each compartment shall be equipped with a gauge connection and a water level gauge with gauge glass. Each gauge connection shall be fitted into the bottom of a sink compartment and in close proximity to the waste outlet. Each gauge shall be mounted on the outside of the sink, adjacent to its respective gauge connection, and shall extend diagonally upward from the bottom center to the top outside corners. These gauges shall be calibrated to read directly the number of inches of water in the sink compartments above the sink waste flange.

3.1.3 Movable Sink Partitions

Each compartment of the sink shall be fitted with a movable partition, making it possible to regulate the size of the compartment to any desired capacity.

3.2 Skimming Tank

The skimming tank is to be rectangular in shape, open at the top and equipped with a stationary baffle located approximately three (3) feet (0.91m) from the end of the tank receiving the discharge from the interceptor. This baffleshall extend the width of the tank and to within four (4) inches (100mm) of the bottom of the tank. The purpose of this baffle is to

limit the heavy spread of grease to one end of the tank and to control to a degree the turbulent water currents created by the overflow from the interceptor. The dimensions of the tank shall be approximately eight (8) feet (2.44m) in length, twenty-eight (28) inches (0.70m) in width, and two (2) feet (0.60m) in depth. The tank shall be constructed of galvanized sheet metal with steel angle rim and reinforcement. The waste outlet from the tank is to be four (4) inches (100mm) in diameter, connected to the bottom of the tank at one end and trapped to retain approximately eighteen (18) inches (0.46m) of water in the tank. The tank is also provided with a four (4) inch (100mm) valved bottom drain to permit draining and cleaning.

4.0 Installation of Testing Equipment

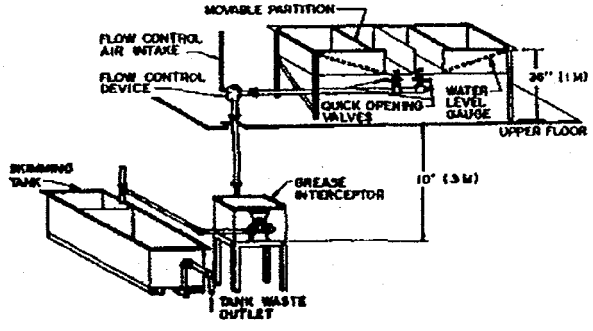


Figure 1
Installation of Grease Interceptor Testing Equipment

4.1 Sink Location

The sink is to be located on an upper floor with the sink rim three (3) feet (0.91m) above that floor level.

4.2 Interceptor Location

The grease interceptor shall be so located that its bottom is ten (10) feet (3.05m) below the floor level upon which the sink is located. The interceptor shall be equipped with a water-tight and air-tight cover.

4.3 Skimming Tank Location

The skimming tank shall be located low enough, with respect to the interceptor, for the discharge piping from the interceptor to clear the tank rim by not less than three (3) inches (76mm).

4.4 Installation of Waste Piping

4.4.1 Sink Connections

The sink outlet waste connection from each sink compartment is to be one and one-half (1½) inches (38mm) in size and each connection shall be fitted with a quick opening gate valve.

4.4.2 Combined Horizontal Waste Piping

The combined horizontal waste piping into which the sink outlets connect shall be two (2) inches (50mm) in size, installed with the center line eleven (11) inches (0.28m) below the bottom of the sink and properly hung and braced from the sink reinforcement and supports. This waste pipe shall be fitted to the inlet of a vented flow control or equal device.

4.4.3 Flow Control Device

The flow control device is to be adequate in size for the interceptor to be tested and shall be equipped with the proper size orifice and/or other details to provide the proposed flow rate of the subject interceptor, based on the simultaneous drainage of both sink compartments as detailed hereinafter. The waste piping on either side of the flow control shall be fitted with unions to permit removal of the device. If the flow control orifice required exceeds two (2) inches (50mm) in diameter, thereby requiring a flow control larger than two (2) inches (50mm), reducing couplings shall be fitted into the inlet and outlet of the larger device to permit connection of the two (2) inch (50mm) waste piping.

4.4.4 Vertical Waste Riser

The two (2) inch (50mm) vertical waste riser shall be connected to the outlet of the flow control device and shall extend downward to connect to the interceptor inlet by means of a two (2) inch (50mm) elbow and a short horizontal nipple.

4.4.5 Interceptor Discharge

The discharge pipe from the interceptor outlet to the skimming tank shall be two (2) inches (50mm) in size with a minimum pitch of one-eighth (⅛) inch per foot (lcm per m) and shall be provided with a two (2) inch (50mm) vent properly located to prevent siphoning of the interceptor.

4.4.6 Interceptor Connections

If the inlet and/or outlet openings of the interceptor to be tested exceed two (2) inches (50mm) in size, use reducing couplings to permit connections of the two (2) inch (50mm) inlet and discharge pipes.

5.0 Preliminary Test Procedure

5.1 Media Analysis

Before conducting certification tests on any interceptor, simple analysis of the test media are to be made to determine the following characteristics:

(a) Water-Hydrogen ion concentration (pH value).

(b) Lard-Specific gravity, at one hundred and fifty (150) degrees Fahrenheit (65.5°C).

-Viscosity in Seconds Sayboit Universal (SSU), at one hundred and fifty (150) degrees Fahrenheit (65.5° C).

5.2 Establishing Sink Compartment Capacity

The size of each test compartment shall be established by means of the movable partitions so that the gross capacity of each compartment in gallons will be equal to one and two-tenths (1.2) times the proposed flow rate in gallons per minute (GPM) of the interceptor to be tested. The gross sink capacity mentioned above is to be calculated on the basis of twelve (12) inches (0.3m) above the sink outlet flange.

5.3 Establishing Volume of Incremental Discharge

The volume of water to be discharged from each sink compartment during each test increment shall be based on ten (10) inches (0.25m) of water above the sink outlet flange. On this basis the incremental discharge in gallons per compartment will be equal to the proposed gallons per minute (GPM) flow rate of the interceptor being tested.

5.4 Computation of Flow Rate

The flow rate from the sink shall be computed by timing the rate of drainage of the first nine and one-half (9½) inches (0.24m) of water from the sink compartment, measured from the ten (10) inch (0.25m) mark to the datum line one-half (½) inch (13mm) above the sink outlet flange.

54.1 Check Flow Rate Tests

After the sink compartment capacities have been established, the sink waste piping connected to the interceptor with the flow control or equivalent device properly sized and installed, and the interceptor discharge pipe properly vented and extended to the skimming tank, a series of check flow rate tests are to be made. Three (3) tests are to be made for each of the following four (4) conditions: (During test groups (a) and (b) the waste outlet from the adjacent compartment shall be closed off.)

(a) Drain, gauge, and compute the flow rate from compartment #1 separately.

(b) Drain, gauge, and compute the flow rate from compartment #2 separately.

Flow rates determined in (a) and (b) are only for purposes of checking against actual flow rates of test increments.

(c) Drain compartments #1 and #2 simultaneously and gauge and compute the flow rate on the basis of the time required to drain compartment #1.

(d) Drain compartments #1 and #2 simultaneously and gauge and compute the flow rate on the basis of the time required to drain compartment #2.

54.2 Callbrated Drainage Flow Rates

The average of the three (3) tests

for each of groups (c) and (d) above shall be considered as the calibrated drainage flow rate for that group provided no one of the tests varies by more than five (5) per cent from the other two in the same group. If such variation occurs, the test showing the discrepancy shall be discarded and additional check tests shall be made until three (3) tests meeting the above condition are obtained. The average of the calibrated drainage flow rates for simultaneous discharge, as determined in Sections 54.1 (c), 54.1 (d), and 54.2 must be equal to or exceed by not more than five (5) per cent the proposed flow rate of the interceptor being tested. If the average flow rate so determined is less than the proposed flow rate of the interceptor, the flow control orifice is to be enlarged and the check flow rate tests rerun and the calibrated drainage flow rates again computed until flow rates within the required limits are obtained. If the average of the calibrated drainage flow rates exceeds the proposed flow rate of the interceptor by more than five (5) per cent, the flow control orifice shall be reduced in size and the above tests shall be repeated until an average flow rate is obtained which falls within the five (5) per cent limit stipulated above.

6.0 Skimming Procedure

The skimming procedure is to be initiated approximately five (5) minutes after the increment to be skimmed has discharged into the tank. A sheet metal hand baffle, slightly shorter than the width of the skimming tank and approximately one (1) foot (0.30m) in width is employed to push all surfaced grease to one corner of the tank from which the layer of grease is readily skimmed by means of a rectangular pan. The mixture of water and grease thus removed is placed in a pail equipped with a drainage spigot. All grease is squeegeed from the baffleand pan. This process is continued until most of the visible grease has been removed from the surface of the water in the skim tank.

6.1 At this point, while the hand baffle previously used is allowed to cool, a second hand baffle is employed in the following manner. The first inch (25mm) of the baffle plate is immersed at one end of the skimming tank and the baffle moved toward the opposite end, as before, to concentrate the now thin film of surfaced grease. The baffle is moved at a rate slow enough to prevent turbulence from drawing the accumulating grease below the baffle, and fast enough so that a minimum of grease will pass through the clearance space between the baffle and the tank walls. Upon reaching a point about two (2) inches (50mm) from the end of the tank, the baffle motion is slowed and, at the same time, the baffle is lowered to bring the cooler surface in contact with the trapped grease. These motions are so regulated as to have the baffle submerged to within an inch (25mm) of its top by the time it reaches the end of the last two (2) inches (50mm) of horizontal travel. The baffle is then removed from the water and moved, grease side up, to the pail where the adhering grease is squeegeed off and added to the previous contents. By now, the first baffle has cooled, and the above procedure is repeated using it. The baffles are used alternately until the amounts of grease collected in this manner are so small as to be negligible.

6.2 Upon completion of the above skimming procedures, the water is drained from the bottom of the pail by means of the spigot. The pail is then placed over a gas flame and its contents heated until the residual water is brought to boiling temperature; that is, until bubbles of steam rise through the molten grease. The mixture is then poured from the pail into a separatory funnel, the pail is squeegeed out and the mixture is allowed to stand in the funnel for approximately five (5) minutes, at the end of which time the water is drawn off from the bottom of the funnel. The remaining liquid is permitted to separate for approximately five (5) more minutes and the water is again removed from the bottom of the funnel. The remainder is drained from the separatory funnel into one or more preweighed cans.

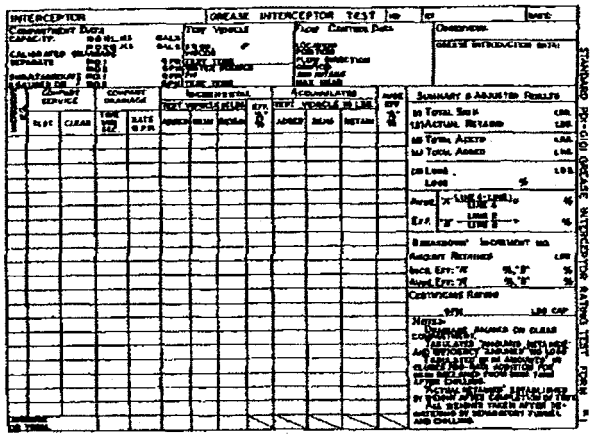
6.2.1 These cans are placed in a deep freeze unit or other suitable cool location and the grease is per-

mitted to solidify. The solidified contents are then scraped and kneaded with a small putty knife, and the water thus worked from the mixture is poured off. If the quantity of water thus removed is greater than several drops, the heating and solidification process is repeated. When only a few drops of water are removed in this manner, the mixture is assumed to be completely dewatered and weights are taken for computation purposes.

6.2.2 The weighing is done on an "Ohaus" gram balance and weights are taken to the nearest one-half (½) gram (0.0011 pound). Tare weights of the preweighed cans are then subtracted from the total weight and the correct weight entered as data.

7.0 Certification Test Procedure

After all preliminary data and tests have been established as previously outlined, the certification tests shall be conducted as follows and all test data is to be recorded on PDI Grease Interceptor Rating Test Form #1.



Larger View

7.1 Test Media

Certification tests shall be conducted with fresh, un-used Swift & Company Prime Steam Lard or equal and water, both within a temperature range of from one hundred and fifty (150) to one hundred and sixty (160) degrees Fahrenheit (65.5° to 71°C).

7.2 Ratio of Lard to Water

Both compartments of the test sink shall be supplied with the required volume of water (Sect. 5.2 and 5.3) at the temperature stipulated in 7.1. The test lard shall be introduced into one compartment, during each incremental discharge, in the ratio of one (1) pound (0.45kg) of lard for each five (5) gallons (19L) of water in that compartment. Consequently, the proportion of lard to the total amount of water discharged from both sink compartments during each increment will be one (1) pound (0.45kg) for each ten (10) gallons (39L). The required amount of test lard, within the above temperature range, shall be weighed out and poured into the test compartment of the sink.

7.3 Test Increments

Each test increment shall consist of the simultaneous discharge of the water from both sink compartments and the lard from the test compartment.

7.3.1 During the first test increment the lard shall be poured into the No. 1 compartment (that compartment having its discharge outlet closest to the interceptor, measured along the waste pipe) and the No. 2 compartment shall discharge clear water. During the second test increment the lard shall be poured into the No. 2 compartment while the water in No. 1 compartment remains clear. This procedure of introducing the lard into alternate sink compartments shall be continued throughout the test.

7.4 Flow Rates

The drainage period for each increment is to be gauged and timed on the basis of the flow from the compartment containing the clear water. The flow rate from the sink is to be computed and recorded for each increment.

7.5 Efficiency Determinations

The grease shall be removed from the skimming tank and the efficiency of the interceptor shall be computed at intervalsof five (5) increments or less until the average efficiency reaches approximately ninety-three (93) per cent and/or the incremental efficiency reaches approximately eighty-five (85) per cent. After this point has been reached, efficiency checks shall be made after each incremental discharge.

7.6 Duration of the Test

The above test procedure is to be con-

tinued until the average efficiency reaches eighty-five (85) per cent or less, and/or the incremental efficiency reaches seventy-five (75) per cent or less.

7.7 Determination of Test Breakdown Point

The test failure, or breakdown point of the interceptor, shall be established at the increment preceding two (2) successive increments in which either the average efficiency is less than ninety (90) per cent or the incremental efficiency is less than eighty (80) per cent. The efficiencies used in determining the breakdown point shall be either: "A," efficiencies determined on the basis of no unaccounted loss or gain, or "B," efficiencies adjusted for unaccounted loss or gain, whichever provides the lesser efficiency for the interceptor. The formulae for determining the above efficiencies shall be as follows:

$$\text{Efficiency "A"} = \frac{\text{Grease Added} - \text{Grease Skimmed}}{\text{Grease Added}}$$

$$\text{Efficiency "B"} = \frac{\text{Grease Added}\left\{100\% \begin{matrix}+\%\ \text{Gain} \\ -\%\ \text{Loss}\end{matrix}\right\} - \text{Grease Skimmed}}{\text{Grease Added}\left\{100\% \begin{matrix}+\%\ \text{Gain} \\ \%\ \text{Loss}\end{matrix}\right\}}$$

7.8 Requirements for Certification and Factor of Safety

To receive certification in accordance with the Plumbing and Drainage Institute Standard Testing Procedure for Grease Interceptors, the interceptor shall conform with or exceed the following requirements at the breakdown point:

(a) Have an average efficiency of ninety (90) per cent or more. (See Section 7.7)

(b) Have an incremental efficiency of eighty (80) per cent or more. (See Section 7.7)

(c) Have retained not less than two and one-quarter (2¼) pounds (1 kg) of grease for each one (1) gallon per minute (GPM) (0.06L/s) average flow rate as determined during the test. (This provides at least a twelve and one-half (12.5) per cent safety factor on the ratio of the rated grease retention capacity to flow rate, as indicated in the following Table I.)

7.9 Certification Capacities

Standard certification flow rate and grease retention capacities for grease interceptors tested in accordance with the above procedure shall conform to the following:

TABLE I
CERTIFICATION STANDARD FLOW RATES AND GREASE RETENTION CAPACITY RATINGS FOR GREASE INTERCEPTORS

	Flow Rate (GPM)	Flow Rate (L/s)	Grease Retention capacity Rating (Pounds)	Grease Retention capacity Rating (kg)	*Recommended Maximum Capacity of Fixtures Connected to Interceptors (Gallons)	*Recommended Maximum Capacity of Fixtures Connected to Interceptors (L)
For Small Domestic Use	4	0.25	8	3.6	10.0	37.9
	7	0.44	14	6.4	17.5	66.2
	10	0.63	20	9.1	25.0	94.6
For Large Domestic, Commercial, and Institutional Use	15	0.95	30	13.6	37.5	141.9
	20	1.26	40	16.2	50.0	189.3
	25	1.56	50	22.7	62.5	236.6
	35	2.20	70	31.6	87.5	331.2
	50	3.16	100	45.4	125.0	473.1

8.0 Recommended Fixture Capacity Limitations*

It is recommended that the total capacity in gallons of fixtures being served by an interceptor conforming to the above standard ratings, shall not exceed two and one-half (2½) times the certified gallons per minute flow rating of the subject interceptor.

9.0 Grease Interceptor Certificate and Certification Seal

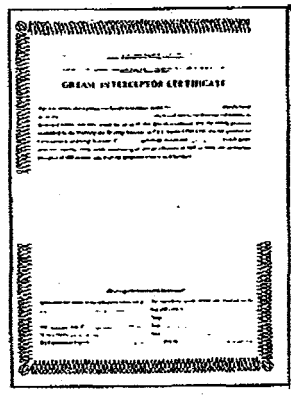


Figure 2

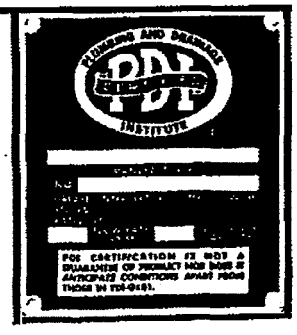


Figure 3

9.1 Certificate

A certificate, Fig. 2, is issued by the authorized testing laboratory upon successful completion of standard PDI-G101 tests for each interceptor tested.

9.2 PDI Certification Seal

Grease interceptors which are certified by the manufactureras being identical in the relevant respects considered in PDI-G101 to the unit tested and certified as detailed herein by an independent laboratory approved by the *Institute* may bear the Institute's Certification Seal as exemplified in Fig. 3, provided such manufacturer also executes the Institute's current Standard Certification Mark License Agreement.

APPENDIX

Realizing the need for uniform sizing, installation and maintenance data for Plumbing and Drainage Institute certified grease interceptors conforming to the testing and rating procedures outlined in Standard PDI-G101, it was deemed advisable to cover this information in an appendix. The recommendations for sizing, installation and maintenance of grease interceptors contained in this appendix are based on experience of the Industry.

AI .O Sizing

AI. 1 Sizing Considerations

AI.I.I A grease interceptor conforming to Standard PDI-G101 isdesigned and certified to operate efficiently at its rated capacity. The larger the interceptor the higher the flow rate it will handle efficiently with a greater quantity of grease retained before cleaning is required. While a small interceptor, undersized, can accommodate a flow of waste water well in excess of its rated capacity, it will not intercept grease efficiently under such overload conditions.

AI .1.2 Fixture drainage period in combination with the service required and the quantity of waste water involved, establishes the rate of flow through the grease interceptor. Flow rate is therefore the primary gauge; and flow rate establishes interceptor size or capacity.

A1.1.3 The link between flow rate and installation to produce satisfactory grease interceptor operation is a Flow Control Fitting. A correctly sized grease interceptor will not regulate the flow of water discharged from the fixture it is serving. Therefore, to ensure that the flow rate does not exceed the grease interceptor's rated capacity, a flow control fitting is required. The flow control fitting is essential for protection against overloading the grease interceptor which could otherwise occur from sudden surges from the fixture. The flow control fitting will control the flow of waste water at all times, enabling the interceptor to operate at its certified capacity.

AI.2 Size Symbols

It has been determined through the testing and rating procedure that eight (8) different sized grease interceptors are required for normal domestic, commercial, and institutional installations. These sizes are based on certification standard flow rates and grease retention capacity ratings for grease interceptors. See Table I, page 8, Standard PDI-G101. **Table AI.2** lists the PDI size symbol for each of the standard rated grease interceptors.

Table AI.2
Sizing and Rating

PDI Size Symbol	4	7	10	15	20	25	35	50
Flow Rate GPM	4	7	10	15	20	25	35	50
L/s	.25	.44	.63	.95	1.26	1.58	2.20	3.16
Grease Capacity Pounds	8	14	20	30	40	50	70	100
Kg	3.6	6.4	9.1	13.6	18.2	22.7	31.8	45.4

AI.3 Sizing Procedure

Table AI.3 is provided to show the standard formula in steps for sizing grease interceptors to suit requirements of specific fixtures. An example of this sizing formula application is included to illustratethe steps.

Table A1.3
Procedure for Sizing Grease Interceptors
(Metric Equivalents Omitted for Simplicity)

Steps	Formula	Example
1	Determine cubic content of fixture by multiplying length x width x depth.	A sink 48" long by 24" wide by 12" deep. Cubic content 48 x 24 x 12 = 13,824 cubic inches.
2	Determine capacity in gallons. 1 gal. = 231 cubic inches.	Contents in gallons $\frac{13,824}{231}$ = 59.8 gallons
3	Determine actual drainage load. The fixture is normally filled to about 75% of capacity with water. The items being washed displace about 25% of the fixture content, thus actual drainage load = 75% of fixture capacity.	Actual drainage load .75 x 59.8 = 44.9 gallons
4	Determine flow rate and drainage period. In general, good practices dictate a one (1) minute drainage period; however, where conditions permit, a two (2) minute drainage period is acceptable. Drainage period is the actual time required to completely drain the fixture. Flow rate = $\frac{\text{Actual Drainage Load}}{\text{Drainage Period}}$	Calculate flow rate for one-minute period $\frac{44.9}{1}$ = 44.9 GPM Flow Rate Two-minute period $\frac{44.9}{2}$ = 22.5 GPM Flow Rate
5	Select interceptor. From Table A1.2 select interceptor which corresponds to the flow rate calculated. Note: Select next larger size when flow rate falls between two sizes listed.	For one-minute period—44.9 GPM requires PDI size "50." For two-minute period—22.5 GPM requires PDI size "25."

A1.4 Selection

Table A1.4 is included as a selection chart for standard PDI Certified grease interceptors applicable to various size fixtures commonly used in domestic, commercial and institutional installations. The selections listed are based on the sizing formula covered in Table A1.3.

A1.5 Dishwashers

A separate grease interceptor is recommended for each commercial dishwasher. The size of the interceptor is determined by the GPM discharge rate of the dishwasher as specified by the manufacturer. Select proper interceptor of equivalent or next higher rate from Table A1.2.

Table A1.4
Selection Chart
(Metric Equivalents Omitted for Simplicity)

Fixture Compartment Size (Inches)	Number of Compartments	Drainage Load (Gallons)	Recommended PDI Size Grease Interceptor	
			One-minute drainage period	Two-minute drainage period
18 x 12 x 6	1	4.2	7	4
18 x 14 x 8	1	5.8	7	4
20 x 18 x 8	1	9.4	10	7
18 x 18 x 8	2	15.0	15	10
20 x 18 x 8	2	18.7	20	10
30 x 20 x 8	1	15.5	20	10
24 x 20 x 12	1	18.7	20	10
22 x 20 x 8	2	23.0	25	15
22 x 20 x 12	2	34.0	35	20
24 x 24 x 12	2	44.9	50	25

A1.6 Multiple Fixtures

Where multiple fixtures are served by a single interceptor, calculate the total capacity of all fixtures, establish the maximum number of fixtures that may be drained simultaneously and apply this factor to the total capacity to determine the maximum simultaneous capacity. Then proceed with sizing and selection of interceptor using sizing formula Table A1.3.

A1.7 Alternate Sizing Method Based on Drainage Fixture-Units

Most plumbing codes list drainage Fixture-Unit values for plumbing fixtures and for fixtures not listed, these values are given for drain outlet or trap size. Fixture-Unit values are converted to discharge rates on the basis of one Fixture-Unit equaling 7.5 GPM. See Table A1.7 for recommended PDI size grease interceptor based on drainage Fixture-Unit sizing method.

Table A1.7

Fixture Outlet or Trap Size (Inches)	Drainage Fixture-Unit Value	GPM Equivalent	PDI Size Grease Interceptor
1¼	1	7.5	10
1½	2	15.0	15
2	3	22.0	25
2½	4	30.0	35
3	5	37.5	50
4	6	45.0	50

A2.0 Installation

A2.1 Installation Considerations

A2.1.1 Install interceptor as close as practical to fixture or fixtures being served, see figures A2.5.1 through A2.5.5. The interceptor may be set on the floor, partially recessed in the floor, with top flush

with the floor, or fully recessed below the floor to suit piping and structural conditions.

A2.1.2 Anticipate sufficient clearance for removal of interceptor cover for cleaning.

A2.1.3 Avoid installation wherein long runs of pipe (exceeding 25 feet) are necessary to reach interceptor. This precaution will preclude the possibility of pipeline becoming clogged with congealed grease that will collect before reaching the grease interceptor.

A2.1.4 Do not install grease interceptor in waste line from garbage grinder. Garbage grinder waste must by-pass interceptor, for rapid accumulation of solid matter will greatly reduce grease interceptor efficiency preventing operation in compliance with rated capacity.

A2.2 Flow Control

A2.2.1 The flow control fitting furnished with PDI certified interceptors must be installed ahead of interceptor in the waste line beyond the last connection from the fixture and as close as possible to the underside of lowest fixture. When waste of two or more sinks or fixtures are combined to be served by one interceptor, a single flow control fitting should be used.

A2.2.2 Air intake for flow control may terminate under sink drain board as high as possible to prevent overflow or terminate in a return bend at the same height and on outside of building. When fixture is individually trapped and back-vented, air intake may intersect vent stack. All installation recommendations subject to approval of code authority.

A2.3 Venting

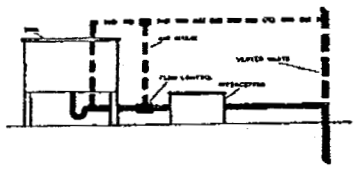
Grease interceptors must have a vented waste, sized in accordance with code requirements for venting traps to retain water seal and prevent siphoning.

A2.4 Multiple Fixture Installation

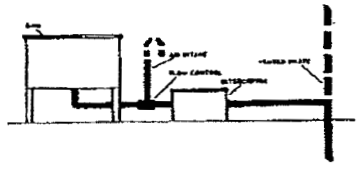
One interceptor to serve multiple fixtures is recommended only where fixtures are located close together. In such installations, each fixture should be individually trapped and back-vented.

A2.5 Installation Diagrams

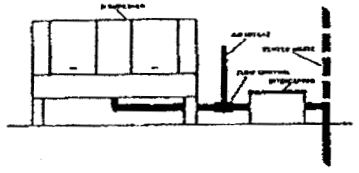
Figures A2.5.1 through A2.5.5 are included to illustrate various grease interceptor installations normally encountered in domestic, commercial and institutional systems. These figures will serve as a guide to practical application of grease interceptors.



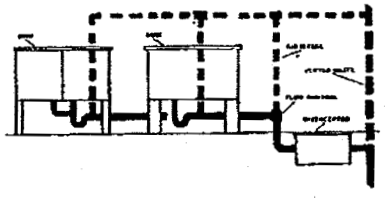
Interceptor Sewing Trapped and Vented Sink-Flow Control Air Intake Intersects Vent
Fig. A2.5.1



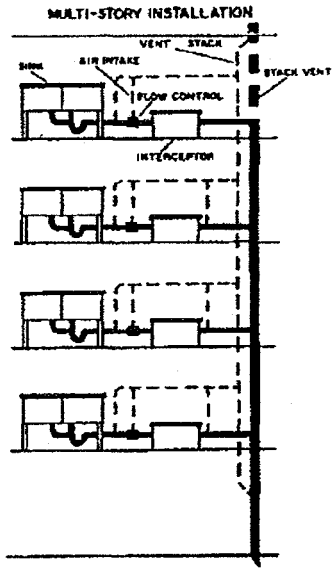
Interceptor Serving Sink-Flow Control Air Intake Terminates in a Return Bend Above Flood Level
Fig. A2.5.2



Interceptor Serving Dishwasher-Flow Control Air Intake Terminates Above Flood Level
Fig. A2.5.3



Interceptor Serving Two Individually Trapped and Vented Sinks-Flow Control Air Intake Intersects Vent
Fig. A2.5.4



Interceptors Sewing Trapped and Vented Sinks-Flow Control Air Intakes Intersect Vent
Fig. A2.5.5

A3.0 Maintenance

A3.1 General Considerations

To obtain optimum operating efficiency of a properly sized and installed PDI certified grease interceptor, a regular schedule of maintenance must be adhered to. All PDI certified grease interceptorsarefurnished with manufacturer's operating and maintenance instructions, which must be followed to insureefficient satisfactory operation.

A3.2 Cleaning

All grease interceptors must be cleaned regularly. The frequency of grease removal is dependent upon the capacity of the interceptor and the quantity of grease in the waste water. Grease removal intervals may therefore vary from once a week to once in several weeks. When the grease removal interval has been determined for a specific installation, regular cleaning at that interval is necessary to maintain the rated efficiency of the interceptor. After the accumulated grease and waste material has been removed, the interceptor should be thoroughly checked to make certain that inlet, outlet and air relief ports are clear of obstructions.

A3.3 Disposition of Intercepted Materials

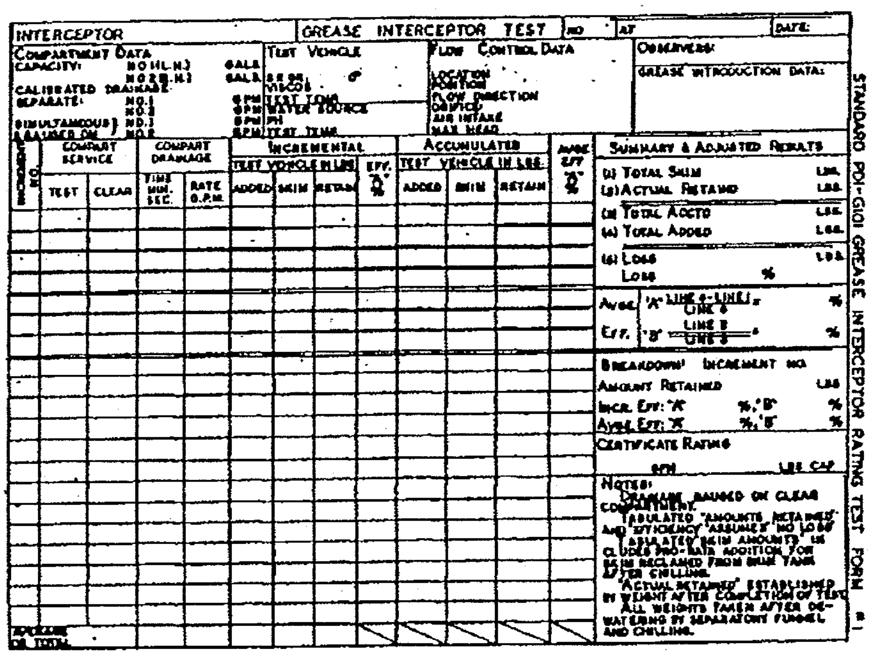
Grease and other waste matter that has been removed from the interceptor should not be introduced into any drain, sewer, or natural body of water. This waste matter should be placed in proper containers for disposal. Where recovery of grease is desired, it can be handled in a manner suitable to the authorities.

THE PLUMBING AND DRAINAGE INSTITUTE
45 Bristol Drive • Suite 101 • South Easton, MA 02375
Tel: (800) 589-8956 • Fax: (508) 230-3529

Printed in U.S.A. 9/96 2M

7.0 Certification Test Procedure

After all preliminary data and tests have been established as previously outlined, the certification tests shall be conducted as follows and all test data is to be recorded on PDI Grease Interceptor Rating Test Form #1.



INTERCEPTOR | GREASE INTERCEPTOR TEST | NO | AT | DATE:

COMPARTMENT DATA
CAPACITY: NO 1 (L.H.) GALS. NO 2 (R.H.) GALS.
CALIBRATED DRAINAGE: SEPARATE: NO.1 GPM, NO.2 GPM; SIMULTANEOUS) NO.1 GPM, BASED ON } NO.2 GPM

TEST VEHICLE: SP. GR., VISCOS., TEST TEMP., WATER SOURCE, PH, TEST TEMP.

FLOW CONTROL DATA: LOCATION, POSITION, FLOW DIRECTION, ORIFICE, AIR INTAKE, MAX HEAD

OBSERVERS:

GREASE INTRODUCTION DATA:

INCREMENT NO.	COMPART SERVICE: TEST	COMPART SERVICE: CLEAR	COMPART DRAINAGE: TIME MIN. SEC.	COMPART DRAINAGE: RATE G.P.M.	INCREMENTAL TEST VEHICLE IN LBS.: ADDED	INCREMENTAL: SKIM	INCREMENTAL: RETAIN	EFF. "A" %	ACCUMULATED TEST VEHICLE IN LBS.: ADDED	ACCUMULATED: SKIM	ACCUMULATED: RETAIN	AVGE EFF "A" %
AVERAGE OR TOTAL												

SUMMARY & ADJUSTED RESULTS
(1) TOTAL SKIM LBS.
(2) ACTUAL RETAINED LBS.
(3) TOTAL ACCTD LBS.
(4) TOTAL ADDED LBS.
(5) LOSS LBS.
LOSS %
AVGE. EFF. "A" = (LINE 4 - LINE 1) / LINE 4 = %
"B" = LINE 2 / LINE 4 = %
BREAKDOWN INCREMENT NO.
AMOUNT RETAINED LBS
INCR. EFF: "A" %, "B" %
AVGE. EFF: "A" %, "B" %
CERTIFICATE RATING
GPM LBS CAP

NOTES:
DRAINAGE BASED ON CLEAR COMPARTMENT.
TABULATED "AMOUNTS RETAINED" AND "EFFICIENCY" ASSUMES NO LOSS.
TABULATED SKIM AMOUNTS INCLUDES PRO-RATA ADDITION FOR SKIM RECLAIMED FROM SKIM TANK AFTER CHILLING.
"ACTUAL RETAINED" ESTABLISHED BY WEIGHT AFTER COMPLETION OF TEST.
ALL WEIGHTS TAKEN AFTER DEWATERING BY SEPARATORY FUNNEL AND CHILLING.

STANDARD PDI-G101 GREASE INTERCEPTOR RATING TEST FORM #1

Return to Section 7.0

Guide To Grease Interceptors

Eliminating the Mystery

- Design & Operation
- Standards
  - *PDI-G101*
  - *A112.14.3 (in preparation)*
  - *A112.14.4 (in preparation)*
- Sizing & Placement
- Maintenance
- New Technology
- Large Outside Interceptors
- Codes & Regulations
- Waste Water Treatment

THE PLUMBING AND DRAINAGE INSTITUTE

45 Bristol Drive · South Easton, MA 02375

Phone: (800) 589-8956
Fax: (508) 230-3529
Web: www.pdionline.org
E-mail: info@pdionline.org

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Acknowledgments

The Plumbing & Drainage Institute wishes to thank its member companies, named below, for their support and assistance in producing this very much needed ***Guide To Grease Interceptors***:

- **Josam Company**
- **Jay R. Smith Mfg. Co.**
- **Wade Division - Tyler Pipe**
- **Watts Regulator Company**
- **Zurn Industries, Inc.**

We particularly wish to thank Jon Wehrenberg whose work entitled ***Understanding Grease Separation and Recovery*** formed the basis for our Guide and who wrote the initial draft. Thanks to George Flegel for his efforts in the areas of technical accuracy and proof-reading which are much appreciated. Many thanks to Cathy Ackil who produced the outstanding illustrations, and to Jerry McDanal, who contributed much effort to revising and fine-tuning the text. Finally, thanks to Billy Smith, Jim Hadley and Al Becker for checking the finished work.

Plumbing & Drainage Institute
South Easton, Massachusetts
William C. Whitehead
June 15, 1998

GREASE INTERCEPTORS: ELIMINATING THE MYSTERY

In the late 1800's Nathanial Whiting of California patented the passive gravity separator, a device known as a grease trap. That device remains relatively unchanged today as a means of separating fats, oils and greases from wastewater. Despite the fact that the technology works well and is little changed from its original design, grease is a problem in almost every locale in the country.

When grease enters the waste stream it creates a variety of problems and once fats, oils and greases have entered the waste stream they are rarely suitable for recycling because of contamination from metals, chemicals and pathogens. Further, disposal must be in accordance with local and federal requirements. The acronym "FOG" is utilized in most contemporary references to fats, oils and greases because with the increased use of vegetable oils and fat substitutes, greases now consist of more than various configurations of fats.

The first problem is not one which affects the waste water system, it is the loss of a potentially valuable resource. When recycled before being in a drain, FOG can be used in a variety of products such as soaps and cosmetics, fertilizer, lamp oil, animal feeds and munitions. Aside from the loss of a valuable commodity, when FOG enters the waste water stream there is a large and unnecessary economic loss due to additional problems. Grease can block pipes, can form aggregates which in turn can also cause blockages, and grease encapsulated solids can increase the time and cost of treating the wastes at waste water treatment plants.

The problems are not limited to any specific size wastewater collection system or treatment facility. Private systems such as septic systems will fail and require costly repair or replacement just as will large systems which might be found in cities such as Chicago, Phoenix, New York or Miami. Grease has been known to cause blockages due to occlusion in pipes many feet in diameter, and in the city of Chicago (as an example) millions of dollars have already been spent replacing large sewers whose internal diameters can now be measured in inches due to solidified grease.

All of the problems are unnecessary because separating grease from waste water is easily accomplished. Grease interceptors or traps function using gravity and coalescence as a means of separation. Greases, fats and oils are about 89 or 90% of the weight of water. To separate them from water an interceptor provides a separation chamber which allows FOG to rise to the surface. FOG free water then exits from the separation chamber at the low point farthest from the inlet end.

To simplify the influences which affect separation one could say there are only three major factors which must be considered. They are the design of the interceptor, the installation of the interceptor, and the maintenance of the interceptor.

INTERCEPTOR DESIGN

Because of the scope of problems relating to FOG, there are a large number of product designs and offerings. Due to this fact it would seem difficult for one to choose an interceptor which would function as designed. Fortunately that is not the case. *See Figures 1 and 2.*

In the early 1940's the United States government through the Army Corps of Engineers, the Quartermaster General, the Surgeon General, and the Research Committee of the Plumbing and Drainage Manufacturer's Association (now the Plumbing and Drainage Institute), and others held a series of conferences to develop a testing program to establish a means of rating flows and capacities for grease interceptors manufactured at that time.

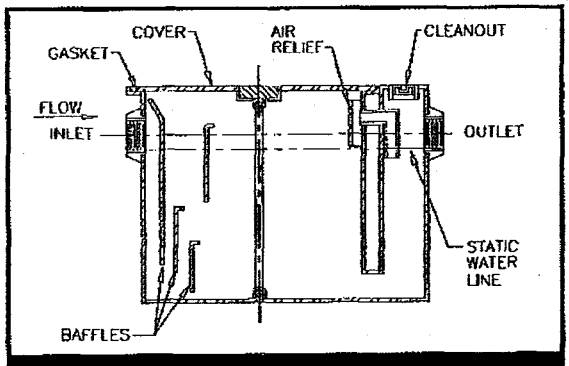


Figure 1: Typical Grease Interceptor

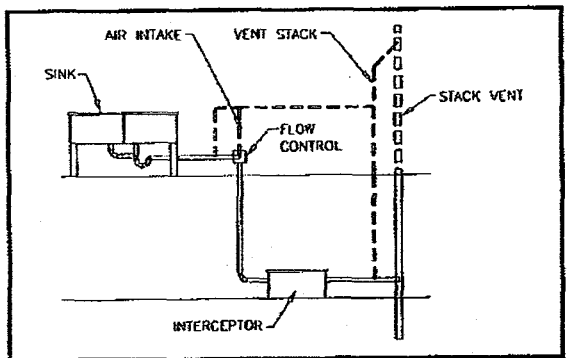


Figure 2: Grease interceptor serving trapped and vented sink on floor above - flow control air intake intersects vent

From the efforts of the involved parties, and as a result of exhaustive laboratory testing by the Iowa Institute of Hydraulic Research at the State University a standard now known as PDI-G101 was developed. Since the first issue of the PDI standard in 1949 it has been widely recognized, and it is included as the basic testing and rating requirement of Military Specification MIL-T-18361, and most recently has become the basis for the yet to be released ASME Standard A112.14.3 which covers Grease Interceptors.

As a result of the existence of PDI-G101 a product which is designed to that standard and is certified as having met that standard can be installed with the confidence that it will be an efficient separator at flow rates up to and including its rated flow and up to and including it's rated capacity for retained FOG.

The products which are certified to PDI-G101 are interceptors up to 50 GPM (soon to be added are 75 and 100 GPM interceptors) which are typically installed at the fixture or the point of use. ***Since a PDI certified interceptor is small, relatively speaking, it accomplishes its separation efficiency by means of specially engineered internal baffling arrangements used in conjunction with an external***

vented flow control device. Using the principles of fluid mechanics, a PDI certified interceptor takes advantage of air entrained in the effluent by the vented flow control device to accelerate separation. *See Figure 3.*

FOG laden waste water passes through a vented flow control device on its way into a PDI certified interceptor. The flow control device has an internal orifice which limits the flow into the interceptor to the interceptor's rated capacity. As the effluent passes through the orifice, which is sized to compensate for the amount of head in the waste water collection system, air is introduced through the vent (which is actually an air intake). The entrained air remains with the effluent until it enters the grease interceptor.

Upon entering the grease interceptor, the effluent is directed through the separation chamber of the interceptor by means of a system of baffles. The baffles serve to lengthen the flow path of the effluent to increase the time of separation while providing a non-turbulent environment for separation to take place. The entrained air will separate from the effluent quickly. As it does so, it accomplishes two things; First, the escaping air accelerates the separation of FOG as it rises rapidly to the surface of the water in the separation chamber. The rising air bubbles literally pull the FOG globules to the top of the water. Second, the air released then provides a small amount of positive pressure above the contents of the separation chamber to regulate the internal running water level of the grease interceptor.

Most manufacturers provide methods to regulate internal air pressure to prevent the contents of the separation chamber from being forced downward thus reducing the interceptor's capacity and efficiency. *See Figure 4.* Furthermore, Most codes contain language requiring a means of preventing the interceptor from becoming air bound. Typically, that language will state: "Venting. Interceptors and separators shall be so designed that they will not become air bound when airtight covers are used".

For the specifier or purchaser of a grease interceptor to be assured the product will perform as intended it is only necessary to verify the product has been certified to a known standard such as PDI-G101.

No discussion of the design of grease interceptors would be complete without covering large capacity interceptors which are

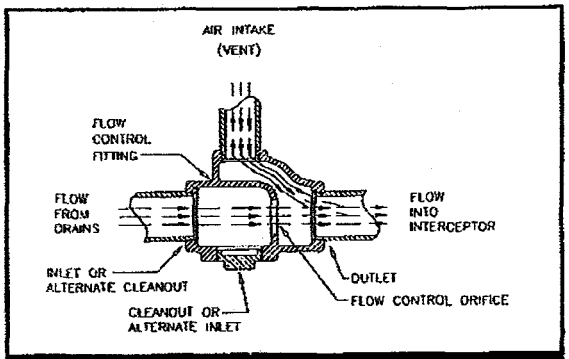


Figure 3: External vented flow control device with air and water flow shown. Actual configuration may vary from design shown.

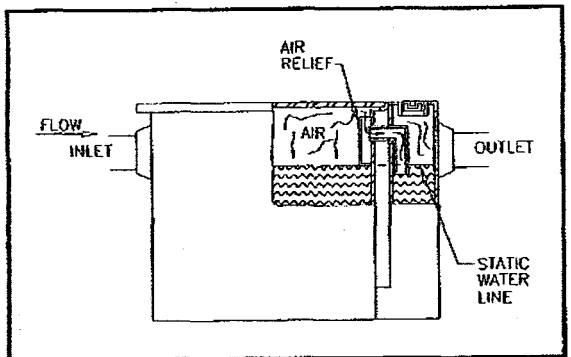


Figure 4: Internal air relief detail

typically located outdoors. In certain areas of the country existing codes will allow or even require an interceptor whose sole specification is size. Unfortunately, even today, more than 100 years since Nathanial Whiting patented the grease interceptor there exists no standard for or base of accumulated data on large capacity interceptors. There is a high expectation that large capacity interceptors will work, but there is no consensus standard or test data to stipulate or verify their performance. *See Figures 5a and 5b.*

Since remotely located outdoor interceptors must deal with conditions different from point of use interceptors the design requirements will vary. One must first define the required retention time based upon the maximum anticipated rate of flow. This varies from city to city or region to region so it must be left up to the appropriate administrative authority to establish this requirement through testing based upon installation conditions. These requirements currently vary from simple statements (in local codes) of minimum capacity size (such as 750 gallons) to retention times based upon flow rates (such as 30 minutes) to formulas which make assumptions about the amount of water used per meal served. The lack of uniformity in sizing requirements for remotely installed interceptors is indicative of the lack of consensus about their performance.

There is an attempt underway to develop a consensus standard for remotely located grease interceptors, but unlike the PDI-G101 or ASME A112.14.3 which have a well documented basis from years of testing, the drafters of that new standard must literally start at the beginning.

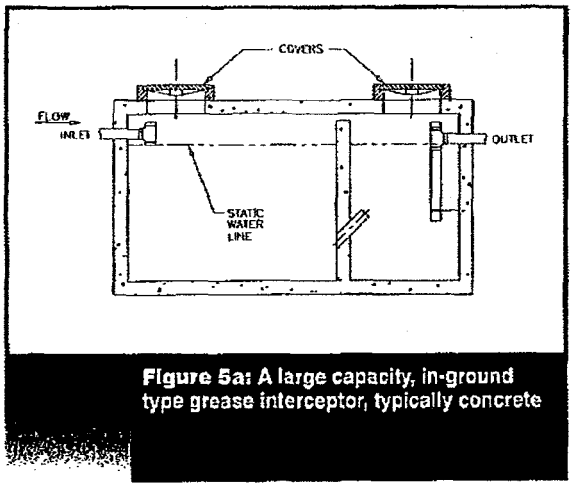


Figure 5a: A large capacity, in-ground type grease interceptor, typically concrete

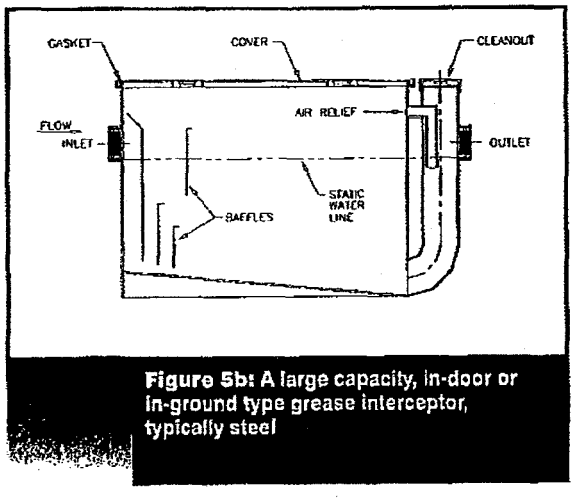


Figure 5b: A large capacity, in-door or in-ground type grease interceptor, typically steel

INSTALLATION

A properly sized and designed grease interceptor may not work or may work less efficiently if it is installed incorrectly. As basic as it seems, the interceptor must not be installed backwards. This is mentioned since far too many interceptors which are condemned for not working have merely been installed backwards. The problems relating to installation, however, go beyond the obvious. Regardless of whether the interceptor is a certified interceptor or a large capacity interceptor, one of the most important installation practices to follow must be to locate the interceptor as near as possible to the source of the FOG laden water. *See Figures 6 and 7.* As stated previously, this is important because every foot of piping between the source of FOG laden waste water and the interceptor is unprotected and is a potential maintenance problem.

A second reason for locating the interceptor near the fixture: FOG separates best when the effluent is relatively hot.

While the laws of physics dictate that FOG separates from water at a slower rate as temperatures increase, in these applications the separation rates at room temperature and at elevated temperatures (testing has been done up to 200 degrees F°) are so close that the other benefits outweigh the slight improvement in separation rate. For example, in waste water, particularly the FOG laden waste water from commercial kitchens, it is likely there will be solids present. These solids and the FOG are more likely to form a globule, the specific gravity of which exceeds that of FOG alone. As the effluent temperature rises however, the FOG will be more likely to separate freely from those solids.

Keeping the FOG from coalescing on the solids is important because the resultant

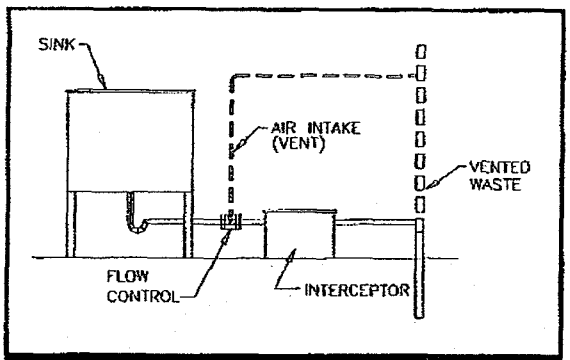


Figure 6: Grease interceptor serving sink - flow control air intake intersects vent

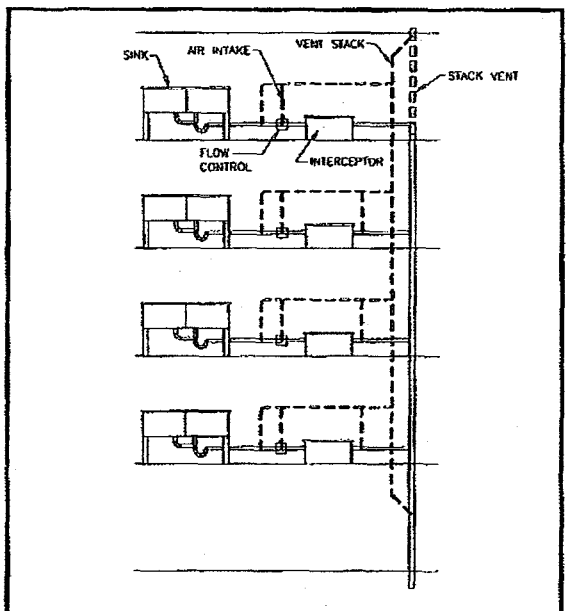


Figure 7: Grease interceptors serving trapped and vented sinks in a multi-story installation - flow control air intakes intersect vent

material may sink, and ultimately be discharged from the interceptor. If on the other hand, the FOG is free to separate from the solids in the waste water due to the higher temperatures, which tend to make the FOG less viscous, the FOG is more likely to be retained in the interceptor.

FOG laden solids passing through the interceptor create two problems. First, they tend to form balls or aggregates (grease can become very hard) posing a blockage problem in the waste water collection system. Second, if these materials do make it to the waste water treatment plant without creating any blockages, they can make waste water treatment much more difficult since degradation of FOG consumes oxygen necessary for the digestion of the waste in the treatment plant and because FOG decomposition is quite slow, it can pass through the plant. This increases the effort required to treat wastes and can cause violations of the plant's discharge permit.

Unfortunately many of the codes in existence around the country fail to recognize the benefits of hot water in the FOG laden waste stream and they forbid such sources of hot water as dishwashers from being a part of the FOG laden waste water system. PDI has done extensive testing on the affect of hot water on separation and can support through data the fact that hot water has little effect on separation efficiency. The Environmental Protection Agency, in their document EPA 625/1-80-012 **(Design Manual: Onsite Wastewater Treatment and Disposal Systems)** is specific in recommending the use of hot water and proximity to the source to enhance retention of FOG.

When discussing the location as a factor in installations, it should also be pointed out that in addition to proximity to the fixture, the interceptor should be located so that maintenance can be easily performed. Although this recommendation also seems so obvious as to not need discussion, some interceptors have been installed under sinks without clearance for removal of the cover. Some interceptors have been placed in the floor and tiled over; some have been located so that they are literally hidden from view; and some large outdoor interceptors have actually been paved over. The placement should allow the cover to be visible and easily removable for cleaning, and clearances should be such that the internal baffling can be serviced. With the cover removed, all wetted surfaces should be visible. This is necessary not only for access to clean the interceptor, but also to have the capability to easily inspect the interior for potential problems such as damaged baffles and blocked air relief bypasses.

The flow control fitting furnished with PDI certified interceptors must be installed in the waste line ahead of the interceptor. It should be located beyond the last connection from the fixture and as close as possible to the underside of the lowest fixture to minimize the effects of head pressure. When the wastes of two or more sinks or fixtures are combined to be served by one interceptor, a single flow control fitting may be used. Any flow control fitting installation not in conformance with these recommendations requires manufacturer consultation.

The air intake for the flow control may terminate under the sink drain board as high as possible above the flood level of the sink in order to prevent overflow. It may also terminate in a return bend at the same height outside the building. When the fixture is individually trapped and back vented, the air intake may intersect the vent stack. All installation recommendations are subject to the approval of the local plumbing code authority. *See Figure 8.*

One of the most controversial issues relating to Installation is: what fixtures or sources must be part of the FOG interceptor system? All drain-bourne FOG is a problem and if the problem is going to be solved all sources of FOG must pass through the grease interceptor. There is little controversy about connecting pot sinks. There is some controversy about connecting dishwashers. There are some questions relating to floor drains, but discharge from food grinders (or garbage disposals) is almost universally required to bypass the grease interceptor or to have the pulverized solids removed from the waste stream before it enters the interceptor.

The food grinder (and the associated prerinse station at the dishwasher) is one of the single greatest sources of FOG. Yet despite that fact, most codes forbid food grinder discharge from passing through a grease interceptor. ***Technologically there is no reason for the waste stream to bypass the grease interceptor if the solids have been removed.*** *See Figure 9.*

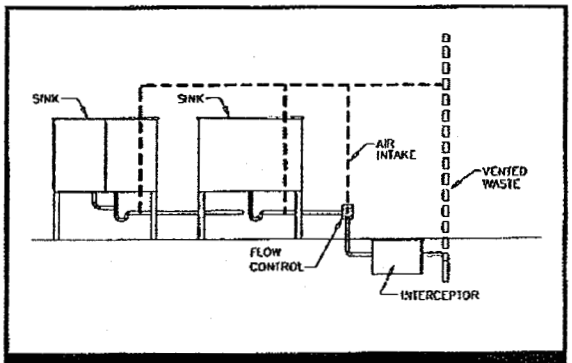


Figure 8: Grease interceptor serving two individually trapped and vented sinks - flow control air intake intersects vent

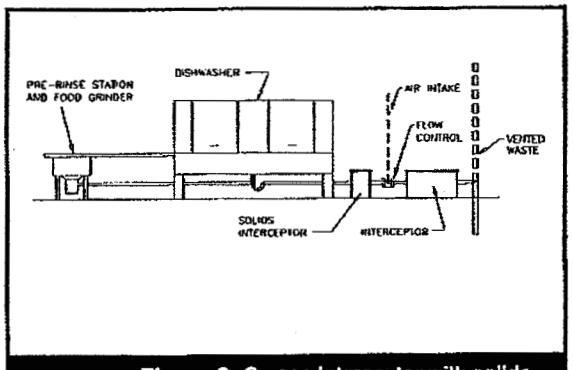


Figure 9: Grease interceptor with solids interceptor servicing dishwasher with prerinse station and food grinder - flow control air intake terminates above flood level

MAINTENANCE

Even the best designed interceptors, properly installed will fail if they are not maintained. The precise requirements for maintenance are not possible to define since conditions at each installation vary. In terms of the typical code, maintenance must be performed before the grease in the waste water down stream from the interceptor exceeds 100 parts per million (100 milligrams per liter) or whatever the local standard is.

While that is a simple statement to make, it is impossible for the user of a grease interceptor to determine when those limits have been exceeded. The method for determining when an interceptor's rated capacity has been reached is fairly simple if it is a PDI certified interceptor. A PDI certified interceptor has a rated retention capacity equal to twice its flow rate expressed in pounds. For example, a 35 GPM interceptor is rated to retain at least 70 lbs. of grease. A user may determine a cleaning schedule by measuring how much grease has been trapped over a period of time.

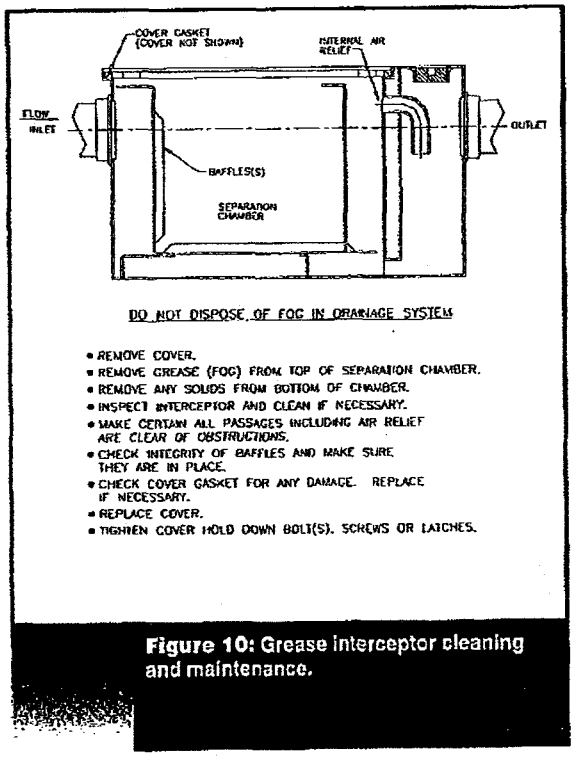


Figure 10: Grease interceptor cleaning and maintenance.

Grease will weigh about 7 pounds per gallon, and if it is determined that a 35 GPM interceptor accumulates about 5 gallons of grease every 4 days it would be easily and correctly assumed that the interceptor must be cleaned no less than once a week. In fact, if the user must comply with a code which limits grease to 100 parts per million, cleaning would be recommended every 2 or 3 days. When cleaning is discussed, it should be understood that cleaning an interceptor should always include the removal of grease from the top of the separation chamber as well as any solids which have accumulated along the bottom. *See Figure 10.*

The actual frequency of cleaning a certified interceptor will vary depending upon a wide variety of factors; the type of food served will determine how much grease will enter the interceptor. An interceptor used for cleaning utensils or limited to serving trays in a restaurant where no food is actually prepared is going to accumulate a lot less grease than one used in a full service restaurant where all of the food preparation equipment and utensils as well as dishes are washed. Another factor affecting the cleaning cycle will be whether a food grinder is discharged into the interceptor, and whether the food specialty is high in FOG.

The allowable grease content in the waste

water will also determine the frequency of cleaning. It should be noted that all PDI certified interceptors will separate efficiently enough to meet any grease limits (which may range from 50 parts per million up to as much as 600 parts per million depending upon the jurisdiction). They may require cleaning when as little as 25% of their rated capacity has been reached depending upon the limits established by the administrative authority. This statement is based on an analysis by PDI of accumulated test data. That data was collected at full rated flows, and does vary from product to product.

The cleaning cycle on large capacity interceptors is less easily determined. Anecdotal evidence gathered from a variety of sources and communities indicates that their size is often interpreted as meaning less frequent cleaning is required, and to a degree this may be true. From information gathered from a variety of sources however, the consensus appears to indicate the cleaning frequency for large interceptors is in the range of 2 to 4 weeks. This amount of time is the maximum allowable for large interceptors to still meet the discharge limits on FOG. Due to the nature of the large interceptors, the user is not likely to be the cleaner, and in some cases may actually be prohibited from cleaning the interceptor. Usually cleaning will be done by a renderer, a septic tank service, or a company which specializes in grease interceptor cleaning. The annual cost of regular cleaning is likely to average between $2,800 and $4,000 depending again upon the discharge limits and the local market costs. (January, 1998 average cost)

Regardless of what the cleaning cycle is determined to be, it has been shown by actual field experience that one of the biggest obstacles to regular maintenance has been the odors usually associated with interceptors. The easiest way to eliminate that problem is frequent cleaning. If cleaning the grease interceptor becomes a part of the daily routine it usually will only require about 15 minutes and there will be limited or no objectionable odors.

It has been determined that when food grinders are part of the waste system, and a properly sized solids interceptor, cleaned daily, is located ahead of the grease interceptor, the odors normally associated with the grease interceptor are not present because the food particles which decay and cause odors never reach the interceptor.

Use of the solids interceptor improves the grease quality to extent that the recovered grease may be disposed of with the golden fryer grease which is usually purchased by the local renderer. Now instead of paying for disposal, the restaurant may be compensated for the grease, since it can be recycled into a variety of products.

When regular maintenance is not performed the obvious result is a grease interceptor which becomes unable to separate the FOG due to overloading, thus passing these materials downstream. ***Unless it is equipped with an electronic, sensor controlled, positive inlet closure valve to prevent such overloading, no grease interceptor will otherwise automatically shut itself down to prevent overload discharge.*** Apart from violating codes or ruining the on-site wastewater treatment system, sewer blockages and the associated health risks are likely. Some FOG generators would rather do almost anything but clean a grease interceptor. FOG generators have several options, some of which are acceptable alternatives, and some of which are possibly legal, but nevertheless unacceptable.

One alternative is to engage the services of a company which specializes in cleaning

interceptors. This is not an inexpensive approach, and in the case of large interceptors is required. If the service is performed as often as necessary, it insures the interceptor will function as intended.

Another alternative is the use of an interceptor that is considered to be a Grease Recovery Device (or Grease Removal Device). A GRD is a separator which has as an integral part of its design a means by which grease is removed.

A GRD will be one of two basic types:

1. Timer controlled - *See Figure 11.*

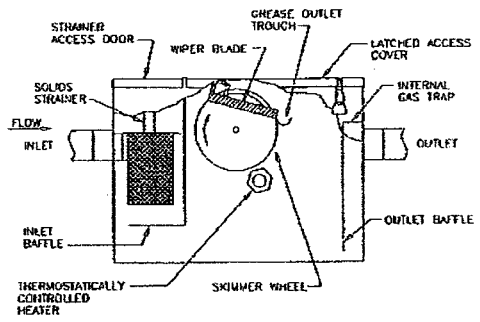


Figure 11: A timer controlled Grease Recovery Device (GRD)

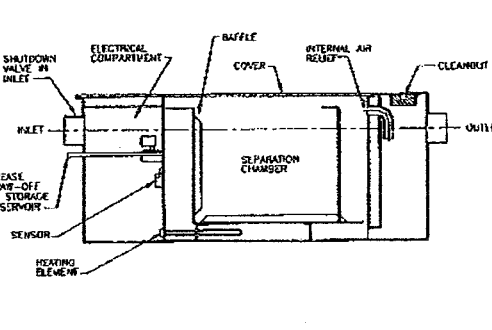


Figure 12: Sensor controlled Grease Recovery Device (GRD)

2. Sensor controlled - *See Figure 12.*

Timer controlled devices typically utilize a disk or belt which passes through the FOG layer and a squeegee device to wipe the accumulated FOG from the disk or belt into a drain trough and into a FOG receptacle. Other means of removing the FOG include a pump or gravity flow activated by the timer. They are usually regulated by a 24 hour timer which is set upon installation. The timer will operate the FOG removal system for a set time or times each day.

Sensor controlled devices have the ability to sense the presence of FOG. By detecting FOG and initiating the removal process only when necessary and as often as necessary, the GRD can always keep the retained FOG below the rated capacity of the device. The sensor operated devices use valving and gravity or pump assisted FOG removal.

A GRD standard, A112.14.4 is currently nearing completion, and as FOG problems continue to be a factor, most jurisdictions will not only allow the use of a GRD, but in some cases a GRD will be mandated. It must be noted that while a GRD eliminates the daily routine of grease interceptor cleaning, these devices do require periodic maintenance to remove trapped solid debris, removal of scum and a check of system operation.

The previous two examples of methods to avoid routine maintenance are certainly good and acceptable choices. ***Some others are not and are to be avoided in conventional grease interceptors.*** The first is the use of chemicals, often touted as environmentally friendly enzymes or emulsifiers. These materials may even have names which imply their use is environmentally acceptable. The second is the use of "bacteria" or organisms designed to digest wastes.

In the first category, the materials used work by changing the structure of FOG from a hydrophobic material that is unlikely to mix freely with water (thus allowing separation to easily occur) to a hydrophilic micelle which mixes freely with water thus inhibiting or preventing separation from occurring in the interceptor. The use of these additives only changes the structure of the FOG for a limited period of time, and eventually the FOG will revert back to its original form, usually downstream in the public waste water collection system. While this practice, in conventional interceptors, works to pass the problems on to somebody else, the methods jurisdictions use today to detect FOG content in the effluent are sophisticated enough to accurately identify any violator of the sewer codes.

The second method, the use of bacteria (or bio-remediation as it is called) works. The concept of bio-remediation is sound: trap greases and digest them in the interceptor to convert the grease permanently into the by-products of digestion. This is exactly what happens in a sophisticated waste water treatment plant. *See Figure 13.* Bio-remediation does not eliminate the need for monitoring the effluent quality, routine maintenance to deal with undigested materials, or inspections to insure all components are clean and functioning properly.

New York City has done an extensive amount of testing using microorganisms for remediation of sewer blockages. Their testing shows that the process has merit and they use bio-remediation in concert with mechanical sewer cleaning to take care of sewer blockages.

For an additive to have any positive effect, it must be known to produce net reduction in weight and volume of the FOG either through biochemical or catalytic processes. Such disposal methods require engineered devices (PDI certified FOG Disposal Systems) and professional administration.

When dealing with a conventional grease interceptor, the most practical and economic maintenance practice is to regularly remove the FOG and dispose of it in accordance with applicable solid and special waste disposal regulations.

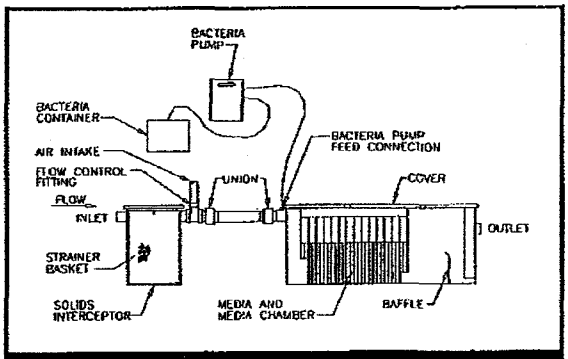


Figure 13: Bio-remediation Grease Interceptor

SUMMARY

The problems relating to fats, oils and greases (FOG) are easily addressed, to do so requires an understanding of the principles of separation and a willingness to do all that is necessary. Dealing with FOG problems is not limited to restaurant owners; it is an issue a number of parties must share in resolving. Codes must be written or, more precisely, rewritten to be technically correct. Administrative Authorities must make certain when they write and/or endorse codes that all of the issues have been correctly addressed.

Interceptors and FOG disposal systems which have been properly designed and certified must be required and used. They must be installed as they were tested and were intended to be installed. And last, but not least, the devices must be maintained according to the codes and the manufacturer's requirements.

REMEMBER: Proper maintenance of even the poorest interceptor will provide better results than the lack of maintenance on the best interceptor.

GLOBAL WATER RESOURCES

CODE OF PRACTICE

GWR-CP-01-003

DRY CLEANING OPERATIONS

APPLICATION

This code of practice for Dry Cleaning operations defines the requirements for managing waste discharged directly or indirectly into a sewer connected to a sewage facility from dry cleaning businesses, or other facilities employing solvent or chemical cleaning routines.

Definitions are included in GWR-CP-01-DEF.

DISCHARGE REGULATIONS

An operator of a dry cleaning operation shall not discharge waste, which at the point of discharge into a sewer contains:

(a) tetrachloroethylene
(b) petroleum solvents, or
(c) a prohibited waste, restricted waste, special waste, storm water, or uncontaminated water.

An operator of a dry cleaning operation that generates wastewater containing tetrachloroethylene or petroleum solvent shall either:

(a) Collect and transport the wastewater from the dry cleaning operation for off-site waste management; or
(b) Install and maintain a solvent/water separator and holding tank in accordance with this code of practice.

Solvent Water Separators and Holding Tanks

Solvent/water separator and holding tank installations must conform to the requirements of this code of practice.

An operator of a dry cleaning operation shall not directly discharge wastewater from the solvent/water separator to a sewage facility

An operator of a dry cleaning operation must:

(a) Collect the wastewater discharged from a solvent/water separator into a transparent, solvent-compatible, holding tank with a containment capacity 25% larger than the total volume of the solvent/water separator; and
(b) Allow the wastewater to stand undisturbed for a period of not less than 12 hours following each operating date.

An operator of a dry cleaning operation must check the contents of the holding tank after the specified period of time has elapsed to determine whether the wastewater contains any visible residual solvent. If there is no visible residual solvent in the holding tank, the contents may be discharged to the sewer.

If the holding tank contains any visible tetrachloroethylene or petroleum solvent after the specified period of time, then the tetrachloroethylene or petroleum solvent must be separated and returned to the solvent recovery system. After the removal of all visible solvent, the wastewater may be discharged to the sanitary sewer.

Visual Inspections

An operator of a dry cleaning operation must:

(a) Visually inspect the solvent/water separator on a daily basis; and
(b) Clean the solvent/water separator at least once every seven (7) days to manufacturer's standards.

Spills and Leaks

An operator of a dry cleaning operation must install spill containment facilities in all chemical storage areas and around all dry cleaning machines.

An operator of a dry cleaning operation must block off all sewer drains within the containment area for chemical storage and dry cleaning equipment to prevent any accidental discharge of solvent to a sewer.

An operator of a dry cleaning operation must inspect all dry cleaning equipment for liquid leaks at least once per day.

An operator of a dry cleaning operation must keep all equipment clean to ensure that leaks are visible.

The following areas and items are to be checked for leaks:

(a) hose connections, unions, couplings and valves
(b) machine door gasket and seating
(c) filter head gasket and seating
(d) pumps
(e) base tanks and storage
(f) solvent/water separators
(g) filter sludge recovery
(h) distillation unit
(i) diverter valves
(j) saturated lint in lint baskets
(k) holding tanks
(l) cartridge filters

An operator of a dry cleaning operation who detects any liquid leak from dry cleaning equipment or chemical storage must repair the leak within 72 hours and must immediately prevent any discharge of contaminants to a sewer.

RECORD KEEPING AND RETENTION

Every dry cleaning operation must keep a record book on site for inspection with records from the previous two years.

The following information shall be recorded in the record book:

(a) record of all inspections done by the operator, employees or other hired personnel;
(b) record of any liquid leaks detected and remedial action taken;

(c) record of solvent/water separator cleaning;
(d) record of holding tank cleaning and solvent transfer; and
(e) record of all other equipment maintenance and repair.

REVISIONS

Date	Revision Number	Revisions	OPI
	ORIGINAL (000)		GSS
25-Mar-04	001	Added revisions table	GSS

GLOBAL WATER RESOURCES

CODE OF PRACTICE

GWR-CP-01-004

PHOTOGRAPHIC IMAGING OPERATIONS

APPLICATION

This code of practice for photographic imaging operations defines mandatory requirements for managing non-domestic waste discharged directly or indirectly into a sewer connected to a sewage facility.

This code of practice applies to photographic imaging operations. Definitions are included in GWR-CP-01-DEF.

DISCHARGE REGULATIONS

An operator of a photographic imaging operation must not discharge waste which, at the point of discharge into a sewer, contains:

a. silver in a concentration that is in excess of 5 milligrams per litre (mg/L) as analyzed in a grab sample; or,
b. prohibited waste, restricted waste, special waste, stormwater, or uncontaminated water as defined in GWR-CP-01-DEF, other than the following restricted wastes: BOD, COD, chloride, iron and sulphate.

An operator of a photographic imaging operation that produces liquid waste containing silver must either:

a. collect and transport the waste from the photographic imaging operation for off-site waste management; or
b. treat the waste at the photographic imaging operation site prior to discharge to the sewer using one of the following silver recovery technologies:
   I. two chemical recovery cartridges connected in a series;
   II. an electrolytic recovery unit followed by two chemical recovery cartridges connected in series; or
   III. any other silver recovery technology, or combination of technologies, capable of reducing the concentration of silver in the waste to 5 mg/L or less where valid analytical test data has been submitted to, and accepted by, the Engineer.

An operator of a photographic imaging operation must install and maintain silver recovery technology according to the manufacturer's or supplier's recommendations.

An operator of a photographic imaging operation must collect all liquid waste containing silver in a holding tank and must deliver this waste to the chemical recovery cartridges using a metering pump.

An operator of a photographic imaging operation must calibrate the metering pump at least once per year.

Spill/Leak Prevention

An operator of a photographic imaging operation must locate the silver recovery system in such a manner that an accidental spill, leak or container failure will not result in liquid waste containing silver in concentrations greater than 5 mg/L entering any sewer.

If a location referred to above is not available, an operator of a photographic imaging operation must do one of the following:

a. install spill containment to contain spills or leaks from the silver recovery system; or
b. cap all floor drains into which liquid spilled from the silver recovery system would normally flow.

Testing

When using two separate chemical recovery cartridges, an operator of a photographic imaging operation must test the discharge from the first cartridge for silver content at least once per month using either silver test paper or a portable silver test kit.

When the discharge from the first chemical recovery cartridge referred to above cannot be sampled, an operator of a photographic imaging operation must:

a. install a cumulative flow meter on the silver recovery system; and
b. test the discharge from the second chemical recovery cartridge once per week using silver test paper or a silver test kit.

Cartridge Replacement

An operator of a photographic imaging operation must replace the chemical recovery cartridges when any one of the following occurs[1] [2] [3]:

a. the manufacturer's or supplier's recommended expiry date, as shown on each cartridge, has been reached;
b. eighty percent (80%) of the manufacturer's or supplier's maximum recommended capacity, or total cumulative flow, for each cartridge has been reached;
c. test data, using silver test paper or a silver test kit, indicates that the discharge from the first cartridge is greater than 1000 mg/L; or
d. analytical data using a method of analysis outlined in standard methods, or an alternative method of analysis approved by the manager, having a method detection limit of 0.5 mg/L

[1] If treatment of liquid waste with two chemical recovery cartridges connected in series is the only silver recovery technology being used, then the owner of the photographic imaging operation must replace both chemical recovery cartridges when one of the events referred to occurs.

[2] If treatment of liquid waste with two chemical recovery cartridges connected in series is used following treatment by an electrolytic recovery unit, the second cartridge may replace the used first cartridge and a new second cartridge may be installed when one of the events referred to occurs.

[3] Both chemical recovery cartridges used following an electrolytic recovery unit must be replaced by the operator of the photographic imaging operation when one of the events referred to above occurs if this is recommended by the manufacturer or supplier of the cartridges.

silver or lower, indicates that the concentration of silver in the discharge from the silver recovery system is greater than, or equal to, 5 mg/L.

RECORD KEEPING AND RETENTION

An operator of a photographic imaging operation that uses a silver recovery system must keep, at the photographic imaging operation site, an operation and maintenance manual pertaining to all equipment used in the silver recovery system.

An operator of a photographic imaging operation that uses two chemical recovery cartridges connected in series must keep a record book at the photographic imaging operation site which includes the following information recorded for the previous two years:

a. serial number of each chemical recovery cartridge used;
b. installation date of each chemical recovery cartridge used;
c. expiry date of each chemical recovery cartridge used (where provided by manufacturers or suppliers);
d. maximum recommended capacity, or total cumulative flow, of each chemical recovery cartridge used;
e. dates of all metering pump calibrations;
f. monthly silver test results on the discharge from the first chemical recovery cartridge; or where the discharge from the first cartridge cannot be sampled, weekly silver test results on the discharge from the second chemical recovery cartridge and weekly cumulative flows through the silver recovery system; and
g. dates and descriptions of all operational problems associated with the chemical recovery cartridges and remedial actions taken.

An operator of a photographic imaging operation that uses an electrolytic recovery unit in addition to two chemical recovery cartridges connected in series must keep a record book at the photographic imaging operation site which includes the following information recorded for the previous two years:

a. all information specified above;
b. date of each removal of silver from the electrolytic recovery unit;
c. date of each maintenance check on the electrolytic recovery unit;
d. dates and descriptions of all operational problems associated with the electrolytic recovery unit and remedial actions taken.

REVISIONS

Date	Revision Number	Revisions	OPI
	ORIGINAL (000)		GSS
25-Mar-04	001	Added revisions table	GSS

GLOBAL WATER RESOURCES

CODE OF PRACTICE

GWR-CP-01-005

DENTAL OPERATIONS

APPLICATION

This code of practice for dental operations defines mandatory requirements for managing non-domestic waste discharged directly or indirectly into a sewer connected to a sewage facility.

This code of practice applies to dental operations.

DISCHARGE REGULATIONS

An operator of a dental operation must not discharge waste which, at the point of discharge into a sewer, contains:

a. prohibited waste, special waste, or stormwater ; or
b. restricted waste with the exception of mercury measured at the point of discharge from a certified amalgam separator.

An operator of a dental operation that produces liquid waste from photographic imaging containing silver shall also comply with the requirements of GWR-CP-01-004.

An operator of a dental operation that produces wastewater containing dental amalgam must either:

a. collect and transport the wastewater from the dental operation for off-site waste management; or
b. treat the wastewater at the dental operation site prior to discharge to the sewer using a certified amalgam separator.

An operator of a dental operation must install and maintain the amalgam separator according to the manufacturer's or supplier's recommendations in order that the amalgam separator functions correctly. Such separator must be certified for use by the manufacturer under the provisions of ISO 11143.

An operator of a dental operation who installs an amalgam separator must ensure that:

a. all dental operation wastewater that contains dental amalgam is treated using the amalgam separator;
b. a monitoring point is installed at the outlet of the amalgam separator or downstream of the amalgam separator at a location upstream of any discharge of other waste;
c. the monitoring point must be installed in such a manner that the total flow from the amalgam separator may be intercepted and sampled; and
d. the monitoring point shall be readily and easily accessible at all times for inspection.

If the amalgam separator is located downstream of a wet vacuum system, an operator of a dental operation must ensure that:

a. the wet vacuum system is fitted with an internal flow control fitting; or

b. a flow control fitting is installed on the water supply line to the wet vacuum system.

The flow control fitting must be sized to limit the flow to a rate that is no more than the maximum inlet flow rate of the amalgam separator as stated by the manufacturer of the amalgam separator.

An operator of a dental operation must locate an amalgam separator in such a manner that an accidental spill, leak or collecting container failure will not result in waste containing amalgam entering any sewer. If a location is not available, an operator of a dental operation must do one of the following:

a. install spill containment to contain spills or leaks from the amalgam separator; or
b. cap all floor drains into which liquid spilled from the amalgam separator would normally flow.

An operator of a dental operation must replace the amalgam separator's collecting container when any one of the following occurs:

a. the manufacturer's or supplier's recommended expiry date, as shown on the amalgam separator, has been reached; or
b. the warning level specified in the ISO 11143 has been reached; or
c. analytical data obtained using a method of analysis outlined in standard methods, or an alternative method of analysis approved by the manager, having a method detection limit of 0.1 mg/L or lower, indicates that the total concentration of mercury in the discharge from the amalgam separator is greater than, or equal to, 2 mg/L.

An operator of a dental operation shall not dispose of dental amalgam collected in an amalgam separator, a collecting container, or any other device, to a sewer.

RECORD KEEPING AND RETENTION

An operator of a dental operation that uses an amalgam separator must keep, at the site of installation of the amalgam separator, an operation and maintenance manual containing instructions for installation, use, maintenance and service of the amalgam separator installed.

An operator of a dental operation that uses an amalgam separator must post, at the site of installation of the amalgam separator, a copy of the ISO Standard test report pertaining to the amalgam separator installed.

An operator of a dental operation that uses an amalgam separator must keep a record book at the dental operation site that includes the following information pertaining to the amalgam separator installed:

a. date of installation of the amalgam separator and name of the installation service provider;
b. serial number and expiry date of the amalgam separator and/or its components;
c. maximum recommended flow rate through the amalgam separator, where applicable;
d. dates of inspection, maintenance, cleaning and replacement of any amalgam separation equipment or components;
e. dates and descriptions of all operational problems, spills, leaks or collecting container failures associated with the amalgam separator and remedial actions taken;
f. name, address and telephone number of any person or company who performs any maintenance or disposal services related to the operation of the amalgam separator; and
g. dates of pick-up of the collecting container for off-site disposal, volume of waste disposed and the location of disposal.

The records must be retained for a period of two years and must be available on request.

REVISIONS

Date	Revision Number	Revisions	OPI
	ORIGINAL (000)		GSS
25-Mar-04	001	Added Revisions Table	GSS

GLOBAL WATER RESOURCES (GWR)

CODE OF PRACTICE

GWR-CP-01-006

DETERMINATION OF CAPACITY IMPACT OF COMMERCIAL UNITS

APPLICATION

This code of practice defines the methodology employed to determine the impact of commercial customers on the water supply, distribution, and wastewater collection, treatment and disposal operations.

The code of practice applies to any non-residential customer, and to other establishments or uses where the GWR Engineer has determined the impact will be greater than a residential customer.

METHODOLOGY

In order to assess the impact of a commercial operation on the Utility's supply and treatment infrastructures, GWR employs a fixture unit (FU) review as compared to a typical residential unit. This analysis ensures that the peak water and wastewater demands are accounted for, and a proper allocation of resources. Fixture unit allocations are developed from the Unified Plumbing Code (UPC). In cases where no direct FU allocation exists in the UPC, the GWR Engineer will assign a value.

The total FU count is compared to the typical residential fixture unit counts to determine the Equivalent Development Unit (EDU) value, which is used for determining capacity fees, hook-up fees and other impact related metrics used by the Utility in maintaining its Capacity Management and Operations Management Plan.

For the purposes of this Code of Practice, the following Residential Fixture Unit values are employed:

Residential Water Use	46 FUs
Residential Sewer Use	44 FUs

An example of this calculation is shown in the accompanying table:

Items		FU's		COMMERCIAL WATER Number	Total (Water)	COMMERCIAL SEWER Number	Total Sewer
Urinals	Stall/Wall	4		2	8	2	8
	Pedestal/Siphon	12					
Sinks							
	Bar	2					
	Industrial Wash-Up	6		0	0	0	0
	Kitchen	4		2	8	2	8
	Lavatory	2		6	12	6	12
Showers		4					
Floor Drains		4				3	12
	Grease & Solids	6					
Dishwashers							
	Conveyor	100					
	Under Counter	10		1	10	1	10
	Residential	8					
Disposals		50					
Clothes Washer							
	Residential	4					
	Automatic 8 lb	16					
	Automatic 12-19 lb	20					
	Automatic 20-39 lb	22					
	Automatic 40-50 lb	24					
Drinking Fountains		2		2	4	2	4
Water Closet							
	Tank	8					
	Flush Valve	12		6	72	6	72
Hose Bibs		2		2	4		
Landscaping		12	/1000 sq ft	250	3		
Swimming Pool		5	/100 sq ft	6550	327.5		
Swimming Pool Filter Backwash		10				1	10
Cooling Water		15	/ton				
		TOTAL			448.5 FU's		136 FU's
		Factor			9.75		3.09

In this case, the impact of the Commercial Customer is equivalent to 9.75 residential units with respect to water, and 3.09 residential units with respect to water.

COMMERCIAL APPLICANT REQUIRMENTS

Prior to applying for water service, a Non-Residential Customer shall provide plans of the proposed structure in sufficient detail for GWR to analyze the impact.

REVISIONS

Date	Revision Number	Revisions	OPI
20-Apr-04	ORIGINAL (000)		GSS

GLOBAL WATER RESOURCES (GWR)

CODE OF PRACTICE

GWR-CP-01-007

OPTIMIZING LANDSCAPE CONFIGURATION

PURPOSE

The purpose of this code of practice is to define the optimum landscape configuration to allow for a minimum of supplemental water and a maximum usage of reclaimed water.

Intuitively, these two requirements are at odds, and in the analysis are divergent goals. Consider the case where the goal is ensure that there is no routine delivery of water to the AzPDES discharge site. Under theses conditions, a configuration that allows for maximum water consumption in the winter months would yield a 100% turf component. In the summer, however, this configuration will result in a maximum requirement for the augmentation of water supplies.

Choosing the other extreme, i.e. the elimination of the supplemental water requirement, will result in substantial discharges to the AzPDES point at all times during the year. This violates the "seasonal" nature of the AzPDES permit, and also discards revenue in the form of reclaimed water.

MODEL

A model has been developed which will determine, on a monthly flow basis, what the requirements for irrigation, supplemental addition of raw water, and flows to the AzPDES point are for a typical section. The goal of the model is to provide the basis from which a determination on the optimum land-use configuration for the utility can be established.

The model minimizes the cost to the utility of providing supplemental water in the summer months, and minimizes discharge of water to the AzPDES point in the winter.

The model operates under the following constraints:

1. One section = 640 acres
2. Occupancy = 3.5 DUs per acre
3. Open Space = 15%
4. Trees in Turf = 375 per section
5. Water production = 162 gallons per day per unit
6. Storage in Lakes is a maximum of 2.5 feet.
7. Storage must result in a minimum storage of 6 days of ADF.
8. The maximum lake size is 3 acres
9. Occupancy is varied from 100% in winter to 90% in summer

The model then manipulates the following variables to minimize the Total Cost to the Utility:

1. The percentage of turf area;
2. The percentage of xeriscape area; and
3. The freeboard in the lakes.

OUTPUT

In order to drive the cost to the utility to zero, the following configuration is required:

Turf = 18% (17.3 ac)
Xeriscape = 44% (42.2 ac)
Lakes = 38% (36.5 ac)

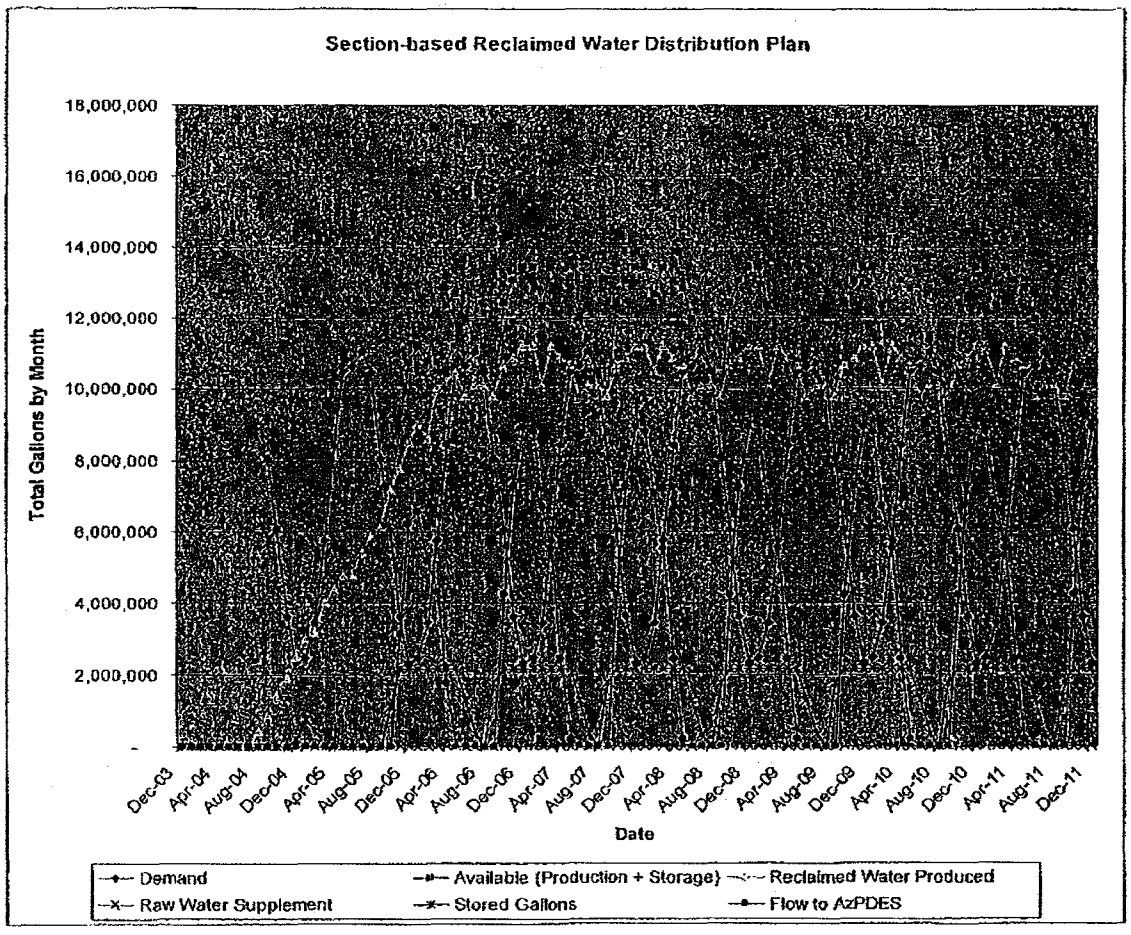
Clearly, the requirement to maintain 36.5 acres of lakes is excessive.

If we then choose to minimize the cost to the utility and maintain the requirement for lakes to say a maximum of 3 acres, the optimum configuration is:

Turf = 22% (21.44 ac)
Xeriscape = 75% (71.88 ac)
Lakes = 3% (2.67 ac)

The cost to the utility under these conditions is in the order of $4380.00 per month, which is represented as missed water revenue – i.e. water treated by the utility but not sold.

As a result, the following graph depicts the seasonal disposition of water in the section:



DIRECTION TO DEVELOPERS

Developers submitting plans for approval to the Utility must provide the following:

1. Storage capable of handling 6 days with no irrigation use.
2. The model employs a maximum lake area of 3.0 acres. Larger lakes are possible, and even desirable for the reduction of flow to the AzPDES point, which corresponds to a lower loss of revenue from wasted reclaimed water.
3. A minimum configuration of the following is required:

   Turf = 22%
   Xeriscape = 75%
   Lakes = 3%

   Changing the configuration is possible, but may result in additional costs to the developers, if it results in increased costs to the Utility.

From an infrastructure standpoint, the following minimum requirements exist:

1. Lakes must have level control stilling well
2. Power to lake control must be provided
3. Ethernet cable to the Control Sites is required
4. A utility specified RTU (radio/controller)
5. Flow meters with a 4-20 mA analog signal are required
6. Motorized valves are required to control flow to the irrigation lakes.

REVISIONS

Date	Revision Number	Revisions	OPI
	ORIGINAL (000)		GSS
25-Mar-04	001	Added revisions table	GSS
30-Jun-04	002	Minor typo corrections	GSS

GLOBAL WATER RESOURCES (GWR)

CODE OF PRACTICE

GWR-CP-01-008

ACCEPTANCE OF UNDERGROUND FACILITIES

BACKGROUND

This code of practice details the requirements for acceptance of builder/contractor-deployed infrastructure into the Utility's inventory.

GENERAL

No new utility improvements shall serve a customer until Global Water is satisfied that all of the facilities have been properly installed, constructed and/or disinfected.

No untreated sewage or inadequately treated wastes shall be discharged to a ditch, stream or lake without a written permit from the applicable regulatory agencies prior to the time of discharge.

No other utility lines or systems are to be placed in the same trench as sewer lines, reclaimed water lines or potable water lines without the prior written authorization from Global Water.

No person shall install, permit to be installed or maintain an interconnection or other connection between any part of the sewerage system and a potable water supply or a public water supply in such manner that sewage or waste may find its way into or otherwise contaminate any potable or public water supply. The developer shall provide an approved backflow prevention device for any water connection to the potable water system that will be used for any construction purposes. The Utility, at its discretion, may require the use of a Utility-owned and maintained back-flow prevention device, the cost of which shall be borne by the Contractor. An air gap between the potable water supply and any water or wastes on site shall be maintained at all times.

FINAL APPROVAL/ACCEPTANCE OF UTILITIES

No new utilities will be accepted by Global Water until the following has occurred:

1. All installed facilities have been inspected, tested, and approved.
2. A video survey of all sewer infrastructure has been completed after paving operations.
3. A copy of all test reports, including trench compaction tests, and inspections has been provided to Global Water.
4. All punchlist items required by the Global Water inspector have been addressed.
5. Record drawings (as-builts) have been supplied to Global Water by the Engineer-of-Record including AutoCAD files.
6. A signed ADEQ "Certificate of Approval of Construction" has been provided to Global Water.
7. The developer has furnished copies of the contract, copies of all checks paid to the Contractor, and UNCONDITIONAL LIEN WAIVERS from the Contractor.
8. Any other outstanding issues.

Water meters will NOT be installed to any water service location until the sewer system is accepted by Global Water, all easements have been signed and recorded, and the video, mainline and services, approved.

Three hard copy set of as-built drawings and one electronic set on CDR disk shall be provided with at least two points referenced to Global Water's GIS system. Drawings shall be supplied in a file format compatible with AutoCAD.

CRITERIA

The code of practice is divided into four Appendices:

A. Inspection, Testing, Approval and Acceptance of Gravity Flow Sanitary Sewers
B. Inspection, Testing, Approval and Acceptance of Man-Holes
C. Inspection, Testing, Approval and Acceptance of Sewer Force Mains
D. Inspection, Testing, Approval and Acceptance of Water Mains

Appendix A

INSPECTION, TESTING, APPROVAL AND ACCEPTANCE OF GRAVITY FLOW SANITARY SEWERS

APPLICATION

This section applies to the inspection, testing, approval and acceptance of gravity flow sanitary sewers, including appurtenances normally installed as part of the system. The work includes leakage testing, deflection testing of flexible pipe system and video inspection of the interior of the finished sewer system.

MATERIALS

Equipment necessary for any of the tests shall be of the type, quality and capacity to perform the operations required and to execute the tests specified, and shall be furnished by the Contractor, including all labor and materials.

INSPECTION

Global Water's Inspector shall inspect and approve all work accomplished.

CLEANING

Prior to testing any section of sewer, the Contractor shall remove all foreign matter from the interior of the system. Flushing a cleaning ball, pressure jetting or other appropriate cleaning method approved by Global Water's Inspector may be used. Watertight plugs or other methods approved by Global Water's Inspector shall then be used to prevent dirt or debris from entering the system.

The material jetted downstream shall be intercepted and removed by a hydrovac truck.

UNDER NO CIRCUMSTANCES SHALL FLUSHING DEBRIS OR MATERIAL BE ALLOWED PASS INTO THE UTILITY'S BACKBONE INFRASTRUCTURE.

TESTING

Testing shall be conducted by the Contractor and at his own expense except as noted herein. Testing shall be conducted after the asphalt has been laid, and the final adjustments have been made in man-hole heights. The following tests are required:

1. Engineer's Certificate of Completion
2. Deflection Test
3. Uniform Slope Tests
4. Leakage Tests of Pipe and Manholes
5. Video Survey (with video tape or other acceptable electronic format and printed test results).

All testing shall be accomplished in the presence of the Global Water Inspector or his authorized representative. Copies of all test results shall be given to the Global Water Inspector.

Global Water shall be notified 48 hours in advance of the testing.

Testing shall not commence on any portion of the pipeline, until all field placed concrete in contact with the pipe, fittings or appurtenances is adequately cured.

DEFLECTION TEST

All sewer pipe made of flexible materials shall be subjected to a deflection test. Deflection tests shall be conducted in the presence of the Global Water's Inspector or his designate and after the pipe has been installed and backfilled.

The deflection test shall be conducted by pulling a mandrel (go-no go device) through the pipe. The mandrel shall be designed and sized for each size of pipe and shall be at least 1.5 pipe diameters in length. The mandrel shall be constructed with an odd number of runners placed parallel to the pipe centerline and equally spaced around the perimeter of the mandrel. Mandrels for 8 inch pipe shall be constructed with at least 9 runners, and more runners shall be utilized for larger pipe sizes. Test mandrel shall be furnished by the Contractor. All test equipment, calibration data and procedures shall be subject to the approval of Global Water's Inspector.

Criteria

Ring or diametric deflection of the installed pipe shall not exceed 5% of the design internal diameter of the pipe. Pipe sections that restrict free passage of the mandrel shall be removed and replaced or excavated, re-bedded, backfilled and retested.

All such repairs, replacement, remedial work and retesting performed by the Contractor shall be at his expense.

The deflection test may be conducted concurrently with the video inspection of the pipe interior, subject to approval by Global Water.

VIDEO INSPECTION

IMPORTANT

VIDEO INSPECTION OF GRAVITY SEWER MAINS IS TO BE COMPLETED AFTER THE MANHOLES HAVE BEEN BROUGHT TO FINAL GRADE, AND ON COMPLETION OF ASPHALTING OF ANY PAVED SURFACE.

All sewer infrastructure shall be inspected by video camera prior to final acceptance of the pipeline. The costs incurred in making the acceptance inspection by video camera shall be borne by the Utility. If on review of the video, deficiencies are noted, these are to be rectified by the Contractor at his expense. On completion of repairs, a second video is required. This re-video shall be paid for by the Contractor.

Video equipment expressly designed for pipeline inspection purposes and operated by experienced and qualified personnel shall be pulled through the entire pipeline. The video operator shall maintain a log of all inspections and note location, type and extent of any deficiencies. The video operator shall also photograph all deficiencies, copies of which shall be given to Global Water.

The Contractor shall bear all costs incurred in correcting deficiencies found during the video inspection, including cost of additional video inspection required to verify correction of noted deficiencies.

The video shall verify the uniform slope of the entire system length, including any installed laterals.

A copy of the video and report (or other acceptable electronic format) and printed test results shall be furnished to Global Water.

NOTE:

The sewer pipeline Contractor, or the Owner/Builder may, for his own use, wish to video the installed sewer lines prior to paving to assure himself that the system will pass the inspection once the streets are

paved and the man-hole rims are brought to the final grade. Any and/or all portions of the sewer collection system that must be removed, replaced, and/or repaired to pass all of the specified testing will require that the streets be repaired prior to final acceptance. This will include trench compaction, replacement of ABC, and replacement of the asphalt surface to the satisfaction of the jurisdictional authority. Following any repairs to the system, that portion of the system plus one man-hole upstream and downstream of the repaired section shall be re-videoed at the Contractor's expense. This video and printed test results shall be provided to the Global Water Inspector.

WATERTIGHT INTEGRITY

The Contractor shall test the sewer line for leakage using the applicable method below and record the results:

1. Standard Test Method for Installation Acceptance of Plastic Gravity Sewer Lines Using Low-Pressure Air (ASTM F 1417-92)
2. Standard Practice for Testing Concrete Pipe Sewer Lines by Low Pressure Air Test Method (ASTM C 924-89)
3. Standard Test Method for Low-Pressure Air Test of Vitrified Clay Pipe Lines (ASTM C 828-98)

ACCEPTANCE

The Contractor shall remedy, at his own expense, any poor alignment or any other defects in workmanship or materials revealed by final inspection. Final acceptance will be based on re-inspection of the sewer after the appropriate repairs and corrections are completed.

Flow of any kind into the existing sewerage system shall not be allowed until the sewer has been approved and accepted for use by Global Water.

Portions of the work completed may be placed in operation after all cleaning, testing and inspection requirements have been fulfilled. Such partial use or partial acceptance shall be subject to approval of Global Water's Inspector.

Under no circumstances shall any portion of the sewer collection system be placed in operations unless the pipeline is able to discharge directly to the Utility's backbone system. Upstream collection, hauling/pumping of raw wastewater will not be allowed.

Appendix B

INSPECTION, TESTING, APPROVAL AND ACCEPTANCE OF MAN-HOLES

APPLICATION

This section applies to the inspection, testing, approval and acceptance of man-holes. The work includes leakage testing.

MATERIALS

Water used for watertight integrity tests shall be potable water, reclaimed water or as otherwise approved by the Global Water Inspector.

Equipment necessary for any of the tests shall be of the type, quality and capacity to perform the operations required and to execute the tests specified, and shall be furnished by the Contractor including all labor and materials (including water).

INSPECTION

Global Water's Inspector shall inspect and approve all work accomplished.

CLEANING

Prior to testing any manhole, the Contractor shall remove all foreign matter from the interior of the manhole. Chunks of concrete, mortar or other debris (including dirt that may have intruded into the interior of the manholes) shall be removed by mechanical means. Small gravel or grit may be removed by flushing, pressure jetting or other appropriate cleaning methods approved by Global Water. After cleaning, the manhole cover shall be positioned to prevent dirt or debris from entering the manhole. Other means of preventing intrusion of dirt or debris may be employed if approved by Global Water.

Any material jetted downstream shall be intercepted and removed by a hydrovac truck. Under no circumstances shall material be allowed pass into the Utility's backbone infrastructure.

TESTING

Testing shall be conducted by the Contractor his own expense. Testing shall be conducted after the asphalt has been laid, and the final adjustments have been made in man-hole heights. The following tests are required:

1. Watertight Integrity Test

All testing shall be accomplished in the presence of the Global Water Inspector or his authorized representative.

Global Water shall be notified 48 hours in advance of the testing.

Testing shall not commence on any portion of the pipeline, until all field placed concrete in contact with the pipe, fittings or appurtenances is adequately cured.

WATERTIGHT INTEGRITY

The Contractor shall test man-holes using one of the following test protocols:

1. Watertight testing by filling the manhole with water. The maximum acceptable water drop is 0.001 of the total man-hole volume in one hour.

2. Air pressure testing using the "Standard Test Method for Concrete Sewer Man-Holes by Negative Air Pressure (Vacuum) Test (ASTM C 1244-93).

Man-hole testing shall be completed after the installation of the man-hole cone to verify the watertight integrity of the man-hole from the top of the cone down. Upon satisfactory completion of the test results, the Contractor shall install the man-hole ring and any spacers, complete the joints and seal the man-hole to a watertight condition.

If the man-hole cone, spacers and ring can be installed to final grade without disturbance or adjustment by later construction, the Contractor may perform the testing from the top of the ring down. In the event that an "accepted" man-hole is disturbed during follow-on construction activities, the Contractor shall re-test the man-hole.

ACCEPTANCE

The Contractor shall remedy, at his own expense, any poor alignment or any other defects in workmanship or materials revealed by final inspection. Final acceptance will be based on re-inspection of the sewer after the appropriate repairs and corrections are completed.

Flow of any kind into the existing sewerage system shall not be allowed until the sewer lines and manholes have been satisfactorily completed and accepted for use by Global Water.

Portions of the work completed may be placed in operation after all cleaning, testing and inspection requirements have been fulfilled. Such partial use or partial acceptance shall be subject to approval of Global Water's Inspector. Portions of the work to be placed in operation shall proceed from the connection to the Utility's backbone collection system moving upstream.

Appendix C

INSPECTION, TESTING, APPROVAL AND ACCEPTANCE OF SEWER FORCE MAINS

APPLICATION

This section applies to the inspection, testing, approval and acceptance of sewer force mains, including appurtenances normally installed as part of the system. The work includes pressure and leakage testing.

MATERIALS

Water employed in testing of sewer force mains shall be potable water, reclaimed water or raw water as determined by Global Water's Inspector.

Equipment necessary for any of the tests shall be of the type, quality and capacity to perform the operations required and to execute the tests specified, and shall be furnished by the Contractor, including all labor, materials and water.

INSPECTION

Global Water's Inspector shall inspect and approve all work accomplished. All tests and inspections shall be made prior to backfilling of the open trench.

CLEANING

Prior to testing any section of sewer force main, the Contractor shall remove all foreign matter from the interior of the system. Flushing a cleaning ball, pig, pressure jetting or other appropriate cleaning method approved by Global Water's Inspector may be used. Watertight plugs, isolation valves or other methods approved by Global Water's Inspector shall then be used to prevent dirt or debris from entering the system.

The material jetted downstream shall be intercepted and removed by a hydrovac truck.

UNDER NO CIRCUMSTANCES SHALL MATERIAL BE ALLOWED PASS INTO THE UTILITY'S BACKBONE INFRASTRUCTURE, INCLUDING LIFT STATIONS AND RECEIVING MAN-HOLES.

TESTING

Testing shall be conducted by the Contractor at his own expense. The following tests are required:

1. Pressure Test
2. Leakage Test

All testing shall be accomplished in the presence of the Global Water Inspector or his authorized representative.

Global Water shall be notified 48 hours in advance of the testing.

Testing shall not commence on any portion of the pipeline, until all field placed concrete in contact with the pipe, fittings or appurtenances is adequately cured.

PRESSURE TEST

The line shall be tested at a minimum pressure of 100 psi, 125% of the design pressure, or the test pressure specified by ADEQ (whichever is more).

The duration of each pressure test shall be as directed by the Global Water Inspector.

Each valved section of pipe shall be slowly filled with water at the specified test pressure measured at the point of lowest elevation. Pressure shall be applied and maintained by means of a pump connected to the pipe in a satisfactory manner. The pump, pipe connection, and all necessary apparatus except meters shall be furnished by the contractor, and the contractor shall furnish all necessary labor for connecting the pump, meter, and gages.

As the line is being filled and before applying the test pressure, all air shall be expelled from the pipe. To accomplish this, taps shall be made, if necessary, at points of highest elevation. After the test, the taps shall be tightly plugged.

During the time the test pressure is on the pipe, the line shall be carefully checked at regular intervals for breaks or leaks. Any joints showing appreciable leaks shall be repaired and any cracked or defective pipes or fittings shall be removed and replaced with sound material in the manner provided and the test shall be repeated until satisfactory results are obtained.

LEAKAGE TEST

After all defects have been satisfactorily repaired and all visible leaks stopped, a leakage test shall be made on each valved section of the lines to determine the quantity of water lost by leakage. The contractor shall furnish all labor, material, and equipment required for making the test. The leakage shall be determined by measuring the quantity of water supplied to each valved section of the lines, during the test period, when the various sections of the lines are under pressure. No pipe installation will be accepted until or unless the leakage as determined by above test is less than the amount set forth below.

The allowable leakage (gallons per hour) shall not be greater than determined by the following formula:

$$L = \frac{JD\ P^{1/2}}{4500}$$

L = Gallons Per Hour
D = Nominal Pipe Diameter (in.)
J = Number of Joints
P = Test Pressure (PSI)

If individual sections show leakage greater than the limits specified above, the contractor shall, at his own expense locate and repair the defective joints until the leakage is within the specified allowance.

ACCEPTANCE

The Contractor shall remedy, at his own expense, any poor alignment or any other defects in workmanship or materials revealed by final inspection. Final acceptance will be based on re-inspection of the sewer after the appropriate repairs and corrections are completed.

Flow of any kind into the existing sewerage system shall not be allowed until the inspection and testing of forcemains has been satisfactorily completed and accepted for use by Global Water.

Portions of the work completed may be placed in operation after all cleaning, testing and inspection requirements have been fulfilled. Such partial use or partial acceptance shall be subject to approval of Global Water's Inspector.

Appendix D

INSPECTION, TESTING, APPROVAL AND ACCEPTANCE OF WATER MAINS

APPLICATION

This section applies to the inspection, testing, approval and acceptance of water distribution mains, including appurtenances normally installed as part of the system. The work includes leakage testing and superchlorination requirements.

MATERIALS

Water employed in testing of water mains shall be potable water only.

Equipment necessary for any of the tests shall be of the type, quality and capacity to perform the operations required and to execute the tests specified, and shall be furnished by the Contractor, including all labor, materials, chemicals and water.

INSPECTION

Global Water's Inspector shall inspect and approve all work accomplished.

CLEANING

Prior to testing any section of water main, the Contractor shall remove all foreign matter from the interior of the system. Flushing a cleaning ball, pig, pressure jetting or other appropriate cleaning method approved by Global Water's Inspector may be used. Watertight plugs, isolation valves or other methods approved by Global Water's Inspector shall then be used to prevent dirt or debris from entering the system.

TESTING

Testing shall be conducted by the Contractor and at this own expense. The following tests are required:

1. Pressure Test
2. Leakage Test

All testing shall be accomplished in the presence of the Inspector or his authorized representative.

Global Water shall be notified 48 hours in advance of the testing.

Testing shall not commence on any portion of the pipeline, until all field placed concrete in contact with the pipe, fittings or appurtenances is adequately cured.

PRESSURE TEST

The line shall be tested at a minimum pressure of 100 psi, 125% of the design pressure or the test pressure specified by ADEQ (whichever is more).

The duration of each pressure test shall be as directed by the Global Water Inspector.

Each valved section of pipe shall be slowly filled with water at the specified test pressure measured at the point of lowest elevation. Pressure shall be applied and maintained by means of a pump connected to the pipe in a satisfactory manner. The pump, pipe connection, and all necessary apparatus except meters shall be furnished by the contractor, and the contractor shall furnish all necessary labor for connecting the pump, meter, and gages.

As the line is being filled and before applying the test pressure, all air shall be expelled from the pipe. To accomplish this, taps shall be made, if necessary, at points of highest elevation. After the test, the taps shall be tightly plugged. All fire hydrants within the test section shall be opened to expel any air in the hydrant barrel.

During the time the test pressure is on the pipe, the line shall be carefully checked at regular intervals for breaks or leaks. Any joints showing appreciable leaks shall be repaired and any cracked or defective pipes or fittings shall be removed and replaced with sound material in the manner provided and the test shall be repeated until satisfactory results are obtained.

LEAKAGE TEST

After all defects have been satisfactorily repaired and all visible leaks stopped, a leakage test shall be made on each valved section of the lines to determine the quantity of water lost by leakage. The contractor shall furnish all labor, material, and equipment required for making the test. The leakage shall be determined by measuring the quantity of water supplied to each valved section of the lines, during the test period, when the various sections of the lines are under pressure. No pipe installation will be accepted until or unless the leakage as determined by above test is less than the amount set forth below.

The allowable leakage (gallons per hour) shall not be greater than determined by the following formula:

$$L = \frac{JD\ P^{\frac{1}{2}}}{4500}$$

L = Gallons Per Hour
D = Nominal Pipe Diameter (in.)
J = Number of Joints
P = Test Pressure (PSI)

If individual sections show leakage greater than the limits specified above, the contractor shall, at his own expense locate and repair the defective joints until the leakage is within the specified allowance.

STERILIZATION OF PIPE LINES

On completion of the leakage test and the pressure tests, all water mains are required to be super-chlorinated and tested prior to acceptance.

The contractor shall furnish all labor, equipment and material necessary for the chlorination of the new pipe lines which shall be sterilized before being placed in service. The lines shall be sterilized by the application of the chlorinating agent. The chlorinating agent may be a liquid chlorine, liquid chlorine gas-water mixture, or a calcium hypochlorite solution, which shall be fed into the lines through a suitable solution-feed device, or other methods approved by ADEQ. The chlorinating agent shall be applied at or near the point from which the line is being filled, and through a corporation stop or other approved connection inserted in the horizontal axis of the newly laid pipe. The water being used to fill the line shall be controlled to flow into the section to be sterilized very slowly, and the rate of application of the chlorinating agent shall be in such proportion of water entering the pipe that the chlorine dose applied to the water entering the line shall be at least 50 parts per million (ppm). The treated water shall be retained in the pipe lines for a period of not less than twenty-four (24) hours.

After the 24 hour period, prior to flushing, a sample shall be taken by the Utility to verify the system was chlorinated at 50 ppm or greater. Upon verification, the system shall be flushed by the Contractor to a chlorine residual of less than 1 ppm, and sampled for bacteriologic contamination by the Utility. On receipt of acceptable bacteriological analysis, the line may be brought into service.

The sampling riser shall be located at a location farthest from the point of chlorination. The riser shall be above ground and equipped with a faucet for control of flow during sampling.

ACCEPTANCE

The Contractor shall remedy, at his own expense, any poor alignment or any other defects in workmanship or materials revealed by final inspection. Final acceptance will be based on reinspection of any deficiencies after the appropriate repairs and corrections are completed.

Connection of any end-user shall not be allowed until the water main has been satisfactorily completed and accepted for use by Global Water.

Portions of the work completed may be placed in operation after all cleaning, testing and inspection requirements have been fulfilled. Such partial use or partial acceptance shall be subject to approval of Global Water's Inspector.

REVISIONS

Date	Revision Number	Revisions	OPI
23-Mar-04	ORIGINAL (000)		GSS
25-Mar-04	001	Incorporate L. Braund comments	GSS
22-Nov-04	002	Incorporate L. Braund comments	GSS
10-Mar-05	003	Incorporate design standards.	SRL

APPENDIX B

STANDARD WATER, SEWER, AND RECLAIMED WATER NOTES

GLOBAL WATER RESOURCES, LLC
WATER NOTES TO CONTRACTOR

1. FINAL ACCEPTANCE OF UNDERGROUND FACILITIES BY GLOBAL WATER RESOURCES, LLC SHALL BE IN ACCORDANCE WITH GLOBAL WATER RESOURCES CODE OF PRACTICE GWR-CP-01-008, LATEST REVISION.

2. WATER METERS WILL NOT BE INSTALLED TO ANY WATER SERVICE LOCATION UNTIL THE ENTIRE SEWER SYSTEM HAS BEEN INSPECTED, APPROVED, AND ACCEPTED BY GLOBAL WATER RESOURCES.

3. ALL WATER METERS SHALL BE ACQUIRED FROM GLOBAL WATER RESOURCES.

4. IT SHALL BE THE CONTRACTOR'S SOLE RESPONSIBILITY TO VERIFY THE PRESENCE AND LOCATION OF ANY AND ALL EXISTING OVERHEAD AND/OR UNDERGROUND UTILITIES THAT MAY INTERFERE WITH THIS CONSTRUCTION, WHETHER OR NOT SAID UTILITIES ARE SHOWN ON THE CONSTRUCTION PLANS FOR THIS PROJECT. CONTRACTOR SHALL ADEQUATELY PROTECT AND MAINTAIN SUCH UTILITIES AND OBSERVE ALL POSSIBLE PRECAUTIONS TO AVOID ANY DAMAGE TO THESE FACILITIES.

5. IT SHALL BE THE CONTRACTOR'S RESPONSIBILITY TO UNCOVER ALL EXISTING WATER LINES BEING CONNECTED TO, AND TO VERIFY THE LOCATION, DEPTH, AND SIZE OF PIPE, BEFORE ANY CONSTRUCTION BEGINS.

6. IT SHALL BE THE CONTRACTOR'S RESPONSIBILITY TO LOCATE AND PROVIDE STATIONING OR DISTANCES ON ALL NEW WATER LINES, VALVES, AND FIRE HYDRANTS INSTALLED AS A PART OF THIS PROJECT.

7. ANY CONSTRUCTION PERFORMED WITHOUT THE KNOWLEDGE OF THE GLOBAL WATER RESOURCES INSPECTOR OR HIS REPRESENTATIVE IS LIABLE FOR REMOVAL AND REPLACEMENT AT THE CONTRACTOR'S EXPENSE.

8. CONTRACTOR SHALL SCHEDULE A PRE-CONSTRUCTION MEETING AT THE JOB SITE WITH THE GLOBAL WATER RESOURCES INSPECTOR PRIOR TO START OF CONSTRUCTION AT (602) 550-3787.

9. THE CONTRACTOR SHALL NOTIFY GLOBAL WATER RESOURCES AT LEAST 72 HOURS PRIOR TO THE START OF CONSTRUCTION AT (602) 550-3787.

10. THE CONTRACTOR SHALL NOTIFY THE DEVELOPER'S ENGINEER AND THE GLOBAL WATER RESOURCES INSPECTOR AT (602) 550-3787, BEFORE BACKFILLING WATER AND/OR SEWER SERVICES TO ALLOW VERIFICATION OF THE AS-BUILT LOCATION OF THE SERVICE.

11. CONTRACTOR SHALL CONTACT THE GLOBAL WATER RESOURCES INSPECTOR AT (602)550-3787 PRIOR TO CHARGING WATER MAINS WITH POTABLE WATER FOR DISINFECTION.

12. ALL COPIES OF TEST RESULTS ARE TO BE GIVEN TO THE GLOBAL WATER RESOURCES INSPECTOR.

13. REVIEW OF THESE PLANS FOR COMPLIANCE WITH THE REQUIREMENTS OF GLOBAL WATER RESOURCES SHALL NOT PREVENT ANY CORRECTION OF ERRORS FOUND TO BE IN VIOLATION OF ANY APPLICABLE STANDARD OF GLOBAL WATER RESOURCES.

GLOBAL WATER RESOURCES, LLC
GENERAL WATER NOTES

1. ALL WORK AND MATERIALS SHALL CONFORM TO GLOBAL WATER RESOURCES STANDARDS, LATEST REVISION, THE ARIZONA DEPARTMENT OF ENVIRONMENTAL QUALITY STANDARDS AND REVISIONS, CURRENT MAG SPECIFICATIONS, AND ANY REQUIREMENTS OF THE AUTHORIZED LOCAL GOVERNING AUTHORITY, AS APPLICABLE. IN THE EVENT OF A CONFLICT, THE MORE STRINGENT REQUIREMENT SHALL GOVERN. FAILURE TO MEET ANY OF THESE REQUIREMENTS SHALL BE CAUSE FOR REJECTION.

2. PRIOR TO CONSTRUCTION, ALL PERMITS SHALL BE SECURED AS REQUIRED FROM THE APPROPRIATE GOVERNING AGENCIES.

3. WATER LINE CONSTRUCTION SHALL BE IN ACCORDANCE WITH THE REQUIREMENTS OF MAG SPECIFICATION SECTION 610 WITH THE EXCEPTION THAT ASBESTOS-CEMENT PIPE AND CONCRETE PIPE ARE NOT ACCEPTABLE.

4. PVC PIPE SHALL BE AWWA C-900 CLASS 200 FOR LINES 6 INCHES TO 12 INCHES IN DIAMETER AND AWWA C-905 CLASS 165 FOR LINES LARGER THAN 12 INCHES.

5. TRENCH EXCAVATION, BACKFILLING AND COMPACTION SHALL BE IN ACCORDANCE WITH THE REQUIREMENTS OF MAG SPECIFICATION SECTION 601.

6. ALL WATER LINES MUST HAVE A MINIMUM COVER OF 36 INCHES OVER THE TOP OF THE PIPE TO FINISH GRADE. PIPES 12 INCHES AND LARGER SHALL HAVE A MINIMUM COVER OF 48 INCHES. ALL WATER SERVICES MUST HAVE A MINIMUM COVER OF 30 INCHES.

7. ALL FRAMES, COVERS, VALVE BOXES, ETC., SHALL BE ADJUSTED TO FINISHED GRADE PRIOR TO PLACING OF ASPHALTIC CONCRETE SURFACE COURSE BY THE PAVING CONTRACTOR. VALVES MORE THAN 5 FT IN DEPTH SHALL BE PROVIDED WITH EXTENSIONS.

8. ALL WATER LINES SHALL BE PRESSURE AND LEAKAGE TESTED IN ACCORDANCE WITH MAG SEC. 610-14. RESULTS ARE TO BE GIVEN, IN WRITING, TO GLOBAL WATER RESOURCES.

9. ALL WATER LINES MUST BE DISINFECTED PER ADEQ ENGINEERING BULLETIN #8 OR AWWA C651-86. RESULTS ARE TO BE GIVEN, IN WRITING, TO GLOBAL WATER RESOURCES.

10. ALL BENDS AND FITTINGS SHALL BE INSTALLED WITH RESTRAINED JOINTS IN ACCORDANCE WITH MAG STANDARDS. CONCRETE THRUST BLOCKS AS A SUBSTITUTE FOR RESTRAINED JOINTS ARE NOT ACCEPTABLE.

11. ALL PIPES, FITTINGS, VALVES, COATING, ETC. SHALL CONFORM TO NSF STANDARD 61.

12. CROSS-CONNECTIONS, IF ANY ARE PROVIDED, SHALL CONFORM TO THE REQUIREMENTS OF A.A.C. R18-4-115.

13. CONTRACTOR SHALL INSTALL LOCATING WIRE AND BLUE LOCATING TAPE ONE FOOT ABOVE TOP OF WATER MAINS PRIOR TO BACKFILL.

14. ALL FIRE HYDRANTS SHALL BE CLOW MEDALLION WITH A MINIMUM 4 FT BURY DEPTH, 5-1/4 INCH MAIN VALVE OPENING, ONE 4 INCH PUMPER CONNECTION WHICH FACES THE CURB OR SIDEWALK, AND TWO 2-1/2 INCH HOSE CONNECTIONS. NO SUBSTITUTIONS WILL BE ALLOWED. ELEVATION OF THE HYDRANT FLANGE SHALL CONFORM TO GLOBAL WATER RESOURCES STANDARD DETAILS.

15. ALL SERVICE SADDLES FOR PVC PIPE SHALL BE WIDE-STRAP FULL CIRCLE BRONZE AS MANUFACTURED BY MUELLER CO., MODEL H-13000, OR AN APPROVED EQUAL.

16. ALL METER BOXES SHALL BE DFW BY NDS MODEL D1500-DUDISB.

17. AIR RELEASE VALVES SHALL BE INSTALLED AT ALL SYSTEM HIGH POINTS IN ACCORDANCE WITH CITY OF SCOTTSDALE DETAIL NO. 2348.

GLOBAL WATER RESOURCES, LLC
SEWER NOTES TO THE CONTRACTOR

1. FINAL ACCEPTANCE OF UNDERGROUND FACILITIES BY GLOBAL WATER RESOURCES, LLC SHALL BE IN ACCORDANCE WITH GLOBAL WATER RESOURCES CODE OF PRACTICE GWR-CP-01-008, LATEST REVISION.

2. PRIOR TO ACCEPTANCE, A VIDEO SURVEY OF THE ENTIRE SEWER SYSTEM, MAINLINE AND SERVICES, SHALL BE COMPLETED AFTER PLACEMENT OF PAVEMENT.

3. WATER METERS WILL NOT BE INSTALLED TO ANY WATER SERVICE LOCATION UNTIL THE ENTIRE SEWER SYSTEM HAS BEEN INSPECTED, APPROVED, AND ACCEPTED BY GLOBAL WATER RESOURCES, ALL EASEMENTS ARE SIGNED AND RECORDED, AND A VIDEO SURVEY AFTER COMPLETION OF PAVING IS COMPLETED AND APPROVED.

4. IT SHALL BE THE CONTRACTOR'S SOLE RESPONSIBILITY TO VERIFY THE PRESENCE AND LOCATION OF ANY AND ALL EXISTING OVERHEAD AND/OR UNDERGROUND UTILITIES THAT MAY INTERFERE WITH THIS CONSTRUCTION, WHETHER OR NOT SAID UTILITIES ARE SHOWN ON THE CONSTRUCTION PLANS FOR THIS PROJECT. CONTRACTOR SHALL ADEQUATELY PROTECT AND MAINTAIN SUCH UTILITIES AND OBSERVE ALL POSSIBLE PRECAUTIONS TO AVOID ANY DAMAGE TO THESE FACILITIES.

5. THE CONTRACTOR SHALL MAKE EXPLORATORY EXCAVATIONS AND LOCATE EXISTING UNDERGROUND FACILITIES SUFFICIENTLY IN ADVANCE OF CONSTRUCTION TO PERMIT THE REVISION OF THESE PLANS IF NECESSARY DUE TO A CONFLICT BETWEEN FACILITIES PROPOSED AND EXISTING FACILITIES.

6. IT SHALL BE THE CONTRACTOR'S RESPONSIBILITY TO UNCOVER ALL EXISTING SEWER LINES BEING CONNECTED TO, AND TO VERIFY THE LOCATION, DEPTH, AND SIZE OF PIPE, BEFORE ANY CONSTRUCTION BEGINS.

7. IT SHALL BE THE CONTRACTOR'S RESPONSIBILITY TO LOCATE AND PROVIDE STATIONING OR DISTANCES ON ALL NEW SEWER LINES, MANHOLES, AND CLEAN OUTS INSTALLED AS A PART OF THIS PROJECT.

8. ANY CONSTRUCTION PERFORMED WITHOUT THE KNOWLEDGE OF THE GLOBAL WATER RESOURCES INSPECTOR OR HIS REPRESENTATIVE IS LIABLE FOR REMOVAL AND REPLACEMENT AT THE CONTRACTOR'S EXPENSE.

9. CONTRACTOR SHALL SCHEDULE A PRE-CONSTRUCTION MEETING AT THE JOB SITE WITH THE GLOBAL WATER RESOURCES INSPECTOR PRIOR TO START OF CONSTRUCTION AT (602) 550-3787.

10. THE CONTRACTOR SHALL NOTIFY GLOBAL WATER RESOURCES AT LEAST 72 HOURS PRIOR TO THE START OF CONSTRUCTION AT (602) 550-3787.

11. THE CONTRACTOR SHALL NOTIFY THE DEVELOPER'S ENGINEER AND THE GLOBAL WATER RESOURCES INSPECTOR AT (602) 550-3787, BEFORE BACKFILLING WATER AND/OR SEWER SERVICES TO ALLOW VERIFICATION OF THE AS-BUILT LOCATION OF THE SERVICE.

12. ALL COPIES OF TEST RESULTS TO BE GIVEN TO THE GLOBAL WATER RESOURCES INSPECTOR.

13. REVIEW OF THESE PLANS FOR COMPLIANCE WITH THE REQUIREMENTS OF GLOBAL WATER RESOURCES SHALL NOT PREVENT ANY CORRECTION OF ERRORS FOUND TO BE IN VIOLATION OF ANY APPLICABLE STANDARD OF GLOBAL WATER RESOURCES.

GLOBAL WATER RESOURCES, LLC
GENERAL SEWER NOTES

1. ALL WORK AND MATERIALS SHALL CONFORM TO GLOBAL WATER RESOURCES STANDARDS, LATEST REVISION, THE ARIZONA DEPARTMENT OF ENVIRONMENTAL QUALITY STANDARDS AND REVISIONS, CURRENT MAG SPECIFICATIONS, AND ANY REQUIREMENTS OF THE AUTHORIZED LOCAL GOVERNING AUTHORITY, AS APPLICABLE. IN THE EVENT OF A CONFLICT, THE MORE STRINGENT REQUIREMENT SHALL GOVERN. FAILURE TO MEET ANY OF THESE REQUIREMENTS SHALL BE CAUSE FOR REJECTION.

2. PRIOR TO CONSTRUCTION, ALL PERMITS SHALL BE SECURED AS REQUIRED FROM THE APPROPRIATE GOVERNING AGENCIES.

3. SEWER LINE CONSTRUCTION SHALL BE IN ACCORDANCE WITH THE REQUIREMENTS OF MAG SPECIFICATION SECTION 615 WITH THE EXCEPTION THAT VCP AND CONCRETE PIPE ARE NOT ACCEPTABLE.

4. TRENCH EXCAVATION, BACKFILLING AND COMPACTION SHALL BE IN ACCORDANCE WITH THE REQUIREMENTS OF MAG SPECIFICATION SECTION 601.

5. SEWER LINES REQUIRE A MINIMUM OF 6 FEET OF BACKFILL TO TOP OF PIPE.

6. WATER TIGHTNESS TESTING OF THE SEWER LINE SHALL BE PERFORMED TO SHOW THAT LEAKAGE DOES NOT EXCEED 200 GAL/DAY/INCH DIAMETER/MILE OF PIPE. EXFILTRATION FROM MANHOLES SHALL BE LIMITED TO 0.1 GAL/HOUR/VERTICAL FOOT.

7. WATER TIGHTNESS OF SEWERS AND MANHOLES SHALL BE DETERMINED BY EXFILTRATION OR LOW PRESSURE AIR TESTING IN ACCORDANCE WITH A.A.C. R18-9-E301(D)(3)(f).

8. ALL PVC SEWER LINES MUST BE TESTED USING LOW-PRESSURE AIR-TESTING (ASTM METHOD F 1417-92, REAPPROVED 1998), IN ACCORDANCE WITH A.A.C. R18-9-E301(D)(2)(j)(i).

9. THE TOTAL LENGTH OF SEWER LINE MUST BE TESTED FOR UNIFORM SLOPE, IN ACCORDANCE WITH A.A.C. R18-9-E301(D)(2)(k).

10. DEFLECTION TESTING SHALL BE DONE ON ALL SEWER LINES MADE OF FLEXIBLE MATERIALS TO ENSURE THE INSTALLATION MEETS OR EXCEEDS MANUFACTURER'S RECOMMENDATIONS, IN ACCORDANCE WITH A.A.C. R18-9-E301(D)(2)(i).

11. INTERIOR MANHOLE COATING SYSTEMS SHALL BE APPLIED TO MANHOLES WITH SEWERS 15 INCHES AND LARGER FOR CORROSION PROTECTION. THE LINING SYSTEM SHALL BE APPROVED BY GLOBAL WATER RESOURCES PRIOR TO INSTALLATION. T-LOC SYSTEMS ARE NOT ACCEPTABLE.

12. DIP SEWER SHALL HAVE A POLYURETHANE OR CERAMIC EPOXY INTERIOR LINING SYSTEM WITH A MINIMUM THICKNESS OF 40 MILS. LINING SHALL BE PROTECTO 401 OR AN APPROVED EQUAL SYSTEM.

13. IN ACCORDANCE WITH A.A.C. R18-9-E301(D)(1)(d), SEPARATION BETWEEN WATER AND SEWER MAIN SHALL COMPLY WITH THE REQUIREMENTS OF 18 A.A.C. 5, ARTICLE 5.

GLOBAL WATER RESOURCES, LLC
RECLAIMED WATER NOTES

1. ALL WORK AND MATERIALS SHALL CONFORM TO GLOBAL WATER RESOURCES STANDARDS, LATEST REVISION, THE ARIZONA DEPARTMENT OF ENVIRONMENTAL QUALITY STANDARDS AND REVISIONS, CURRENT MAG SPECIFICATIONS, AND ANY REQUIREMENTS OF THE AUTHORIZED LOCAL GOVERNING AUTHORITY, AS APPLICABLE. IN THE EVENT OF A CONFLICT, THE MORE STRINGENT REQUIREMENT SHALL GOVERN. FAILURE TO MEET ANY OF THESE REQUIREMENTS SHALL BE CAUSE FOR REJECTION.

2. PRIOR TO CONSTRUCTION, ALL PERMITS SHALL BE SECURED AS REQUIRED FROM THE APPROPRIATE GOVERNING AGENCIES.

3. RECLAIMED WATER LINE CONSTRUCTION SHALL BE IN ACCORDANCE WITH THE REQUIREMENTS OF MAG SPECIFICATION SECTION 616.

4. TRENCH EXCAVATION, BACKFILLING AND COMPACTION SHALL BE IN ACCORDANCE WITH THE REQUIREMENTS OF MAG SPECIFICATION SECTION 601.

5. PVC PIPE SHALL BE AWWA C-900 CLASS 150 FOR LINES 6 INCHES TO 12 INCHES IN DIAMETER AND AWWA C-905 CLASS 165 FOR LINES LARGER THAN 12 INCHES.

6. ALL RECLAIMED WATER LINES 12" AND LARGER MUST HAVE A MINIMUM COVER OF 48 INCHES OVER THE TOP OF THE PIPE TO FINISH GRADE.

7. IT SHALL BE THE CONTRACTOR'S SOLE RESPONSIBILITY TO VERIFY THE PRESENCE AND LOCATION OF ANY AND ALL EXISTING OVERHEAD AND/OR UNDERGROUND UTILITIES THAT MAY INTERFERE WITH THIS CONSTRUCTION, WHETHER OR NOT SAID UTILITIES ARE SHOWN ON THE CONSTRUCTION PLANS FOR THIS PROJECT. CONTRACTOR SHALL ADEQUATELY PROTECT AND MAINTAIN SUCH UTILITIES AND OBSERVE ALL POSSIBLE PRECAUTIONS TO AVOID ANY DAMAGE TO THESE FACILITIES.

8. IT SHALL BE THE CONTRACTOR'S RESPONSIBILITY TO UNCOVER ALL EXISTING RECLAIMED WATER LINES BEING CONNECTED TO, AND TO VERIFY THE LOCATION, DEPTH, AND SIZE OF PIPE, BEFORE ANY CONSTRUCTION BEGINS.

9. ANY CONSTRUCTION PERFORMED WITHOUT THE KNOWLEDGE OF THE GLOBAL WATER RESOURCES INSPECTOR OR HIS REPRESENTATIVE IS LIABLE FOR REMOVAL AND REPLACEMENT AT THE CONTRACTOR'S EXPENSE.

10. ALL FRAMES, COVERS, VALVE BOXES, ETC., SHALL BE ADJUSTED TO FINISHED GRADE PRIOR TO PLACING OF ASPHALTIC CONCRETE SURFACE COURSE BY THE CONTRACTOR. VALVES MORE THAN 5 FT IN DEPTH SHALL BE PROVIDED WITH EXTENSIONS.

11. THE CONTRACTOR SHALL SCHEDULE A PRE-CONSTRUCTION CONFERENCE WITH THE GLOBAL WATER RESOURCES INSPECTOR AT (602) 550-3787 PRIOR TO START OF CONSTRUCTION.

12. THE CONTRACTOR SHALL NOTIFY THE GLOBAL WATER RESOURCES INSPECTOR AT (602) 550-3787 AT LEAST 72 HOURS IN ADVANCE OF ANY CONSTRUCTION.

13. ALL RECLAIMED WATER LINES SHALL BE PRESSURE AND LEAKAGE TESTED IN ACCORDANCE WITH MAG SECTION 610.14. RESULTS ARE TO BE GIVEN, IN WRITING, TO GLOBAL WATER RESOURCES.

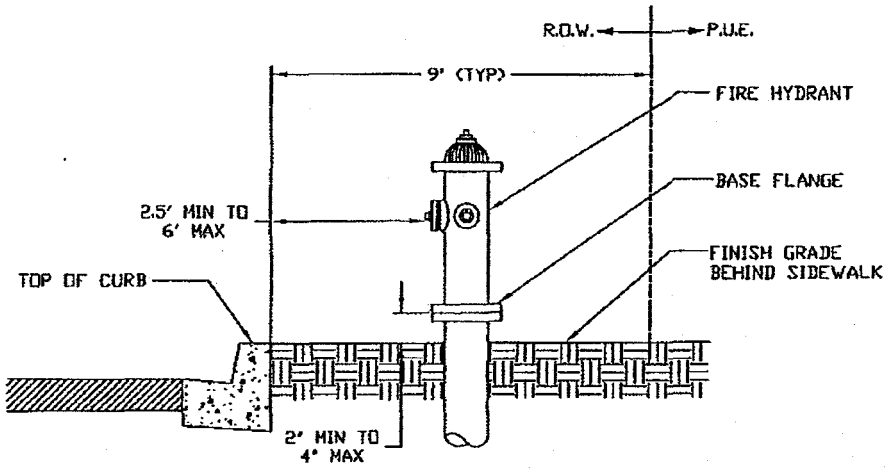
14. ALL BENDS AND FITTINGS SHALL BE INSTALLED WITH RESTRAINED JOINTS IN ACCORDANCE WITH MAG STANDARDS. CONCRETE THRUST BLOCKS AS A SUBSTITUTE FOR RESTRAINED JOINTS ARE NOT ACCEPTABLE.

15. CONTRACTOR SHALL INSTALL LOCATING WIRE AND PURPLE LOCATING TAPE ONE FOOT ABOVE THE TOP OF RECLAIMED WATER LINES PRIOR TO BACKFILL.

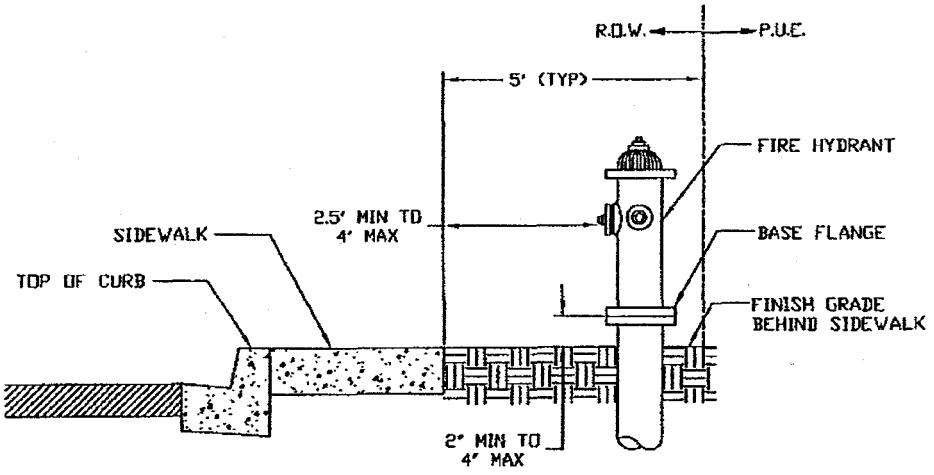
16. ALL COPIES OF TESTING RESULTS ARE TO BE GIVEN TO THE GLOBAL WATER RESOURCES INSPECTOR

APPENDIX C

STANDARD DETAILS



WITHOUT SIDEWALK



WITH SIDEWALK

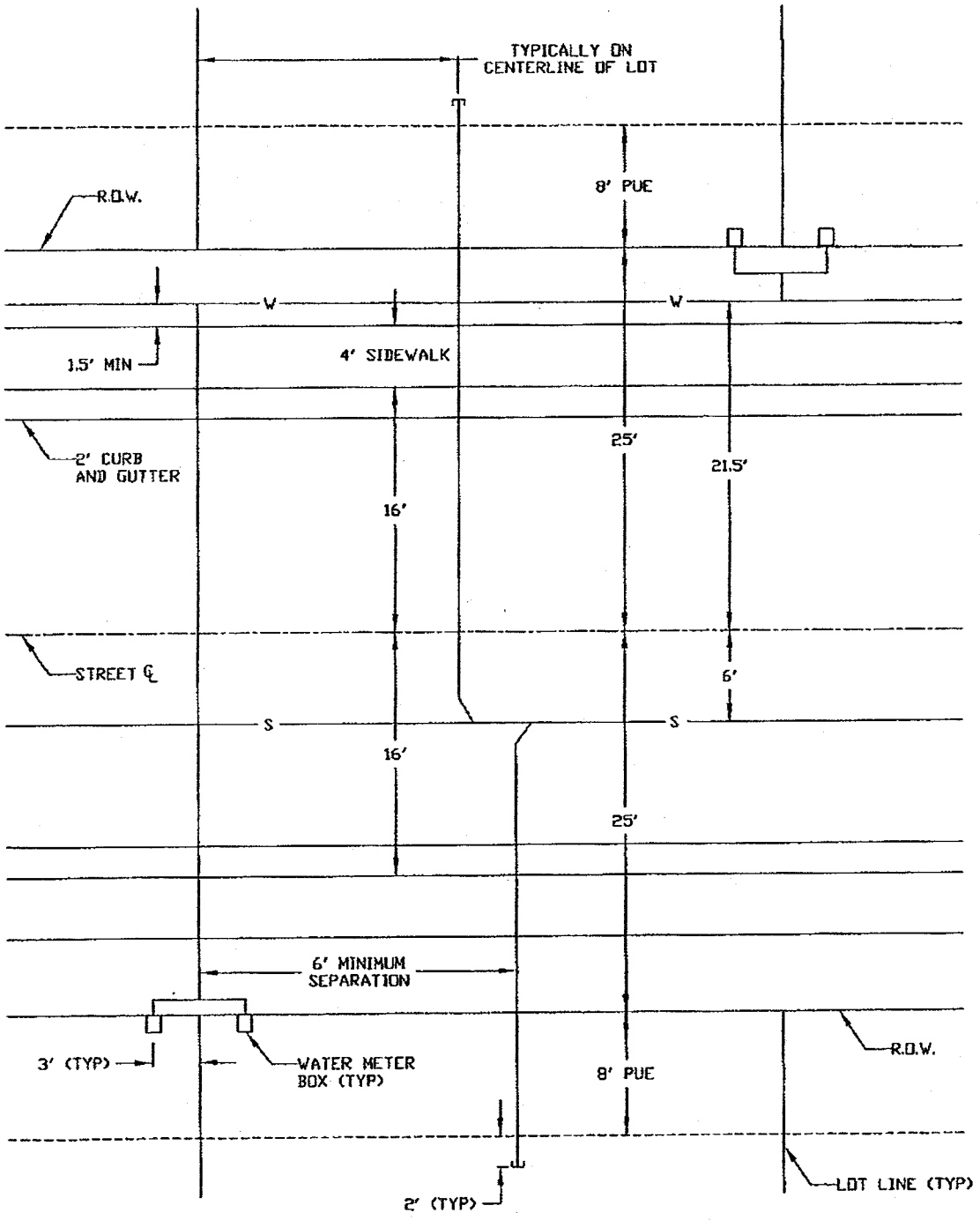
NOTES:
1. ALL VALVE BOX COVERS SHALL BE LEVEL WITH THE ADJACENT TOP OF CURB OR BACK OF SIDEWALK. NO VALVES SHALL BE LOCATED IN SIDEWALKS.
2. ALL FIRE HYDRANTS SHALL BE CLOW MEDALLION WITH A 4' MIN BURY DEPTH, 5-¼" MAIN VALVE OPENING, ONE 4" PUMPER CONNECTION, AND TWO 2-½" HOSE CONNECTIONS. NO SUBSTITUTIONS ALLOWED.

GLOBAL WATER RESOURCES, LLC
22601 NORTH 19TH AVENUE
SUITE 210
PHOENIX, ARIZONA 85027
623.580.9600 PHONE
623.580.9659 FAX
WWW.GWRESOURCES.COM

STANDARD DETAILS

FIRE HYDRANT ASSEMBLY

SCALE: NONE	DATE: MARCH 2005	DETAIL NO. 1	REV. 0



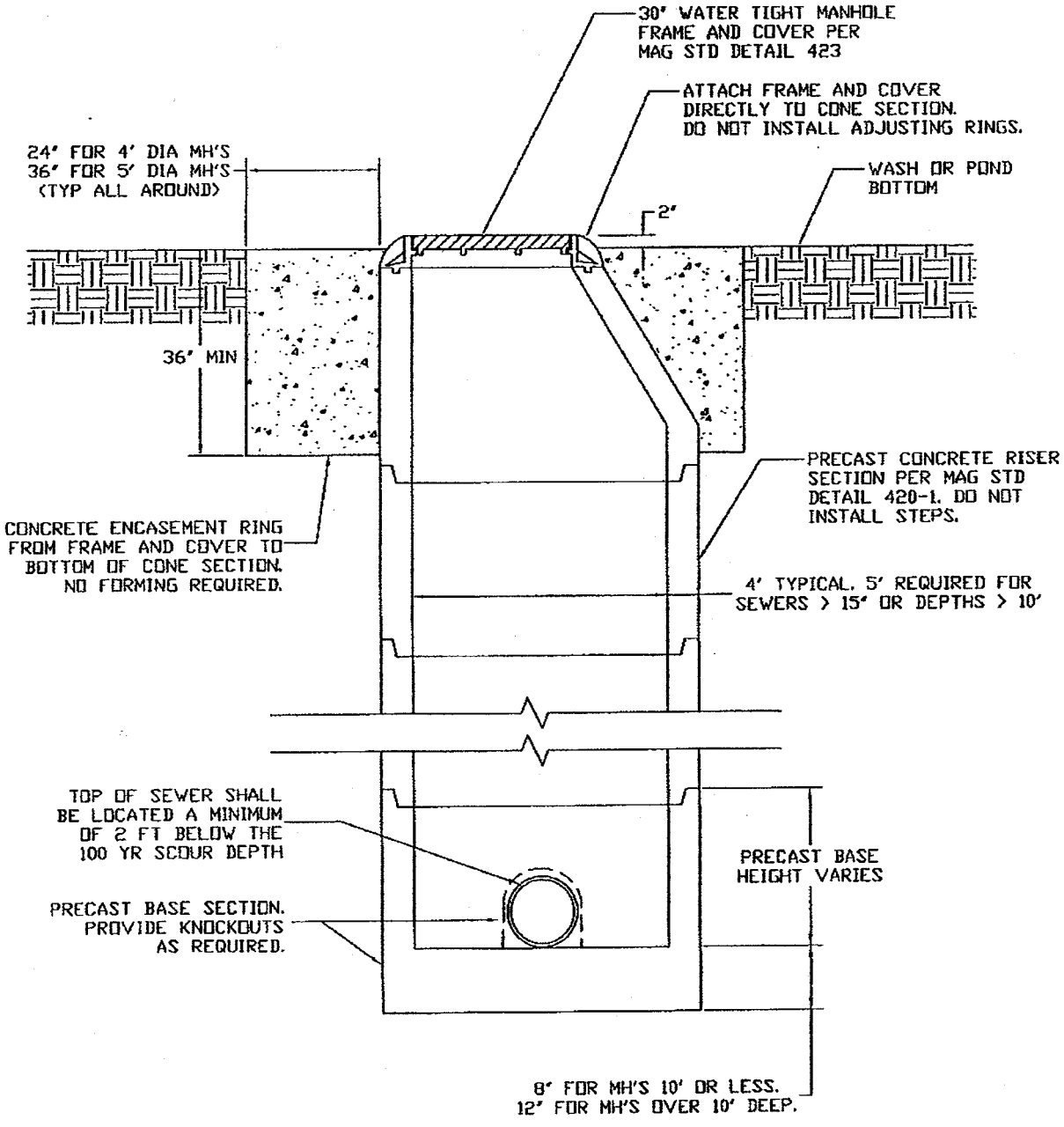
NOTE: WATER MAINS SHALL BE LOCATED ON THE NORTH AND EAST SIDES OF THE STREET A MINIMUM OF 1.5 FT BEHIND THE SIDEWALK. SEWERS SHALL BE LOCATED ON THE SOUTH AND WEST SIDES OF THE STREET, 6 FT FROM THE CENTERLINE.

GLOBAL WATER RESOURCES, LLC
22601 NORTH 19TH AVENUE
SUITE 210
PHOENIX, ARIZONA 85027
623.580.9600 PHONE
623.580.9659 FAX
WWW.GWRESOURCES.COM

STANDARD DETAILS

TYPICAL STREET LAYOUT

SCALE: NONE	DATE: MARCH 2005	DETAIL NO. 2	REV. 0



NOTE: COMPACT TO 95% MIN DENSITY PER MAG SPECIFICATIONS SECTION 601.

GLOBAL WATER RESOURCES, LLC
22601 NORTH 19TH AVENUE
SUITE 210
PHOENIX, ARIZONA 85027
623.580.9600 PHONE
623.580.9659 FAX
WWW.GWRESOURCES.COM

STANDARD DETAILS

WATER TIGHT MANHOLE

SCALE: NONE	DATE: MARCH 2005	DETAIL NO. 3	REV. 0

APPENDIX D

FLOW CHART FOR REQUEST AND APPROVAL

OF WATER AND WASTEWATER SERVICE

FLOW CHART FOR REQUEST AND APPROVAL OF WATER AND WASTEWATER SERVICE