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BEFORE THE TENNESSEE REGULATORY AUTHORITY
AT NASHVILLE, TENNESSEE

In Re:	)	
	)	
PETITION FOR APPROVAL TO TRANSFER CARTWRIGHT CREEK UTILITY COMPANY, INC.'S AUTHORITY TO PROVIDE WASTEWATER UTILITY SERVICES TO CARTWRIGHT CREEK, LLC.	)	**No.** 04-00307

PETITION TO TRANSFER AUTHORITY TO PROVIDE UTILITY SERVICES

Introduction

Come now Cartwright Creek Utility Company, Inc. ("Seller") and Cartwright Creek, LLC ("Buyer," collectively referred to as the "Petitioners") and submit this Petition to the Tennessee Regulatory Authority ("TRA") for approval to transfer authority to provide wastewater utility services currently provided by Seller as derived from its Certificate of Public Convenience and Necessity ("CCN") to Buyer pursuant to Tenn. Code Ann. § 65-4-113 and Section 1220-1-1, et seq. of the Rules of Tennessee Regulatory Authority.

Seller desires to sell all of its stock, and Buyer desires to purchase all of Seller's stock. Following the proposed transaction, Buyer will continue to provide wastewater utility services currently offered by Seller. Further, the proposed acquisition and transfer of authority will be a seamless change in ownership and will not have any detrimental impact on Seller's customers; rather, the proposed transaction will benefit customers and the environment furthering the public interest by way of facility renovations and improvements in service quality and efficiency.

Parties

The Seller, Cartwright Creek Utility Company, Inc., is a privately owned Tennessee corporation created to own and operate a wastewater treatment plant and to provide sewer service with its principal address being 2033 Richard Jones Road, Nashville, Tennessee 37215. Seller is solely owned by Reese L. Smith, III (51%) and Steven B. Smith (49%) and provides wastewater treatment and sewer services to customers located within its service area in Williamson County, Tennessee.

Buyer is a member-managed Tennessee limited liability company. Attached as **Exhibit A** and incorporated herein by reference is a copy of Buyer's Operating Agreement. Buyer's members are comprised of Sheaffer International, L.L.C. ("Sheaffer") with a ninety percent (90%) membership interest and M.R.S. LLC ("M.R.S.") with a ten percent (10%) membership interest. Sheaffer is a Delaware limited liability company with its record office located at 800 Roosevelt Road, Building B, Suite 200, Glen Ellyn, Illinois 60137. Sheaffer's agent for service of process is William N Weaver located at 30 South Wacker Drive, Chicago, Illinois 60606. M.R.S. is a Tennessee limited liability company with its principal office located at 2033 Richard Jones Road, Nashville, Tennessee 37215, and Reese L. Smith, III is the agent for service of process for M.R.S. located at the same address as the principal office.

Designated Contact

The designated contact for questions regarding this Petition is T. Chad White, Esq., Tune, Entrekin & White, P.C., AmSouth Center, Suite 2100, 315 Deaderick Street, Nashville, TN 37238-2100; 615/244-2770 (Office), 615/244-2778 (Facsimile).

Proposed Transaction

Buyer and Seller have entered into a proposed Agreement for Sale and Purchase of Stock (the "Agreement") pursuant to which and for good and valuable consideration all of Seller's stock will be sold to Buyer. Attached as **Exhibit B** and incorporated herein by reference is a copy of the Agreement. The proposed transaction pursuant to the Agreement will be accomplished in a seamless fashion and will not adversely affect Seller's customers. Rather, Buyer intends to inject significant capital to renovate current facilities, improve the quality and efficiency of services offered to customers, and upon appropriate approval, extend the updated facilities and improved services to additional customers In addition, the proposed improvements to be made by Buyer will have a significant, positive impact on the local community and the environment as a whole. Consequently, the proposed transaction will not have any detrimental impact on Seller's customers and will benefit these customers, the local community, and the environment.

Grounds

As grounds for this Petition, Petitioners state (1) that Buyer is a suitable, financially responsible entity that is capable of efficiently and effectively performing the utility services sought to be transferred to it by Seller; (2) that said transfer furthers the public interest; (3) that Buyer's managing and majority ownership member is a nationally renowned, innovative, proven leader in wastewater reclamation and reuse systems; (4) that the current and future consuming public will gain substantial benefit from the proposed transfer; and (5) that the proposed transfer will be a smooth transition between Buyer and Seller who agree to all terms of the Agreement subject to TRA approval of this Petition.

Public Interest and Efficiency Considerations

To assist the TRA's consideration of Buyer's suitability, financial responsibility, and capability to perform efficiently the utility services sought to be transferred to it for the benefit to the consuming public, Petitioners have attached as collective **Exhibit C** extensive operational and demonstrative materials addressing these factors.

Conclusion

For the reasons stated herein, the Petitioners respectfully request that the TRA grant this Petition and approve the transaction described herein and grant all other relief as necessary and appropriate to effectuate the transaction described herein.

FILED this the 21st day of September, 2004.

Respectfully submitted,

Thomas V. White, B.P.R. No. 2727
T. Chad White, B.P.R. No. 21950
Tune, Entrekin & White, P.C.
AmSouth Center, Suite 2100
315 Deaderick Street
Nashville, TN 37238-2100
615/244-2770 (O)

H \Sheaffer (General) 14124 00\Petition Transfer Authority wpd

OPERATING AGREEMENT
OF
CARTWRIGHT CREEK, LLC

THIS OPERATING AGREEMENT (the "Agreement") is made and entered into effective as of the 15 day of September, 2004 by and among the undersigned parties on the attached Exhibit A (the "Members").

RECITALS:

WHEREAS, Cartwright Creek, LLC (the "Company" or the "LLC") was duly organized pursuant to Articles of Organization filed with the Tennessee Secretary of State, and recorded in the Register's Office for Davidson County. The Members own all of the Interests in the Company.

WHEREAS, the Members have agreed to enter into this Agreement to regulate the affairs of the Company, the conduct of its business, and the relations of its Members.

WHEREAS, the Members have agreed that this Agreement shall serve as an "operating agreement" within the meaning of Section 48-206-101 of the Tennessee Limited Liability Company Act

AGREEMENT:

NOW, THEREFORE, it is mutually agreed as follows:

1.1 **Formation and Taxation** The Company shall constitute a member managed limited liability company formed pursuant to the Tennessee Limited Liability Company Act (the "Act"), as codified in the Tennessee Code Annotated §48-201-101 et seq. All references herein to the Articles shall mean such document as it is in effect on the relevant date, including any amendments thereto, made from time to time. It is the intention of the Members that the Company be treated as a partnership for federal and Tennessee income tax purposes. The Company shall fund taxable income pass through on K-1's at the maximum applicable marginal tax rate.

1 2 **Name**. The name of the Company is "CARTWRIGHT CREEK, LLC" (hereinafter referred to in this Agreement as the "Company").

1.3 **Business**. The Company will enter into a management agreement with Sheaffer International, LLC, a Delaware limited liability corporation to manage the Cartwright Creek Utility Company facility located in Franklin, Tennessee, (the "Property") as its principal business. The Company is authorized to engage in and conduct all and every kind of lawful business, including, but not limited to, the acquisition, ownership, financing, development, construction, marketing, leasing, management, operation and sale of real property, by acquiring interests in real property directly or indirectly through option contracts, the ownership of

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interests in general or limited partnerships, limited liability companies and other entities, and the financing of new and existing business ventures through the making of secured and unsecured loans and equity investments. The Company also shall have all the powers described in the Act except as otherwise provided herein.

1.4. **Principal Office, Registered Office and Registered Agent.** The location of the principal office of the Company shall be _____, Tennessee _____ or such other location as the Members may, from time to time, designate. T. Chad White, who is a resident of Tennessee, is the registered agent for the Company. The registered agent's address is 315 Deaderick Street, Suite 2100, Nashville, Davidson County, Tennessee 37238.

1.5 **Duration.** The duration of the Company shall be perpetual, unless earlier terminated in accordance with the provisions of this Agreement.

ARTICLE II: DEFINITIONS

2.1. "Act" means the Tennessee Limited Liability Company Act as codified in the Tennessee Code Annotated §48-201-101 et seq

2.2. "Articles" mean the Articles of Organization of Cartwright Creek, LLC as it is in effect on the relevant date, including any amendments thereto, made from time to time, and filed with the office of the Secretary of State of the State of Tennessee.

2.3. "Agreement" means this Operating Agreement, as may be hereafter amended.

2.4 "Chief Manager" means the person elected from time to time by the Members to manage the affairs of the Company pursuant to the provisions of this Agreement and perform the duties of "Chief Manager" as set forth in the Act. The Members hereby elect Sheaffer International, LLC to be Chief Manager to serve until his/her successor is elected in accordance with this Agreement.

2.5. "Code" means the Internal Revenue Code of 1986, as amended.

2.6. "Company" means Cartwright Creek, LLC, the limited liability company to which the undersigned parties are Members.

2.7. "Contributed Capital" means with respect to any Member as of any particular time, the cumulative amount of capital contributions made by such Member to the Company less the cumulative amount of distributions made by the Company to such Member.

2 8 "Members" means collectively the persons shown on the signature page executing this Agreement together with any additional Members admitted pursuant to the provisions of this Agreement

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2.9. "Net Losses" means the excess of all expenses of the Company over all income of the Company during a calendar year, all as determined in accordance with the method of accounting utilized by the Company for federal income tax purposes.

2.10. "Net Profits" means the excess of all income of the Company over all expenses of the Company during a calendar year, all as determined in accordance with the method of accounting utilized by the Company for federal income tax purposes.

2.11. "Percentage Interest" means the interest of each Member, as defined in Article 5 herein below.

2.12. "Secretary" means the person elected from time to time by the Members to maintain the records of the Company, perform the duties of "Secretary" as set forth in the Act, and perform such other duties prescribed by the Members and as set forth in this Agreement. The Members hereby elect _____ to be Secretary to serve until his/her successor is elected in accordance with this Agreement.

ARTICLE III: PURPOSE & POWERS

3.1 **Purpose.** The purpose and business of the company shall be:

a. To Purchase the common stock of Cartwright Creek Utility Company, Inc. and operate and manage the utility company in accordance with this Agreement;

b. To own and operate a wastewater treatment facilities;

c. To provide wastewater treatment services;

d. To conduct all and every kind of lawful business except as otherwise provided by this Agreement.

3.2. **Powers.** In furtherance of the foregoing purposes, the Company shall have the power and authority to do all things necessary or convenient to carry out its business and affairs to the maximum extent permitted under the Act.

Company is authorized to engage in and, including, but not limited to, the acquisition, ownership, financing, development, construction, marketing, leasing, management, operation and sale of real property, by acquiring interests in real property directly or indirectly through option contracts, the ownership of interests in general or limited partnerships, limited liability companies and other entities, and the financing of new and existing business ventures through the making of secured and unsecured loans and equity investments. The Company also shall have all the powers described in the Act except as otherwise provided herein.

4. **Members and Membership Interests.**

4.1 **Original Members.** The Members of the Company as of the date first identified herein above are as follows:

b. Sheaffer International, L L.C. Sheaffer International, L L.C. is a Delaware limited liability company with its principal place of business located at 800 Roosevelt Road, Building B, Suite 200, Glen Ellyn, Illinois 60137. The registered agent for Sheaffer International, L.L.C.

c. M.R.S , LLC. M.R.S., LLC is a Tennessee limited liability company with its principal place of business located at 2033 Richard Jones Road, Nashville, TN 37215. The registered agent for M R S., LLC is Reese L. Smith, III located at same address.

ARTICLE V: PERCENTAGE INTERESTS

5.1. The Members' Percentage Interest in the Company as of the date first identified herein above is as follows:

a. Sheaffer International, L.L.C. holds a ninety percent (90.00%) ownership interest in the Company.

b. M.R.S., LLC holds a ten percent (10.00%) ownership interest in the Company.

6 **Separate Capital Accounts.** The Company shall maintain a separate Capital Account for each Member in accordance with the regulations promulgated under Section 704(b) of the Internal Revenue Code of 1986 (the "Code").

7. **Capital Contributions.**

(a) Initial Contributions. The Managing Member and Investor Members shall contribute, as their initial Capital Contributions to the Company, the amounts of cash listed opposite their respective names on Exhibit A attached hereto

(b) Additional Capital Contributions. After one (1) year from the date hereof, in the event that the cash receipts or other resources of the Company are insufficient to meet its cash needs for operating expenses, debt service, any other current expense or obligation, or any required capital

expenditure, each of the Members shall contribute the funds required therefore according to the Percentage Interest of such Member. The total amount and timing of such additional capital contributions shall be determined by the Managing Member. The Managing Member shall specify the payment date for additional capital contributions upon ten (10) days prior written notice to the Members. In the event that (a) the Managing Member determines that additional contributions of capital are required and (b) any Member fails to make the contribution required of said Member on or before the thirtieth (30th) calendar day following the due date specified by the Managing Member, the Percentage Interests of the Investor Members shall be recomputed effective as of the due date of such additional capital contributions. In such event, the Percentage Interest of each Member shall be the amount of such Investor Member's total contributed capital divided by the aggregate amount of contributed capital for all Members. In the event of a default by a Member in the payment of an additional capital call, the non-defaulting Members shall contribute a prorata amount of said defaulting Members share of the additional capital call based upon their Percentage Interests as set fort on Exhibit A. M.R.S. LLC will not be required to make any additional capital contributions until the note payable by Cartwright Creek Utility Company to Reese and Steve Smith is paid in full.

(c) No Third Party Rights. The provisions of this Section 8 are not for the benefit of any creditor or other person other than a Member to whom any debts, liabilities, or obligations are owed by, or who otherwise has any claim against the Company or any Member, and no creditor or other person shall obtain any rights under this section or by reason of this section, or shall be able to make any claim in respect of any debts, liabilities, or obligations against the Company or any Member.

8. **Members Not Liable for Company Losses.** Except as expressly provided under the Act, no Member shall have personal liability for the losses, debts, claims, expenses or encumbrances of or against the Company or its property. Nor shall any Member be obligated to restore a deficit balance, if any, in the Member's Capital Account

9. **Profits and Losses.**

(a) Allocation of Profits and Losses. Except as provided in paragraphs 9(b) through (d) of this section, profits and losses shall be allocated as follows:

(1) Profits Profits shall be allocated in the following order of priority:

(I) First, to the Members and among them in proportion to and to the extent of prior allocations of loss made in accordance with paragraph 9(a)(2) of this section, as

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reduced by all prior allocations of profits under this paragraph 9(a)(1)(I).

(ii) Next, to the Members in proportion to and to the extent of the amount of cash distributions to them for the current and all prior fiscal years reduced by all prior allocations of profit under this paragraph 9(a(1)(ii).

(iii) Thereafter, to each Member in proportion to his/her Profit Sharing Percentage Interest set forth on Exhibit A.

(2) Losses. Losses shall be allocated to the Members in the same manner as profits..

(b) Allocations To Reflect Contributed Property and Capital Account Revaluations. In accordance with Section 704(c) of the Code and the Regulations thereunder, taxable income, gain, loss and deduction with respect to any property contributed to the capital of the Company shall, solely for Federal income tax purposes, be allocated among the Members so as to take into account any variation between the adjusted basis of such property for Federal income tax purposes and its fair market value, as recorded on the books of the Company. As provided in Section 1.704-1(b)(2)(iv)(f) of the Regulations, in the event that the Capital Accounts of the Members are adjusted to reflect the revaluation of Company property on the Company's books, then subsequent allocations of taxable income, gain, loss and deduction with respect to such property shall take into account any variation between the adjusted basis of such property for Federal income tax purposes and its adjusted fair market value, as recorded on the Company's books. Allocations under this paragraph shall be made in accordance with Section 1.704-1(b)(4)(I) of the Regulations and, consequently, shall not be reflected in the Members' Capital Accounts.

(c) Varying Percentage Interests During Fiscal Year. In the event there is a change in any Member's Interest in the Company during a fiscal year (e.g , as a result of a valid transfer of all or part of a Member's interest pursuant to Section 17 below), net profits and net losses shall be appropriately allocated among the Members to take into account the varying interests of the Members so as to comply with Section 706(d) of the Code.

(d) Regulatory Allocations. Notwithstanding any other provision in this Section 10 to the contrary, in order to comply with the rules set forth in the Regulations for (I) allocations of income, gain, loss and deductions attributable to nonrecourse liabilities, and (ii) partnership allocations where partners are not liable to restore deficit capital accounts, the following rules shall apply:

(1) "Partner nonrecourse deductions" as described and defined in Section 1.704-2(I)(1) and (2) of the Regulations attributable to a particular "partner nonrecourse liability" (as defined in Section 1.704-2(b)(4), e.g., a Company liability which one or more Members have guaranteed) shall be allocated among the Members in the ratio in which the Members bear the economic risk of loss with respect to such liability;

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(2) Items of Company gross income and gain shall be allocated among the Members to the extent necessary to comply with the minimum gain charge back rules for nonrecourse liabilities set forth in Sections 1.704-2(f) and 1.704-2(I)(4) of the Regulations; and

(3) Items of Company gross income and gain shall be allocated among the Members to the extent necessary to comply with the qualified income offset provisions set forth in Section 1.704-1(b)(2)(ii)(d) of the Regulations, relating to unexpected deficit capital account balances after taking into account (I) all capital account adjustments prescribed in Section 1.704-1(b)(2)(ii)(d) of the Regulations and (ii) each Member's share, if any, of the Company's partnership minimum gain and partner nonrecourse minimum gain as provided in Sections 1.704-2(g)(1) and 1.704-2(I)(5) of the Regulations.

Since the allocations set forth in this Section 10(d) (the "Regulatory Allocations") may effect results not consistent with the manner in which the Members intend to divide Company distributions, the Managing Member is authorized to divide other allocations of net profits, net losses, and other items among the Members so as to prevent the Regulatory Allocations from distorting the manner in which distributions would be divided among the Members under Section 12 but for application of the Regulatory Allocations. The Managing Member shall have discretion to accomplish this result in any reasonable manner that is consistent with Section 704 of the Code and the related Regulations. The Managing Member may make any election permitted by the Regulations under Section 704 of the Code that may reduce or eliminate any Regulatory Allocation that would otherwise be required.

(e) Tax Conformity; Reliance on Attorneys or Accountants. The determination of each Member's share of each item of income, gain, loss, deduction or credit of the Company for any period or fiscal year shall, for purposes of Sections 702 and 704 of the Code, be made in accordance with the allocations set forth in this Section 10. The Managing Member shall have no liability to the Members or the Company if the Managing Member relies upon the written opinion of tax counsel or accountants retained by the Company with respect to all matters (including disputes) relating to computations and determinations required to be made under this Section or other provisions of this Agreement.

10 **Company Property.** Title to the property and assets of the Company may be taken and held only in the name of the Company. The Chief Manager and/or the Secretary shall have the authority to sign and deliver in the name of the Company any deeds, mortgages, bonds, contracts or other instruments pertaining to the business of the Company and all third parties dealing with the Company shall be entitled to rely upon such execution as evidence of such authority without the obligations to determine approval by the Members.

11. **Distributions To Members.**

(a) Preferred Return. No Member shall receive a preferred return of cash each year. All distributions shall be prorata to the Members, based upon the amount their

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individual Percentage Interest bears to the total Percentage Interest of all the Members, the timing and amount of which shall be determined in the sole discretion of the Managing Member.

(b) Final Distributions. Distributions in termination of the Company shall be made as provided for in paragraph 20 of this Agreement, and in accordance with Regulation §1.704-1(b)(2)(ii)(b)(2).

(c) Restrictions. Except as otherwise provided herein, all distributions by the Company to its Members shall be subject to the terms and conditions of Section 48-236-105 of the Act, regarding the solvency of the Company.

12. **Management.**

(a) Managing Member. The Managing Member shall be as shown on Exhibit A. The Members hereby appoint Sheaffer International, LLC as Chief Manager. The Managing Member shall have exclusive authority to manage the operations and affairs of the Company and to make all decisions regarding the business of the Company, subject only to those matters which are reserved for the vote or approval of the Investor Members by the terms of this Agreement (by the vote herein specified) or by the terms of the Act. Subject to the foregoing, it is understood and agreed that the Managing Member shall have all of the rights and powers of members as provided in the Act and as otherwise provided by law, and any action taken by the Managing Member in accordance with this Section 13 shall constitute the act of, and serve to bind the Company and its Members.

(b) Specific Authority of Managing Member. In furtherance of Section 13(a) above, the Managing Member shall have all right, power and authority necessary, appropriate, desirable or incidental to carry out the conduct of the Company's business, including, but not limited to, the right, power and authority:

(I) to incur and pay all costs, expenses and expenditures, including payments and reimbursements to affiliates of the Members in accordance with this Agreement, incurred in good faith in the course of the conduct of the Company business;

(ii) to finance the operation of the Company's business by causing it to borrow funds upon such terms and conditions as the Managing Member deem proper, which financing may be secured by one or more security interests on the property or assets of the Company, to take any and all actions and to execute, acknowledge and deliver all documents in connection therewith; provided, however, that the Managing Member shall have no right or power to create or impose personal liability on any Member for any of the Company's obligations without the express written consent of such Member;

(iii) to employ and dismiss from employment any and all employees, agents, independent contractors, consultants, appraisers, attorneys and accountants, and to pay such fees, expenses, salaries, wages or other compensation to such persons, as the Managing

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Member determines to be reasonable;

(iv) subject to the voting rights of the Investor Members pursuant to Paragraph 13(c), to acquire, purchase or contract to purchase, or sell or contract to sell, or to lease or hire any property, real or personal, including interests in general and limited partnerships, limited liability companies, and other entities, and to pay the purchase price or make the capital contribution required therefor, for any purposes connected with the Company's business;

(v) subject to the voting rights of the Investor Members pursuant to Paragraph 13(c), to sell all or any portion of the Company's property, or any other assets of the Company, or any interest therein, at any time upon such terms as the Managing Member determines to be in the best interest of the Company;

(vi) to pay, extend, renew, modify, submit to arbitration, prosecute, defend or compromise, upon such terms as the Managing Member deems proper and upon any evidence as they may deem sufficient, any obligation, suit, liability, cause of action or claim, either in favor of or against the Company;

(vii) to pay or cause to be paid any and all taxes, charges or assessments that may be levied, assessed or imposed on any of the property or assets of the Company;

(viii) to invest funds which, in the judgment of the Managing Member, is not immediately required for the conduct of the Company's business, in such investments as may be selected by the Managing Member; which investments may include loans to individuals, corporations, partnerships, or other entities affiliated with the Company or the Members;

(ix) to execute, acknowledge, and deliver any and all instruments to effectuate any and all of the foregoing.

(c) Vote by Members. The following actions shall require the approval of a majority in percentage interest of all Members:

(I) Subject to the exemptions set forth in Section 16, Transfers of Membership Interests shall require the consent specified in Section 16 below;

(ii) The sale, exchange, or other disposition of substantially all of the property and other assets of the Company,

(iii) The Members shall have the right to remove a Managing Member, but only with cause and only with the written consent of Members holding 75% of the Percentage Interests in the Company (excluding for this purpose the Interest held by the Managing Member sought to be removed). Cause for removal shall be deemed to exist where a Managing Member is grossly negligent in the performance of his management duties or willfully

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or recklessly neglects to carry out such duties. Notwithstanding the foregoing however, in the event a Managing Member is a guarantor of any loan or debt of the LLC, then such Managing Member shall not be removed as Manager unless and until such Managing Member is fully released and held harmless from any such loan or debt guarantee. Upon the removal of a Managing Member or upon the death, incompetence or resignation of a Managing Member, the remaining Managing Member, if one, shall become the sole Managing Member unless the Members elect, by the written consent of Members holding 75% of the Membership Interests, a successor Managing Member;

(iv) The merger of the LLC into another entity or another entity into the LLC;

(v) The termination and dissolution of the LLC;

(vi) An amendment to the Articles of Organization or Operating Agreement, but only if the amendment materially affects the rights of the Investor members.

(vii) Approval of the annual operating Budget for the Property which Budget shall be prepared by the Managing Member.

(d) Authority to Engage in Other Activities. No Member shall be required to manage the Company as his or its sole and exclusive function, and a Member may have other business interests and may engage in other activities in addition to those relating to the Company. The Members acknowledge that certain of the Members' other activities and business interests may consist of the ownership, development, marketing, sale, operation or management of real properties or entities that compete with the business of the Company. Neither the Company nor any Member shall have any right in or to such other ventures by virtue of this Agreement or the relationship among the Members created hereby, and agree to waive any potential conflict of interest

(e) Fees to Members and Affiliates. The Managing Member may cause the Company to contract with any Member or any firm or corporation in which a Member may have an interest or any affiliated corporation or entity of a Member, at reasonable and competitive rates of compensation, commission or remuneration, for the performance of any and all services which may at any time be necessary, proper or convenient to carry on the business of Company. The validity of any transaction, agreement or payment involving the Company and a Member or any affiliate thereof otherwise permitted by the terms of this Agreement shall not be affected by reason of the relationship between the Company and the Member or such affiliate. The members hereby agree to waive any and all appearance of, potential or actual conflict of interest these affiliated interests may create.

(f) Exculpation Except as otherwise expressly provided by the Act or herein, the Managing Member shall not be liable, responsible or accountable in damages or otherwise to

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the Company, or to any Member for any acts or omissions performed or omitted in good faith and in a manner reasonably believed by the Member to be within the scope of the authority conferred upon him or it by this Agreement and in the best interests of the Company. Specifically, and without limiting the scope of the foregoing, the Managing Member shall not be liable, responsible or accountable in damages or otherwise to the Company or any other Member for any action taken by the Managing Member, in good faith, including, but not limited to, any actions taken by the Managing Member as "tax matters partner" in connection with the examination by the Internal Revenue Service of the Company's Federal partnership tax return or the determination, protest, adjustment or adjudication of any Federal or state income tax liability of any Member resulting from the Company.

(g) Indemnification. The Company shall indemnify and hold harmless each Member from and against any loss, expense, damage or injury suffered or sustained by him or it by reason of any acts or omissions or alleged acts or omissions arising out of his or its activities on behalf of the Company or in furtherance of the interests of the Company, including, but not limited to, any judgment, award, settlement, reasonable attorney's fees and other costs or expenses incurred in connection with the defense of any actual or threatened action, proceeding or claim, provided that the act or omissions, or alleged acts or omissions, upon which such actual or threatened action, proceeding or claim is based were performed or omitted in good faith and in a manner reasonably believed by the Member to be within the scope of the authority conferred upon the Member by this Agreement and in the best interests of the Company. Such indemnification shall be made only to the extent of assets of the Company.

13. **Bank Accounts.** All funds of the Company shall be deposited in such bank or savings and loan account or accounts as shall be designated by the Managing Member. Withdrawals from any such bank account shall be made upon such signature or signatures as the Managing Member may designate, and shall be made only for the purposes of the Company.

14. **Books and Records.** The Company shall keep true, exact, and complete books of account in which shall be entered fully and accurately each and every transaction of the Company. The fiscal year and the taxable year of the Company shall be the calendar year. All books of account shall be kept by the Secretary at the principal office of the Company and all Members shall have the right to inspect and copy such books at all reasonable times. An accounting shall be made at the end of each fiscal year and a copy of the accounting report shall be transmitted to each Member.

15. **Tax Elections.**

(a) Elections Made by Members. All elections by the Company for Federal income tax or other tax purposes shall be made by the Managing Member.

(b) Tax Matters Partner. The Chief Manager shall be the "tax matters partner," as that term is defined in Section 6231(a)(7) of the Code.

16. **Transferability and Disposition of Membership Interests.**

16.01 General. Except as otherwise specifically provided herein, no Interest Holder shall have the right, as to all or any part of its Membership Interest or Economic Interest to:

(a) sell, assign, pledge, hypothecate, transfer, exchange or otherwise transfer for consideration, (collectively, "sell"); or

(b) gift, bequeath or otherwise transfer for no consideration (whether or not by operation of law, except in the case of bankruptcy).

(c) Each Member shall have the right to transfer to immediate family members or a related entity without the Right of First Refusal.

16.02 Right of First Refusal.

(a) If a selling Member desires to sell all or any portion of its Membership Interest or Economic Interest in the Company to a third party purchaser, the selling Member shall obtain from such third party purchaser a bona fide written offer to purchase such interest, stating the terms and conditions upon which the purchase is to be made and the consideration offered. The selling Member shall give written notification to the remaining Members, by certified mail or personal delivery, of its intention to so transfer such interest, furnishing to the remaining Members and Manager(s) a copy of the written offer to purchase such interest, and the name and business and personal addresses of the proposed transferee.

(b) Primary Option to Purchase. Within 35 days of the receipt of the notice of intention to transfer a Percentage Interest by the last of the Members to receive such notice, each remaining Member may exercise an option to purchase that proportion of the Percentage Interest proposed to be transferred which equals the proportion which the Percentage Interest owned by such remaining Member at the time of his receipt of the notice is of the total of the Percentage Interests then owned by all the remaining Members. The purchase option granted in this paragraph is herein referred to as the "Primary Option."

(c) Secondary Option to Purchase. If a Member fails to exercise a Primary Option granted to him to purchase the Percentage Interest proposed to be transferred, each remaining Member who is granted and who exercises a Primary Option, and the Company, may, within ten days after the expiration of the 35-day option period provided for above, exercise an option to purchase the Percentage Interest with respect to which such Member has failed to exercise his Primary Option (hereinafter "the Option Interest"). In the case of a single remaining Member, his option shall be to purchase all of the Option Interest. In the case of two or more remaining Members, each such remaining Member's option shall be to purchase the portion of Option Interest which bears the same proportion to the total Option Interest as the Percentage Interest owned by

each such remaining Member at the time of receipt of the notice provided for above bears to the total Percentage Interest then owned by all such remaining Members; provided that all such remaining Members may, by agreement among themselves, determine the proportions in which some or all of their number may exercise the option granted in this paragraph. Any portion of the Option Interest not acquired by Members under the Primary Option or Secondary Option may be (but need not be) acquired by the Company. The purchase option granted by this paragraph is referred to as the "Secondary Option."

(d) In the event the remaining Members (or any one or more of the remaining Members) or the Company give written notice to the selling Member of their desire to exercise this right of first refusal and to purchase all of the selling Member's interest in the Company which the selling Member desires to sell upon the same terms and conditions as are stated in the aforesaid written offer to purchase, the remaining Members shall have the right to designate the time, date and place of closing, provided that the date of closing shall be within sixty days after written notification to the Selling Member of the remaining Member or Members' election to exercise their right of the first refusal.

(e) As a condition to the Company recognizing the effectiveness of either the purchase of the Selling Member's interest in the Company by a third party purchaser or the gift of an interest in the Company (including an Economic Interest), (subject to Section 16.03) substitution of a new Member, the remaining Members may require the Selling Member, Gifting Member or the proposed purchaser, donee or successor-in-interest, as the case may be, to execute, acknowledge and deliver to the remaining Members such instruments of transfer, assignment and assumption and such other certificates, representations and documents, and to perform all such other acts which the remaining Members may deem necessary or desirable to·

(1) verify the purchase, gift or transfer, as the case may be;

(2) confirm that the person desiring to acquire an interest in the Company, or to be admitted as a Member, has accepted, assumed and agreed to be subject and bound by all of the terms, obligations and conditions of the Operating Agreement, (whether such Person is to be admitted as a new Member or an Economic Interest Owner);

(3) maintain the status of the Company as a partnership for federal tax purposes; and

(4) assure compliance with any applicable state and federal laws including securities laws and regulations

(a) Any sale or gift of a Membership Interest or Economic Interest or admission of a Member in compliance with this Article 16. shall be deemed effective as of the last day of the calendar month in which the remaining Members' consent thereto was given, or, if no such consent was required pursuant to Section 16.02(e), then on such date that the donee or successor

interest complies with the conditions set forth in Section 16.02(c). The Selling Member agrees, upon request of the remaining Members, to execute such certificates or other documents and to perform such other acts as may be reasonably requested by the remaining Members from time to time in connection with such sale, transfer, assignment, or substitution. The selling Member hereby indemnifies the Company and the remaining Members against any and all loss, damage, or expense (including, without limitation, tax liabilities or loss of tax benefits) arising directly or indirectly as a result of any transfer or purported transfer in violation of this Article 16.

16.03 Transferee Not Member in Absence of Unanimous Consent.

(a) Notwithstanding anything contained herein to the contrary (including, without limitation, Section 16.02 hereof), if all of the remaining Members do not approve by unanimous written consent of the proposed sale or gift of the Transferring Member's Membership Interest or Economic Interest to a transferee or donee which is not a Member immediately prior to the sale or gift, then the proposed transferee or donee shall have no right to participate in the management of the business and affairs of the Company or to become a Member. The transferee or donee shall be merely an Economic Interest Owner. No transfer of a Member's interest in the Company (including any transfer of the Economic Interest or any other transfer which has not been approved by unanimous written consent of the Members) shall be effective unless and until written notice (including the name and address of the proposed transferee or donee and the date of such transfer) has been provided to the Company and the non-transferring Member(s)

(b) Upon and contemporaneously with any sale or gift of a Transferring Member's Economic Interest in the Company which does not at the same time transfer the balance of the rights associated with the Economic Interest transferred by the Transferring Member (including, without limitation, the rights of the Transferring Member to participate in the management of the business and affairs of the Company), all remaining rights and interest which were owned by the Transferring Member immediately prior to such sale or gift or which were associated with the transferred Economic Interest shall immediately lapse until either (1) the remaining Members, by unanimous consent, reinstate such rights to the Economic Interest Owner who did not previously obtain the unanimous written consent of the Members or (2) upon the remaining Members, by unanimous written consent, reinstating such rights to a successor or transferee of such Economic Interest Owner.

17. **Dissolution.** (a) The Company shall dissolve upon a vote of the Members subject to the voting rights of the Members set forth in Paragraph 13(c).

18. **Continuation of Company Business Following Dissolution.**

(a) Dissolution Event. The Company shall not dissolve upon the occurrence of any of the events described in T.C.A. §48-245-101(a)(5)(A)-(K) of the Act, which events

include (but are not limited to) the dissolution, resignation, termination, expulsion, bankruptcy, death, withdrawal, retirement, removal, insanity or incompetency of any Member unless the occurrence of the event reduces the number of Members to less than two (2).

(b) Death of a Member.

(1) Successor of Deceased Member. The following rules shall apply following a Member's death, and the interest of the deceased Member ("deceased Member") passes to any one or more of the following persons ("Qualified Successors") (I) the deceased Member's estate (but only if the estate will be required to distribute the deceased Member's interest to persons described in Section 16(b)), and (ii) persons described in Section 16(b):

(A) Each Qualified Successor may continue to hold the financial rights to the Membership Interest to which the qualified successor succeeds. However, a Qualified Successor shall not be admitted as a substituted member unless (I) the unanimous written consent of remaining Managing Member (excluding for this purpose the entire Membership Interest which was held by the deceased Member) is obtained and the other conditions set forth in paragraph 16(d) are met, or (ii) the Qualified Successor was a Member at the time of the deceased Member's death.

19. **Winding Up.** Upon dissolution of the Company by reason of the events described in Section 18(a) above or if any event described in 19(a) reduces the number of Members to less than two (2), the Company shall liquidate its assets and wind up its affairs in the following manner:

(a) Liquidation of Assets and Discharge of Liabilities. A reasonable time shall be allowed for the orderly liquidation of the assets of the Company and the discharge of its liabilities in order to minimize the normal losses attendant upon such a liquidation. The Managing Member shall liquidate the Company and shall have the authority to perform any and all acts and to take any and all actions which may be necessary, appropriate, or incidental to continue the land development, construction, marketing, rehabilitation and renovation of real estate and to operate and manage real estate in the process of winding up, including, but not limited to, entering into, amending, or changing any and all plans, specifications, or contracts, arranging necessary financing (whether on an interim or permanent basis), and mortgaging or otherwise encumbering real estate therefor.

(b) Survival of Company Contracts. Any act or event (including the passage of time) causing dissolution of the Company shall in no way affect the validity of, or shorten the term of, any lease, deed or trust, mortgage, contract or other obligation entered into by or on behalf of the Company, or acquired by the Company as assignee

(c) Proceeds of Liquidation Net Liquidation Proceeds shall be applied and distributed in the following order of priority:

DLS III

(1) First, to the payment of or provision for the debts and liabilities of the Company (including loans from Members) and the expenses of liquidation in order of priority as provided by law, and to the creation of any reserves which may be reasonably necessary for any contingent or unforeseen liabilities or obligations;

(2) Second, to all of the Members in proportion to their respective Profit Sharing Percentage Interests in the Company as set forth on Exhibit A.

20. **Written Consents in lieu of Meetings.** Insofar as practicable, any consent of the Members, required or appropriate under this Agreement, shall be accomplished by written instrument without the necessity of meetings of the Members.

21. **Definitions.** As used herein, the term:

(a) Act shall mean the Tennessee Limited Liability Company Act, as codified in the Tennessee Code Annotated §48-201-101 et seq and as amended from time to time.

(b) Bankruptcy and variants thereof mean an adjudication of bankruptcy under the Bankruptcy Act of the United States, as now in force or hereafter amended, or an adjudication of insolvency under the laws of a state or the District of Columbia, an assignment for the benefit of creditors, or the filing of a voluntary or involuntary petition in bankruptcy which is not dismissed within sixty (60) days of the filing thereof.

(c) Capital Account means, with respect to any Member, the initial Capital Contribution made by such Member:

(1) decreased by the amount of (I) any losses or deductions allocated to such Member, (ii) any distributions of Net Distributable Cash, Net Liquidation Proceeds or other property made to such Member and (iii) any liabilities of such Member assumed by the Company; and

(2) increased by the amount of (I) any profits allocated to such Member, (ii) any subsequent Capital Contributions made by such Member and (iii) any liabilities of the Company that are assumed by such Member.

Capital Accounts shall be maintained in accordance with the provisions of Section 1.704-1(b)(2)(iv) of the Regulations and, to the extent not inconsistent therewith, generally accepted accounting principles. Capital Account balances shall be determined as of the last day of the fiscal year in which a sale, refinancing or liquidation occurs, but prior to distribution of the proceeds of the sale or other disposition resulting in the gain being allocated therein.

(d) Capital Contribution means, with respect to each Member, the aggregate amount of cash or the fair market value of any property that such Member has agreed to contribute or contributes to the Company in accordance with Section 8 above.

(e) Immediate Family means the spouse of a Member and any ancestor or lineal descendant (including a legally adopted descendant) of a Member.

(f) Incompetency or variants thereof mean a judicial determination that a person is not competent to handle his own affairs, whether by reason of physical or mental incapacity or otherwise.

(g) Interest or Membership Interest or Percentage Interest has the meaning set forth in Section 6(a) above.

(h) Managing Member is the person identified in Section 13(a) having the powers and duties set forth in Section 13 and the other provisions of this Agreement.

(i) Majority in Interest means a 51% or greater interest of the total percentage interests held by all Managing Member, unless a greater percentage vote is otherwise provided for herein.

(j) Net Distributable Cash means all cash and funds received by the Company (other than funds received as Capital Contributions or as Net Liquidation Proceeds by the Company) less the sum of the following to the extent made from such cash and funds received by the Company (but not to the extent made from other sources, including without limitation from Capital Contributions, Net Liquidation Proceeds or cash reserves maintained by the Company): (1) all principal and interest payments on indebtedness of the Company and all other sums paid to lenders; (2) all cash expenditures (including capital expenditures) incurred incident to the operation of the Company's business; and (3) such cash reserves and additions thereto as the Managing Member shall determine is advisable and in the best interests of the Company and as may be required by the terms of the Company's lenders.

(k) Net Liquidation Proceeds means the amount of money, the principal amount of any indebtedness due to the Company and the fair market value (as of the date of distribution) of any and all other property, distributed to the Members in liquidation of the Company pursuant to Section 20, reduced by any liabilities of the Company that are assumed by such Members or which are secured by any property that is distributed by the Company to such Members.

(l) Qualified Successor has the meaning set forth in Section 19(b)(1) above

(m) Regulations means the Income Tax Regulations, including Temporary Regulations, promulgated by the United States Treasury Department under the Code, as the same may be amended from time to time.

(n) Exhibit A means the Exhibit attached to this Agreement and captioned "Exhibit A," as in effect at the relevant time, including any amendments, modifications or supplements made from time to time

22. **Separability.** The invalidity or unenforceability of any provision in this Agreement shall not affect the other provisions hereof and this Agreement shall be construed in all respects as if such invalid or unenforceable provision were omitted.

23. **Interpretation.** This Agreement shall be interpreted and construed in accordance with the laws of the State of Tennessee. All pronouns and any variations thereof shall be deemed to refer to the masculine, feminine, neuter, singular, or plural as the identity of the person or persons referred to may require. The captions of sections of this Agreement have been inserted as a matter of convenience only and shall not control or affect the meaning or construction of any of the terms or provisions hereof.

24. **Entire Agreement.** The parties hereto agree that all understandings and agreements heretofore made between them are merged in this Agreement, which alone fully and completely expresses their agreement with respect to the subject matter hereof. There are no promises, agreements, conditions, understandings, warranties, or representations, oral or written, express or implied, among the parties hereto, other than as set forth in this Agreement and the Articles. All prior agreements among the parties are superseded by this Agreement, which integrates all promises, agreements, conditions, and understandings among the parties with respect to the Company and its property. No termination, revocation, waiver, modification or amendment of this Agreement shall be binding unless agreed to in writing and executed by all the Members.

25. **Counterparts; Effective Date.** This Agreement may be executed in multiple counterparts, each of which shall be deemed an original and all of which shall constitute one agreement. The signature of any party to a counterpart shall be deemed to be a signature to, and may be appended to, any other counterpart. This Agreement is dated and shall be effective among the parties as of the date first above written

26 **Binding Effect.** This Agreement shall be binding upon, and shall inure to the benefit of, the parties hereto and their respective successors, assigns, heirs, executors, administrators, and legal representatives.

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

Sheaffer International, LLC

By: _____

Michael A. Stahelin, President

M. R. S., LLC

By: _____

Reese L. Smith, III, President

EXHIBIT A

MEMBERS

NAME	Description of Contribution	Agreed value of capital contribution	Membership Interest
M. R. S., LLC	Construction Management and Development Services	$100.00	10.00%
Sheaffer International, LLC	Construction Management and Development Services	$900.00	90.00%

AGREEMENT FOR SALE AND PURCHASE OF STOCK

This stock sale and purchase agreement is made on September 15, 2004 by and between Reese L. Smith III and Stephen B. Smith, (Sellers), the sole owners and stockholders of Cartwright Creek Utility Company, Inc., each being residents of Williamson County, Tennessee, and Cartwright Creek, LLC, a Tennessee Limited Liability Company, (Buyer). This Agreement replaces the existing Agreement for Sale and Purchase of Stock dated June 14, 2004 between Reese L. Smith, IIII and Stephen B. Smith, (Sellers), and Sheaffer International, LLC (Buyer).

In consideration of Ten Dollars and other good and valuable consideration, the parties agree as follows;

1. Sellers, Reese L. Smith III and Stephen B. Smith, are the sole stockholders of Cartwright Creek Utility Co., Inc., with Reese L. Smith III owning fifty-one (51) shares and Stephen B. Smith owning forty-nine (49) shares.

2. Sellers agree to sell and Buyer agrees to purchase one hundred (100%) percent of the stock of each Seller in said Company for Ten Dollars ($10.00), and for other good and valuable consideration agreed to, bargained for, and exchanged between the parties, plus the consideration set forth in Paragraphs 3 and 4

3. Company is indebted to Reese L. Smith III and Stephen B. Smith in equal shares for the total sum of Four Hundred Fifteen Thousand ($415,000.00) Dollars which is currently due (see attached Promissory Note as Exhibit _). Sellers agree to extend this payment for four years from date of closing with monthly payments amortized over a period of thirty years, bearing interest at prime rate as adjusted annually in accordance with rates shown in the Wall Street Journal. A note, which will include provision for a 5% late payment penalty, will be executed at closing reflecting these terms. Payment of the note will be guaranteed by Cartwright Creek, LLC by standard Tennessee guaranty. The note will further provide that prepayment may be made at any time without penalty.

4. At time of closing, Reese L. Smith III and Stephen B. Smith will each be issued a five (5%) percent interest in Cartwright Creek, LLC.

5. Accounting functions for Company are presently performed by Haury and Smith. Haury and Smith will continue such accounting functions for Buyer, including billing, for one year at a fee of $2,500.00 per month payable in arrears beginning one month from closing date. Buyer may terminate this accounting agreement with seven (7) days written notice to Haury and Smith at any time within said one-year period. The intention of the parties is to effectuate a seamless transition for the benefit of current customers and that this proposed transaction will not adversely affect or otherwise interrupt the service of current customers.

6. At the date of this Agreement, the Due Diligence period of sixty (60) days from the date of the original Agreement, June 14, 2004, is complete. This contract is no longer contingent upon said Due Diligence period. However, Seller will continue to give Buyer access to books and records as needed in order to prepare for the purchase.

7. Sellers covenant and warrant that they have the full right to sell and transfer the stock which is subject of this agreement and that such stock shares are free and clear of restrictions or encumbrances

8. The closing of this transaction shall take place at the office of Haury and Smith no later than 15 days after this Agreement has been approved by the Tennessee Regulatory Authority.

9. All parties agree that no real estate agents or brokers are involved in this transaction and as such neither party is represented by an agent or broker.

10. Each party shall pay their own attorney and customary costs as it relates to this transaction. Buyer shall pay for any surveys or engineering studies it deems necessary.

WITNESS our hands this 15 day of September, 2004.

Reese L. Smith III

REESE SMITH, III

STEPHEN B. SMITH

CARTWRIGHT CREEK, LLC

BY: _____

HAURY & SMITH CONTRACTORS, INC.

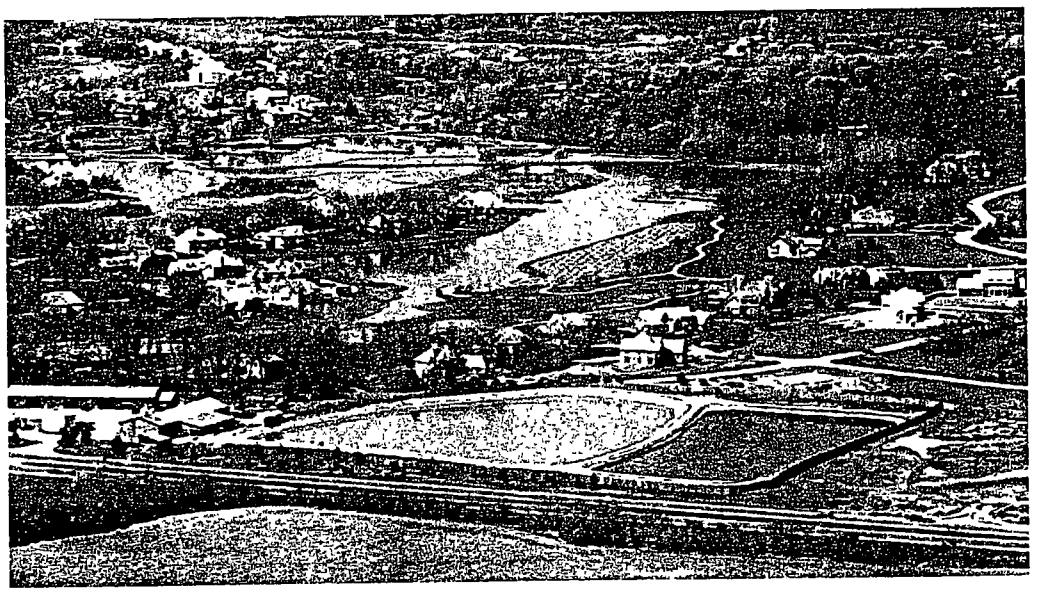
BY: Reese L. Smith III

CARTWRIGHT CREEK UTILITY CO., INC.

BY: Reese L. Smith III

Sheaffer International, L.L.C.

Company Information



Presented To:

TENNESSEE REGULATORY AUTHORITY

JUNE 2004

Prepared By:

Sheaffer International, LLC

800 Roosevelt Road

Suite B-200

Glen Ellyn, IL 60137

630-446-4080

www.sheafferinternational.com

Enhancing Land and Water, Naturally

Sheaffer International Services

I. **Feasibility Studies (Basis of Design Report)**

Additional Services:

- **Site Layout and Planning**
- **Stormwater Management assessment and design**
- **Water Supply Engineering**
- **Assistance with local land use permits**

II. **Design Plans and Specifications; State permitting**

Additional Services:

- **Bid Documents**
- **Bid Evaluation**

III. **Construction & Post-Construction Services**

- **Construction Observation;**
- **Operations & Maintenance Manual;**
- **As-Built Drawings;**
- **Construction Completion Certificate**

IV. **Ongoing Operations and Maintenance Support**

Experience

Permits: Over 60 Sheaffer Modular Reclamation & Reuse Systems (SMRRS) have been permitted and/or built in 17 different states over the past 25 years. The following states have permitted the SMRRS:

- Illinois
- Iowa
- Indiana
- Ohio
- Michigan
- Pennsylvania
- New Jersey
- Massachusetts
- Tennessee
- North Carolina
- South Carolina
- Colorado
- Arizona
- Texas
- Idaho
- Virginia
- Delaware

Customers: A wide variety of customers have chosen the ecologically sound Sheaffer system to recycle wastewater, including:

- Subdivision Developers
- Municipalities
- Resorts
- Golf Clubs
- Industries
- Dairies
- Business Campus Developers
- Schools
- Hospitals
- Nursing Homes
- Correctional Facilities
- Swine Feeding Operations

Reclaimed Water Uses: The reclaimed water from a SMRRS has been productively used in numerous ways:

Irrigation:

- Row Crops
- Pasture
- Parks
- Athletic Fields
- Golf Courses
- Forest Nurseries
- Prairie Wildflowers
- Landscaping
- Lawns

Industrial Reuse:

- Equipment Washing
- Work Yard Cleaning
- Air Conditioning
- Process Cooling
- Interior Grey Water
- Decorative Fountains

Chicago Area Sheaffer Systems and Comparative Sizes

Operating Systems	County	Use	Homes/EDUs	Com. Sq Ft	Flow (gallons)	Property (acres)	Site (acres)	Irrigation (acres)
Banner Day Camp	Lake	Camp	71		25,000	N/A	2	6
Chancellory	Itasca	Commercial		6,000,000	254,000	274	13	128
Fields of Long Grove	Lake	Residential	87		33,000	160	3	10
Fox Mill	Kane	Residential	730		316,000	737	16	81
Glenwood School for Boys	Kane	School	46		16,000	120	3	4
Mill Creek	Kane	Residential	1,800		650,000	1,374	32	167
Prairie Bluff	Will	Golf Course	4	Clubhouse	1,400	N/A	<1	<1
Riverwoods Christian Center	Kane	Camp	20		7,000	85	<1	2
Saddlebrook	Lake	Residential	3,800		595,000	700	17	120
Silver Glen Estates	Kane	Residential	143		50,000	273	5	22
Valley Hi Nursing Home	McHenry	Nursing Home	100		35,000	30	7 5	7
Willowmere	Cook	Residential	54		19,000	132	3	5
Wynstone	Lake	Residential	450		189,000	867	7	76

Systems Underway	County	Use	Homes/EDUs	Com. Sq Ft	Flow (gallons)	Property (acres)	Site (acres)	Irrigation (acres)
Cortland	Dekalb	Municipal			750,000	N/A	32	219
Fisher Corp Center	DuPage	Commercial		800,000	20,000	60	3	6
Maple Hill	McHenry	Residential	637		223,000	462	14	65
Prairie Creek	Will	Residential	1,100		377,000	500	19	110
Prairie Path	McHenry	Residential	133		46,000	80	5	14
Woods Creek	McHenry	Residential	145		51,000	85	5	15

John R. Sheaffer, Ph.D.
Chairman
Sheaffer International, L.L.C.

Dr. Sheaffer has served as the Chairman of Sheaffer International since forming the company in 1996. As company Chairman, Dr. Sheaffer plays an active role in the formulation and implementation of major projects. His problem solving skills are as legendary as his capability for fresh, insightful thinking. He has had a long and distinguished career as a champion of reclamation and reuse, and was instrumental in the inclusion of these concepts in the landmark Clean Water Act Amendments of 1972. He served at that time as the Scientific Advisor to the Secretary of the Army. His earlier dissertation at the University of Chicago on flood proofing served as a template for national, state, and local regulations on this topic.

His work in the recycling of wastewater began in 1972 with the 40 MGD system designed and installed by the City of Muskegon, Michigan. His related work in Illinois started in 1982 with the design, permitting, and construction of the reclamation and reuse system serving the Hamilton Lakes (Chancellory) development in Itasca, Illinois. Since then, more than 60 Sheaffer systems have been permitted and installed in the United States.

The Department of the Army in 1972 decorated him for Exceptional Civilian Service. "Dr. John R. Sheaffer has performed exceptional civilian service from September 1970 to August 1972. His outstanding leadership in establishing the Army in the vanguard of the Nation's effort to control and reduce environmental degradation of our water resources has resulted in significant redirection of the Army Civil Works Program mission and objectives. He has demonstrated incomparable engineering skills and judgment as a natural resources planner in solving numerable complex technical problems related to all facets of water resources development. Dr. Sheaffer's preeminent accomplishments during this period meet the highest traditions of public service and reflect great credit upon himself and the Department of the Army."

He was a recipient of The John R. Sheaffer Award for Excellence in Floodproofing in 1993, established by The Association of State Floodplain Managers and initially awarded to John R. Sheaffer, the man whose name it bears. "Dr. John "Jack" Sheaffer laid the groundwork for floodproofing to be a viable flood protection method, adding an important nonstructural damage reduction alternative to our inventory of floodplain management tools.

In 1995, Dr. Sheaffer was the recipient of the Life Time Environmental Achievement Award, by the City of Wheaton, Illinois.
He currently also serves as the Chairman of the Environmental Commission of DuPage County, Illinois, and is a member of the National Review Committee on Floodplain Management in the United States.

He is the author or co-author of 10 books and more than 50 technical articles on wastewater management, irrigation, floodproofing, and fresh water resources.

Sheaffer INTERNATIONAL LLC
800 Roosevelt Road
Bldg B, Ste 200
Glen Ellyn, IL 60137
PH 630 446 4080 FX: 630 446 4085
www sheaffernternational com

Wastewater Reclamation and Reuse

The Sheaffer Modular Reclamation and Reuse System provides several economic and environmental advantages to existing communities and new developments:

- Accommodates fluctuations in wastewater flow and loadings
- Operates without producing odors
- Minimizes sludge production
- Requires solids removal every 20 years or more
- Produces clear, clean, odor-free water for beneficial reuse
- Operates easily using simple, rugged components
- Reduces life cycle costs through efficient operations and maintenance
- Competes with capital costs of conventional systems
- Makes wastewater treatment an amenity, not an embarrassment

Sheaffer systems are composed of large reclamation cells made from compacted soils, and reclaimed wastewater is commonly reused for irrigation of croplands, golf courses, large lawns, and landscapes.

How does it work? The Sheaffer system uses a four-step process, which is described below:

Step One: Maceration

Maceration is another word for grinding. Incoming sanitary wastewater is passed through a comminutor to grind solids into small particles and maximize their surface area. This improves mixing and biodegradation. Comminutors are rugged, automatic units with bypass channels. Routine maintenance is limited to grinder motor servicing.

Step Two: Anaerobic and Aerobic Reclamation

Macerated wastewater flows by gravity through a buried pipe from the comminutor to the base of Cell I. This prevents wastewater from direct exposure to the air, and delivers the wastewater directly to an anaerobic zone at the base of Cell I. Biodegradation occurs within this oxygen free zone (typically 3 to 4 feet deep). Organic solids break down into constituent chemicals and compounds.

Air is introduced directly above this anaerobic zone to form a well-oxygenated column of water 12 to 20 feet deep. Air blowers installed at the top of the cell berm feed course bubble aerators. The odorous gases produced in the anaerobic zone are chemically transformed in the aerobic zone into non-odorous compounds.

Treated wastewater at the top of Cell I is transferred through a manhole and allowed to flow by gravity to the base of Cell II, where the anaerobic/aerobic process is repeated.

The reclamation cells are sized to provide a total of 14 days or more of detention time. This feature produces several benefits:

- Long detention times reduce the need for billions of bacteria to degrade wastewater. Treatment time is lengthened and sludge production is reduced.
- Large cells can readily accommodate fluctuations in wastewater flow and loadings.
- The large volumes in the anaerobic zone provide long-term storage capacity for solids which do not biodegrade, for example, sand and ground up plastic.
- Deep cells promote oxygen transfer efficiency

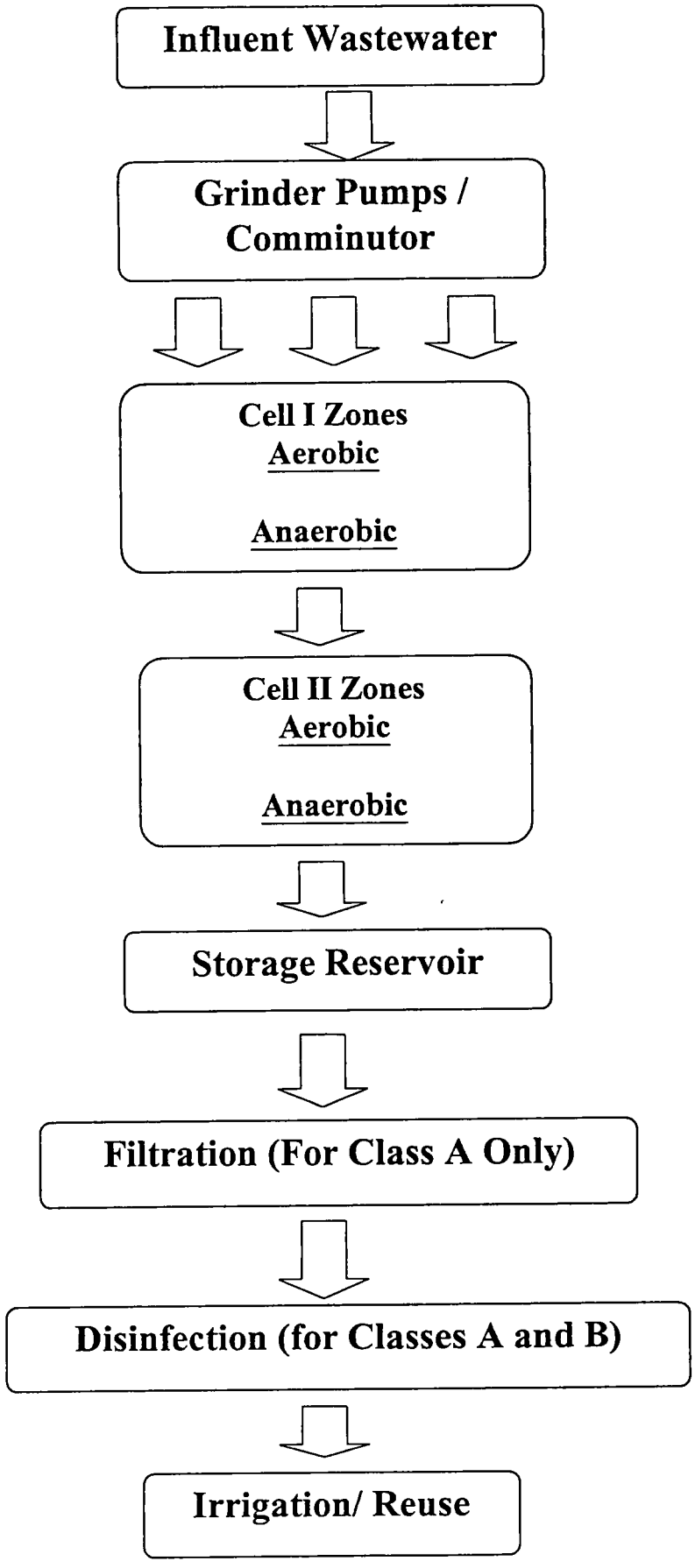
Step Three: Storage Reservoir

Reclaimed water from Cell II flows by gravity to a storage reservoir, where submerged aerators are used to keep the water mixed. The storage reservoir is sized for local climactic conditions to allow irrigation to be controlled to avoid inclement weather.

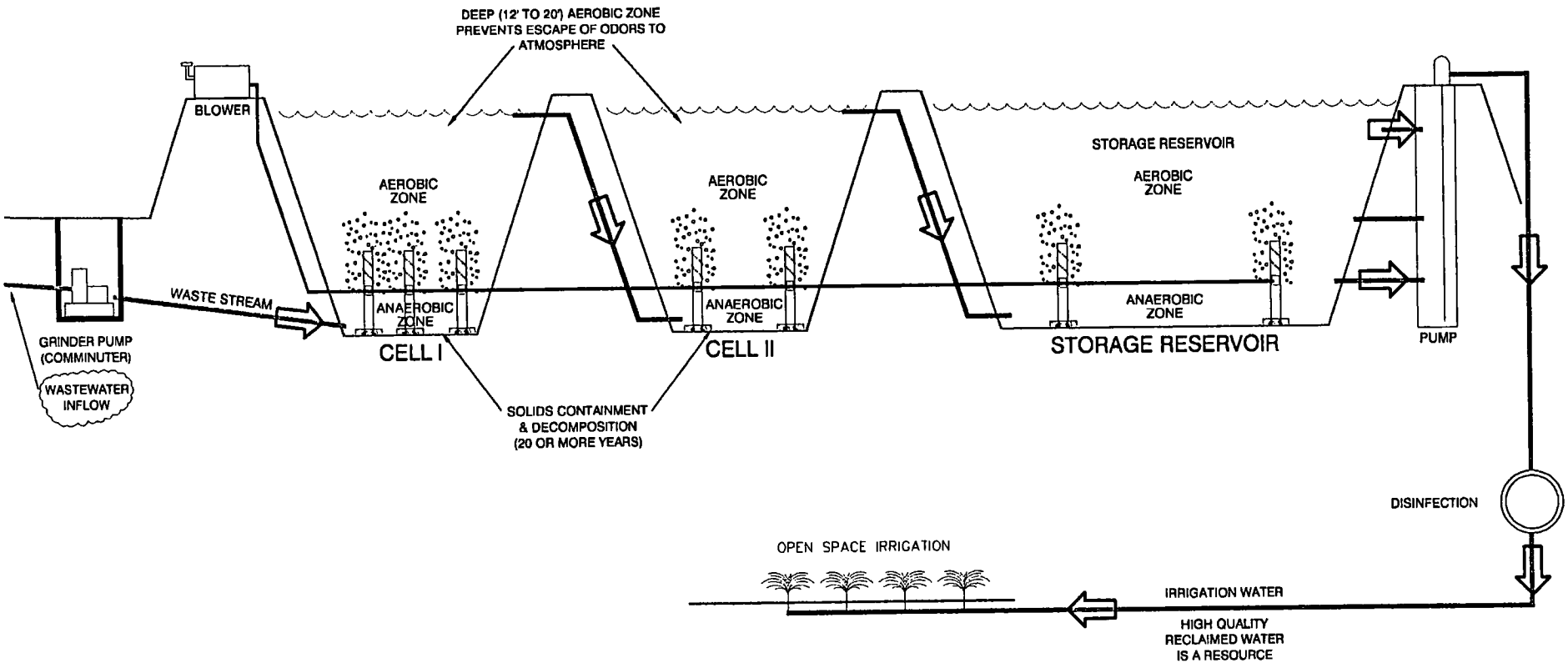
Step Four: Reuse of Reclaimed Water

Reclaimed water is most commonly reused for irrigation. Soils in potential irrigation areas need to be evaluated to locate acceptable areas. Typically, irrigation rates of 36 acre inches/acre/year are permitted by state agencies. This means that for every 100,000 gallons of design flow, 37 net acres of irrigation land are needed. In many communities, cropland is available nearby for this purpose. Sheaffer International has been successful in many cases in obtaining no-cost irrigation easements from cooperating landowners to allow irrigation on their land. This eliminates the need to purchase irrigation acreage, and allows local farm families to stay in farming and produce consistently high yields.

THE SHEAFFER SYSTEM PROCESS



SCHEMATIC DIAGRAM



Sheaffer
INTERNATIONAL LLC

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Stormwater Management

Stormwater Management is an essential element in the administration of communities and the development of new properties. The fundamental principle in the Sheaffer approach is to manage stormwater where it falls, rather than allowing stormwater to swiftly flow and flood. The unique nature of each location's topography, soils, and land uses requires a site-specific solution. However, key concepts can be identified and adapted to many situations (see below).

The traditional approach to stormwater management frequently focuses on costly engineered structures, such as large capacity sewers, culverts, and constructed basins with outlet and overflow controls. These measures collect and relocate stormwater as rapidly as possible. However, their inlet and carrying capacities limit the effectiveness of storm sewers, and they are customarily designed to convey a pre-set design event, typically the 10-year storm. Commonly, there are no indirect public benefits from investments in engineered structures.

An alternative approach – non-structural drainage – emphasizes natural conveyance, storage, and vegetation. This results in:

- Reduction in capital costs
- Preservation of existing site contours, soils, and vegetation
- Creation of linear greenways for recreation and for wildlife habitat
- Reduction in stormwater flow velocity
- Improvement of stormwater filtration and water quality
- Increased infiltration and reduced discharge
- Avoidance of flooding and surcharging
- Mitigation of erosion and sedimentation
- Preservation of floodplains and wetlands
- Minimization of flooding and combined sewer overflow problems

The first one inch of stormwater runoff contains the greatest pollutant and sediment load. Non-structural drainage provides the best opportunity for detaining, filtering, and infiltrating this level of stormwater runoff. This

improves water quality in detention and retention areas receiving runoff from larger storm events.

Elements of non-structural drainage include:

- Identifying natural stormwater pathways, which follow site contours
- Allowing stormwater to follow its natural pathways, and using low cost measures to slow and detain flow
- Grading slowly flowing grassed swales throughout existing communities and new developments
- Using native plants to enhance infiltration, filtering, habitat, and plant variety
- Designing non-structural storage in flat, open areas such as lawns, athletic fields, parking lot landscaping, boulevard parkways, etc.
- Installing detention and retention ponds within natural drainageways to minimize construction costs and store runoff which cannot otherwise be held.
- Using existing contours and drainageways as the basis for design of new property developments

Integrating water resources management and land use is the basis of a stormwater management plan. This allows multiple functional uses of the same acreage, for example, using the same acreage for both recreation and stormwater management.

Sheaffer non-structural drainage systems have successfully managed stormwater in residential and business settings since 1980. One example is the Mill Creek new town in Kane County, Illinois. Following a record storm event in July 1996, which dropped 17 inches of rain in 24 hours, the town's managers said:

> **"It could have rained twice as much and not swamped our system...It was the right thing to do. After all, we are all downstream from somebody else."**

Oil and Grease in Wastewater and Biological Treatment Processes: A Literature Review

by

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Executive Summary

Wastewater materials classified as oil and grease originate from biological lipids or mineral hydrocarbons. In either case, they can be dissolved or dispersed in the water, or they can form agglomerates that can include other solid materials. Most of the potential problems associated with oil and grease in wastewater treatment processes are associated with agglomerates, both because they can clog and foul process equipment, but also because they are relatively difficult to degrade. These problems can be managed by limiting the amount of agglomerated oil and grease into the process, removing materials that enter using skimming or solids removal techniques, or by pulverizing the agglomerates

Once in a biological treatment process, oil and grease proceed through all or parts of a series of biochemical reactions involving sorption, hydrolysis, oxidation, and possibly complete mineralization of the compounds End products from these reactions depend on influent concentrations and characteristics, reaction rates, treatment times, and the reaction pathway In general, animal and vegetable oils in a dispersed state are broken down and readily removed in a wastewater treatment plant; materials that occur in an agglomerated state are more resistant to degradation

The Sheaffer Modular Reclamation and Reuse System (SMRRS), which includes influent maceration, long residence times, and a combination of aerobic and anaerobic zones in a single basin, appears to be very well designed for dealing with oil and grease in wastewater

Introduction and Overview

This paper is a comprehensive review of literature dealing with oil and grease in wastewater The section immediately following this introduction includes a brief description of definitions and characteristics of materials classified as oil and grease In the wastewater treatment literature, the abbreviation "FOG" historically refers to "fats, oils, and grease", which represents a host of materials with a variety of physical and chemical characteristics Although the current analytical technique drops the reference to "fats" and refers only to "oil and grease", throughout this paper we retain the abbreviation FOG. The following section includes a table showing the reported range in concentrations of FOGs in wastewater. A detailed description of the mechanisms involved in the degradation process is presented in the next section. In most cases, the rate-limiting step in the process is a hydrolysis reaction that breaks up complex compounds into smaller molecules that are accessible to microorganisms Potential problems associated with FOGs in a treatment system are also reviewed. The paper concludes with a discussion of some implications of this literature review for the SMRRS, and a list of references.

Definitions and Characteristics of FOGs

This section begins with a review of physical and chemical characteristics of FOGs. The current analytical definition is also presented. Terminology used in the literature is not consistent from source to source, probably reflecting different perspectives from biology, chemistry, and engineering.

Physical and Chemical Characteristics

Physically, FOGs can be agglomerated, dispersed, or dissolved in wastewaters Agglomerated materials can be free-floating or attached to other solids in the system. Dispersed materials can also occur as discrete, fine particles in suspension or attached to other solids.

Chemically, the two major categories of FOGs are biological lipids and mineral hydrocarbons Mineral hydrocarbons, derived from coal tar and petroleum, include materials such as lubricating and road oils, and kerosene. They tend to accumulate at water-air or water-solid interfaces. Lipids are cellular components of plants and animals They are distinguished from other common cellular components, such as proteins and carbohydrates, because they are soluble in nonpolar

organic solvents, but not in water All lipids share this solubility property, but they have a variety of chemical structures.

One group of lipids includes fats and oils, which are triesters of glycerol with fatty acids, also known as triglycerides. Most naturally occurring fats and oils are mixtures of various triglycerides. Depending on their exact composition (primarily the chain length and the relative numbers of saturated and unsaturated carbon bonds) these mixtures can exist as liquids or solids at ambient temperature. When a fatty acid glyceride is liquid at ordinary temperature it is known as oil. When the material is a solid at room temperature, it is known as fat or grease.

In aquatic systems, fats and oils can undergo hydrolysis reactions Rates of these reactions can be accelerated under acid or alkaline conditions. In the case of the acid reaction, known as acid hydrolysis, the products are glycerol and free fatty acids. When treated under alkaline conditions (saponification reaction), the products are glycerol and the salt of a fatty acid. The saponification reaction has a long history in its application to the manufacture of soap.

The fatty acids produced through hydrolysis can be divided into two groups, saturated and unsaturated. Lauric, myristic, palmitic, stearic, and arachidic acids are examples of saturated fatty acids, those with no double carbon bonds Common unsaturated fatty acids – those with double carbon bonds – include oleic, linoleic, and linolenic acids.

Saturated fatty acids can form long chains with a staggered configuration, so that the chains pack closely together almost as in a crystal structure. The result is that saturated compounds tend to be solid at room temperature; the exact melting point depends on the chain length. Relative to fats, oils have a much higher percentage of unsaturated fatty acids. Fatty acids with more double bonds have lower melting points (Mariella and Blau, 1968).

This hydrolysis reaction is also an important step in the overall biological degradation of FOGs (see the section on FOG Degradation Processes). Relative to fats, alkali salts of fatty acids are more soluble and therefore more susceptible to degradation. However, alkali salts of fatty acids also readily react with calcium and magnesium in water, forming mineral soaps These mineral soaps are relatively insoluble, and therefore resist degradation

Analytical Definitions

FOGs are defined not in terms of a specific substance, but in terms of a class of materials that can be identified by an analytical technique Loehr and Kukar (1965) defined FOGs as substances that are insoluble in water but soluble in one or more organic solvents such as either, chloroform,

or hexane A current widely accepted analytical definition for these materials can be found in the reference *Standard Methods for the Examination of Water and Wastewater* (APHA, 1995). According to *Standard Methods*, the term "oil and grease" encompasses materials with similar physical characteristics that are quantitatively determined based on their common solubility in an organic solvent. Historically, that solvent has been trichlorotrifluoroethane However, because of concerns about the effect of fluorocarbons on stratospheric ozone, recent editions of *Standard Methods* suggest an alternative solvent that is 80% *n*-hexane and 20% methyl-*tert*-butyl ether. Based on this definition, these substances can include hydrocarbons, fatty acids, soaps, fats, waxes, oil, and any other material extracted by the solvent from an acidified sample These materials can come from a variety of sources and cover a range of concentrations in wastewater.

Sources and Typical FOG Concentrations in Wastewater

FOGs find their way into wastewater with highway runoff, domestic wastes, and wastes produced from animal and plant processing industries. Concentrations (Table 1) range from tens of mg/L for domestic and dilute municipal wastewaters to more than 5,000 mg/L for concentrated food processing wastes. Metcalf & Eddy, Inc (1991) suggests 100 mg/L as an average FOG concentration for untreated domestic wastewater.

Table 1. Reported FOG concentrations for various types of wastewater [(1)].

Wastewater	Reported FOG (mg/L)	Reference
Domestic	16 – 200	Mahlie (1940)
Domestic	40 – 100	Bowerman and Dryden (1962)
Municipal	16 – 1480	Mahlie (1940)
Nut and seed processing	1000	Tunay et al (1992)
Meat processing	2100	Kantardjieff and Jones (1996)
Wool processing	1800 – 3100	Robinson and Gibson (1985)
Edible oil processing	2000 – 5800	Setiadi and Djajadiningrat (1996)

(1) Data in Table 1 cover a span of more than 50 years Analytical techniques for the various studies were probably not consistent throughout that time, and the operational definition of FOGs probably changed These data, therefore, provide a sense of the wide range in concentrations of FOGs in wastewater

The total amount of FOG in the wastewater can be further subdivided according to how it partitions among various fractions of the total waste stream For example, Heukelikian and

Mueller (1958) and Hunter and Heukelikian (1965) concluded that FOGs constituted from 14 to 19 percent of the dry solids in the settled fraction, from 20 to 51 percent in the colloidal fraction, and from 18 to 23 percent in the emulsion fraction of domestic wastewater.

One goal of a wastewater treatment process is to oxidize organic matter and produce a relatively stable material. FOGs represent a challenge in this respect because compared to other common organic compounds in wastewaters, biological lipids are relatively resistant to microbial degradation. Mechanisms in the degradation process are described in the next section.

FOG Degradation Processes

In a wastewater treatment process, microbes utilize FOGs both as an energy source and for cell synthesis. Because FOGs are relatively complex materials, microorganisms use a series of mechanisms to break FOGs down into more manageable and accessible compounds. These mechanisms include sorption, hydrolysis, and oxidation.

Sorption

Sorption refers both to the accumulation of material at an interface (a two-dimensional process known as *adsorption*), and the partitioning of material into another phase (a three-dimensional process known as *absorption*).

Non-dispersed FOGs that enter a biological treatment process are mostly incorporated into biological floc. In a conventional aerobic treatment process, much of these sorbed FOGs are removed through sedimentation to become part of the waste sludge (Young, 1979). In fact, FOGs can represent from 5% to 25% of the total dry solid content of typical municipal wastewater sludge (Metcalf & Eddy, 1991).

Although sorption does not change the total amount of FOGs in the treatment process, it does alter the distribution of those materials Sorption decreases the concentration of FOGs in the supernatant and increases their concentration in the biosolids. As a result, removal of lipid from the supernatant is more rapid than that from the mixed liquor (Hsu et al , 1983).

The importance of sorption is not limited to removing FOGs from the supernatant. Sorption is also critical for the biological degradation of relatively insoluble FOGs, such as long-chain fatty acids, which are most effectively metabolized when they come in contact with microorganisms The first step in that process is a microbially mediated hydrolysis reaction

Hydrolysis

Because of their complex structures, FOGs are suitable substrates for microorganisms only after hydrolysis of the ester bond. Microorganisms produce extracellular enzymes called lipases to catalyze this reaction. Triglycerides are hydrolyzed by lipase, liberating free fatty acids (typically lauric, myristic, palmic, and stearic acids) and glycerol. This conversion step is critical in the degradation process but the total FOG concentration in the wastewater does not decrease significantly as a result of the reaction because the liberated free fatty acids are also measured as FOGs (Grulois et al, 1993). Hsu et al. (1983) concluded that this initial hydrolysis step to form fatty acids is probably the rate-limiting step in the biological degradation of FOGs.

The rate of hydrolysis depends on characteristics of the compound, such as degree of saturation, solubility, fatty acid chain length, and particle size. For example, unsaturated hydrocarbons (those that include double or triple carbon bonds) are relatively amenable to enzymatic attack. In contrast, saturated hydrocarbons are more resistant to hydrolysis, especially under aerobic conditions (Loehr and Ross, 1968). In general, less soluble, longer, more saturated, and larger particles require greater time for hydrolysis

As noted previously, fatty acids form complexes with cations (such as calcium and magnesium) present in wastewater. The resulting alkali fatty acid salts probably represent the major fraction of materials measured as oil and grease in wastewater.

There seems to be some disagreement as to whether the formation of alkali fatty acid salts enhances or inhibits the degradation of FOGs. Loehr et al. (1965) reported that formation of calcium salts increased the opportunity for biological degradation. In contrast, Loehr and Roth (1968) reported that the alkali salts are relatively insoluble and can agglomerate to form grease layers and balls. As a result, they felt that calcium salts of long-chain fatty acid require longer biodegradation times.

Grady and Lim (1980) report that no more than 1% of the energy available in the compounds is released in the hydrolysis reaction and most of that energy is dissipated as heat Products of the hydrolysis reaction, glycerol and fatty acids, yield additional energy and intermediates for cellular synthesis when they are further oxidized in subsequent reactions.

Oxidation

The glycerol and fatty acid products follow different degradation pathways depending on whether the reactions take place in aerobic or anaerobic environments Fatty acids react through a process known as beta oxidation in which two carbon atoms of the fatty acid are split off, yielding acetyl

coenzyme A (acetyl-CoA) and a fatty acid that is shorter by two carbon atoms. The acetyl-CoA is either further oxidized through the tricarboxylic acid cycle, or it is converted into cell constituents (Brock, 1979) In aerobic environments, oxidation continues from glycerol to pyruvic acid, ultimately releasing energy and intermediates for cell synthesis.

Anaerobic degradation is a two-phase process that involves acidogenesis and methanogenesis (Hwang and Hansen, 1998). Initially, fatty acids and glycerol are converted to intermediate products such as acetic (CH_3COOH), propionic (CH_3CH_2COOH), and butyric acid s ($CH_3CH_2CH_2COOH$).

Acidogenesis reactions for the conversion of propionic acid and butyric acid to acetic acid and hydrogen (Lin et al , 1986) are.

$$CH_3CH_2COOH + 2\ H_2O \rightarrow CH_3COOH + 3\ H_2 + CO_2$$

$$CH_3CH_2CH_2COOH + 2\ H_2O \rightarrow 2\ CH_3COOH + 2\ H_2$$

Reactions showing the conversion of acetic acids and hydrogen to methane (methanogenesis) are·

$$CH_3COOH \rightarrow CH_4 + CO_2$$

$$4\ H_2 + CO_2 \rightarrow CH_4 + H_2O$$

Under proper conditions and given sufficient time, there can be complete mineralization of the compounds yielding carbon dioxide and water under aerobic conditions or methane and water under anaerobic conditions (Loehr et al., 1965).

Observations and Potential Problems with Traditional Treatment Processes

Potential problems associated with FOGs in treatment systems range from fouling of process equipment to inhibiting biological activity Some studies suggest that FOGs in a wastewater treatment process can enhance the growth of undesirable organisms

Most common problems associated with FOGs in wastewater are related to maintenance issues such as sanitary sewer blockage and accumulation of floating grease In primary sedimentation processes, substantial amounts of floatable materials can be removed by skimming However, management of skimmed materials that include high concentrations of FOGs can be problematic, these materials can congeal on the walls of the wastewater treatment plant piping and restrict flow (Rudolls, 1944) In anaerobic digesters, the Water Environment Federation (WEF, 1994) notes

that accumulation of layers of semi-solid or solid grease, often agglomerated with hair and other fibrous matter, can cause problems Liquid oil, which can accumulate where supernatant is drawn from below the surface, can reduce the effective capacity of the digester. Accumulation of surface scum layers can place intolerable stresses on pipes, supports, and other structural elements within anaerobic digesters. High levels of free floating animal or vegetable FOGs can also interfere with monitoring equipment, such as dissolved oxygen probes, level indicators, pH probes, and other instruments. Because of these problems, non-dispersed or floatable FOGs generally are restricted to specific concentration limits in industrial discharge to sanitary sewers.

During the 1960's, Loehr and co-workers reported on what appears to be one of the first comprehensive studies of FOGs in wastewater treatment systems Loehr and Rohlich (1962) used a wet extraction technique and thin layer chromatography to estimate the type and magnitude of lipid classes present in wastewater at various locations in a treatment system. Lipid classes they reported included hydrocarbons, compounds lipids, fatty acids, and triglycerides. Methyl esters were not observed.

They compared lipid groups found in the influent wastewater with those found in the settled wastewater following primary treatment. No alteration of lipid types, such as would be caused by chemical or biological oxidation, was reported, suggesting that FOG removal in primary units occurs because of sorption and subsequent physical separation of lipid materials from the aqueous phase

Subsequent studies revealed that there were significant changes in the relative proportions of lipid classes with increasing amounts of biological treatment For example, Loehr and Roth (1968) reported that shorter chain length fatty acids were metabolized more readily than the longer chain acids. They also noted that unsaturated acids were more readily degraded than saturated ones, soluble acids could be metabolized faster than insoluble ones, and the rate of degradation of insoluble fatty acids was a function of the insoluble particle's size

In general, aerobic biological organisms are efficient in oxidizing soluble organic compounds, including some dispersed or emulsified oil. However, Davis and Richard (1977) pointed out that aerobic biological treatment processes could face limitations when dealing with FOG removal, especially when free oil is involved. Large amounts of free oil, in excess of approximately 10% of the MLVSS (mixed liquor volatile suspended solids), must be avoided because the oil can coat the biological floc and inhibit oxygen transfer within the biomass The oil coating can also inhibit sludge settling Therefore, pretreatment facilities must be carefully designed to remove oil to concentration levels that the biological process can treat effectively

Aerobic Processes

In addition to general fouling concerns, aerobic treatment processes may have their own unique problems associated with FOGs. For example, formation of fatty acid-mineral complexes can be a problem. Loehr et al , (1968) noted that grease deposits and balls could be degraded aerobically at a faster rate if they were broken up before entering the biological system. The degree of pulverization needed, however, may not be typical of traditional treatment plant operations

Several authors suggest that FOGs may stimulate the growth of filamentous microorganisms, which can cause bulking problems in biological reactors. In some cases, the mechanism appears to be related to the high oxygen demand of the waste, as reported by Adamse (1968) for the treatment of dairy wastewater. Similarly, Boutin et al. (1975) suggested that oxygen transfer limitation occurs when there is either lack of mixing, which affects the particle size of grease agglomerates, or low alkalinity, which inhibits the ability of microorganisms to attack the waste. Other studies, however, suggest that FOGs can play a more direct role in altering the structure of the biological community. For example, Rice (1980), Lemmer and Baumann (1988), and Grulois et al. (1993) reported that hydrophobic compounds such as grease and oils were nutrients for filamentous organisms, and therefore could stimulate bulking and foaming problems.

Regardless of the reason for bulking problems, the phenomenon can severely disrupt removal of FOGs during the oxidation process. FOG removal is inhibited because microorganisms tend to partition into and become concentrated in the scum layer at the top of the reactor.

Anaerobic Processes

High grease removal efficiency is possible for anaerobic systems when the grease is composed largely of fatty acids, triglycerides, and other lipids from animal or vegetable origin. Petroleum products, however, are poorly degraded under anaerobic conditions (McCarty et al , 1971).

Lin et al. (1986) reported that an increase in feed FOGs concentration can adversely affect degradation of propionic acid, and that a decrease in hydraulic residence time will adversely affect acetate and the propionate degradation

Hwang and Hansen (1998) noted that the absolute concentration of propionic acid that begins to inhibit the performance of an anaerobic process varies with respect to the characteristics of the specific microbial population. They also reported that a combination of chemical (pH = 6 5) and hydraulic (HRT = 0 5-d) controls favored the population of acidogens capable of converting major organic compound in wastewater into short-chain organic acids.

Summary Comments

Key points from this review include·

- Both biological lipids and mineral hydrocarbons are included under the label "oil and grease".
- Microorganisms relatively easily degrade soluble and dispersed oil and grease.
- Substantial amounts of the oil and grease in the influent to a traditional wastewater treatment process are removed in the primary settling process.
- Agglomerated oil and grease materials can cause problems in wastewater treatment processes because they can foul surfaces, and because they are more resistant to biodegradation
- Limited evidence suggests that oil and grease compounds can stimulate the growth of microorganisms that cause bulking and foaming problems in aerated treatment systems
- The biodegradation process includes sorption, hydrolysis, and oxidation steps.
- The rate-limiting step in biological degradation, especially with agglomerated oil and grease, is usually hydrolysis.
- Fatty acids, a product of hydrolysis, can form complexes with calcium and magnesium. These complexes are relatively insoluble and resist degradation.

Implications for the SMRRS

When viewed in the context of the SMRRS, the above key points suggest that the SMRRS has both disadvantages and advantages in terms of dealing with oil and grease

One potential disadvantage is related to the possible growth of microorganisms that cause bulking and foaming problems in aerated treatment systems. According to several of the studies considered in this review, FOGs could stimulate the growth of such organisms. To our knowledge, this type of problem has not been observed with any existing SMRRS installations

The most significant disadvantage would seem to be the lack of a primary settling basin In a traditional treatment system, a traditional amount of the FOG loading is removed in the primary because it is associated with particulate matter Here again, however, empirical evidence from existing SMRRS installations suggests that the additional loading is not a problem

Perhaps these potential problems have not come up because the SMRRS appears to be well designed for dealing with FOGs in wastewater For example, maceration of the influent wastewater breaks up oil and grease agglomerates, increasing surface area for subsequent biological reactions The SMRRS also has relatively long residence times that provide both a buffer against process upsets and long reaction times for relatively slow biological reactions (such as hydrolysis of oil and grease) Finally, because the SMRRS combines aerobic and anaerobic zones within a single reactor, any low solubility, fatty acid mineral complexes that form can settle into the anaerobic zone to undergo long-term anaerobic processing Products from the hydrolysis reaction are then released into the aerobic zone for further degradation.

Cited References

Adamse, A. (1968) "Bulking of Dairy Waste Activated Sludge" *Water Research*, Vol. 2, pp. 715-722

American Public Health Association (1995) *Standard Methods for the Examination of Water and Wastewater*. 18th Ed., Washington, D C.

Boutin, P.; Vachon, A ; Benchac, J.; Lopez, B (1975) "Mesure de la Capacite d'oxygenation dans les stations de traitement a boues activees en melange integral" TSM-L'eau, 11, pp. 493-501.

Bowerman, F.; Dryeden, F. (1962) "Garbage Detergent and Sewers" *Journal of Water Pollution Control Federation*, Vol. 34, pp. 475-481.

Brock, T.D. (1979) *Biology of Microorganisms*, Prentice-Hall, Inc., Englewood Cliffs, N J.

Davis, L ; Richard, L. (1977) "Removal of Oil and Grease from Industrial Wastewater" *Chemical Engineering / Deskbook* pp 49-56.

Grady, C ; Lim, L. (1980) *Biological Wastewater Treatment and Application*, Marcell Dekker Inc , New York.

Grulois, Ph.; Alric, G.; Brochon, J.; Bridoux, G ; Manem, J. (1993) "L'elimination des Graisses par Treatement Bilogique Aerobic" Centre Internationnal de Recherche sur l'Eau et l'Environnement. Lyonnaise des Eaux-Dumez, France

Heukelekian, H ; Mueller, P. (1958) "Transformation of some Lipids in Anaerobic Sludge Digestion" *Sewage and Industrial Waste*, Vol 30, No 1108.

Hsu, T., Hanki, K.; Matsumoto, J (1983) "Kinetics of Hydrolysis, Oxidation and Adsorption during Olive Oil Degradation by Activated Sludge" *Biotechnology and Bioengineering*, Vol XXV, pp. 1829-1839.

Hunter, J.; Heukelikian, H. (1965) "The Composition of Domestic Sewage Fraction" *Journal of Water Pollution Control Federation*, Vol. 37, pp.1142-1163.

Hwang, S , Hansen, C. (1998) "Characterization of and Bioproduction of Short-Chain Organic Acids from Mixed Dairy-Processing Wastewater" *American Society of Agricultural Engineers*, Vol 41, No. 3, pp 795-802

Kantardjieff, A ; Jones, P (1996) "Practical Experiences with Aerobic Biofilters in TPM, Sulfite and Fine Paper Mills in Canada" *IAWPRC Specialty Conference on Biological Treatment of Pulp and Paper Wastewater*, Vancouver, BC

Lemmer, H ; Baumann, M. (1988) "Scum Actinomycetes in Sewage Treatment Plant-part 2 The Effect of Hydrophobic Substrate" *Water Research*, Vol 22, No. 6, pp 761-763

Lin, C., Sato, K , Noike, T ; Matsumoto, J. (1986) "Methanogenic Digestion Using Mixed Substrate of Acetic, Propionic and Butyric acids" *Water Research*, Vol 20, No 3, pp 385-394

Loehr, C ; Roth, C. (1968) "Aerobic Degradation of Long-chain Fatty Acid Salt" *Journal of Water Pollution Control Federation*, Vol. 51, No. 8, pp. 385-403.
Loehr, R ; Kukar, T (1965) "Removal of Lipids by Conventional Waste Treatment Methods" *Journal of Air and Water Pollution*, Vol. 9, pp.479-485.
Loehr, R ; Rohlich, G (1962) "Wet Method for Grease Analysis" *Proceeding, 17th Industrial Waste Conference*, Purdue University, Ext. Ser. 112, 215.
Mahlie, W (1940) "Oil and Grease in Sewage" *Sewage Works Journal*, Vol 12, No. 5, pp 527
Mariella, R.P. and Blau, R. A. (1968) *Chemistry of Life Processes*; Harcourt, Brace & World, Inc., New York.
McCarty, P ; Hahn, D.; McDermott, G. (1971) "Treatability of Oily Wastewater" Presented to the Annual Meeting of the Americans Oil Chemist Society (A O.C S) at Atlantic City. New Jersey.
Metcalf & Eddy, Inc. (1991) *Wastewater Engineering* 3rd Edition, McGraw-Hill, Inc., New York.
Rice, D. (1980) "The Effect of Oil and Grease on the Filamentous Population in a Complete Mix Activated Sludge Plant" Presented at 61st Annual Conference of Water Pollution Control Federation, Dallas, Texas
Robinson, B.; Gibson, J. (1985) "Current Development in Raw Wool Scouring Technology and Wastewater Treatment" Proc. of the 7th Int. Wool Text. Res Conf , Vol. 5, pp 279-288.
Rudolls, W. (1944) "Decomposition of Grease Digestion, the Effect of Gas Production and Fuel Value of Sludge" *Sewage Works Journal*, Vol. 16, No. 6, pp 1125-1155.
Setiadi, T ; Djajadiningrat, A. (1996) "Palm Oil Mill Effluent Treatment by Anaerobic Baffled Reactors: Recycle Effects and Biokenetic Parameters" *Water Science Technology*, Vol. 34, No. 11, pp. 59-66
Tunay, O.; Akbatur, N.; Orhon, D.; Ozturk, I. (1992) "Final Treatability of Raw and Anaerobically Treated Olive Oil Wastewater" Fresenius Environmental Bulletin, Vol. 1, pp 434-438
Water Environment Federation. (1994) *Pretreatment of Industrial Wastes Manual of Practice FD-3*, Chapter 6, pp. 103-122.
Young, C (1979) "Removal of Grease and Oil by Biological treatment Process" *Journal of Water Pollution Control Federation*, Vol 51, No. 8, pp. 2071-2087.

General References

Chin, K.; Lee, W.; Mohammad, H. (1996) "Study of Palm Oil Mill Effluent Treatment Using Pond System" *Water Science Technology*, Vol. 34, No. 11, pp. 119-123
Christoe, J. (1977) "Treatment of Wool Scouring Effluents with Inorganic Chemicals" *Journal of Water Pollution Control Federation,* Vol 49, pp 848-853.
Entressangles, B. (1980) "Matiere Grasses Alimentaires. Generalites" Lipids et Sante, Etablissement Lesieur, pp 2-22
Gibson, J.; Morgan, W.; Robinson, B. (1982) "Wool Scouring and Effluent Treatment" *Wool Science Revolution*, Vol. 57, pp.1-32.
Grobicki, A , Stuckey, D. (1991) "Performance of the Anaerobic Baffled Reactor under Steady State and Shock Loading Conditions" *Biotechnology Bioengineering*, Vol 37, pp. 344-355.
Hanaki, K ; Matsuo, T ; Nagase, M ; Tabata, Y. (1987) "Evaluation of Effectiveness of Two-Phase Anaerobic Digestion Process Degrading Complex Substrate" *Water Science Technology*, Vol 19, pp 311-322
Hashim, M , Hassan, R , Lee, K (1986) "Anaerobic Digestion of Palm Oil Mill Refinery Effluent" *Proceedings World Congress II of Chemical Engineering* Tokyo
Heukelikian, H. (1943) "Grease in Sewage Sludge, and Scum. Transformation of Grease in Activated Sludge" *Sewage Works Journal*, Vol. 15, pp 499.

Jachmanian, I ; Mukherjee, D. (1985) "Germinating Rapeseed as Biocatalyst. Hydrolysis of Oils Containing Common and Unusual Fatty Acids" *American Chemical Society*, Vol. 43, No 11, pp. 2789-3000

Lehinger, (1972). *Biochemistry*. 2nd edition, Worth Publishers Inc , New York

Loehr, R , DeNavarra, C (1969) " Grease Removal at Municipal Treatment Facility" *Journal of Water Pollution Control Federation*, Vol. 41, No. 142, pp

McCarty, P. (1964) "Anaerobic Waste Treatment Fundamentals Part one-Chemistry and Microbiology, *Public Works*, pp 107-112.

Novak, J.; Carlson, D (1970) "The Kinetics of Anaerobic Long Chain Fatty Acid Degradation" *Water Pollution Control Federation*, Vol 42, No. 1932.

Ozturk, M (1991) "Conversion of Acetate, Propionate and Butyrate to Methane under Thermophilic Conditions in Batch Reactors" *Wat. Res.* Vol 25, No. 12, pp. 1509-1513

Setiadi, T.; Ahmad, A , Ginting, R. (1993) "Palm Oil Mill Effluent Treatment by two Stage Fluidized Bed Reactor" Proceding 11th Australian Biotechnology Conference, Perth

Setiadi, T.; Arief, M (1992) "The Application of Anaerobic Fluidized Bed Reactor in Treating Palm Oil Mill Effluent" Abstract the Ninth International Biotechnology Symposium and Exposition, Virginia

Setiadi, T.; Faisal, M (1994) "Palm Oil Mill Effluent Treatment by Anaerobic Baffled Reactors" Proceeding Aquatech Asia, Singapore, pp. 134-141.

Stronach, S.; Rudd, T.; Lester, J. (1986) *Anaerobic Digestion Process in Industrial Wastewater Treatment*, Springer, London

Thanh, N. (1980) "High Organic Wastewater Control and Management in the Tropics" Proceding Water Pollution Control Conference, CDG-ATT-ERL, Bangkok.

U.S. Environmental Protection Agency (1971) "The Impact of Oily Materials on Activated Sludge" EPA Report, 12050 DSH 93/71.

U.S. Environmental Protection Agency (1975) *Treatability of Oil and Grease Discharged to Publicity Owned Treatment Works*. Effluent Guidelines Division, EPA/440/1-75-066, Washington, D.C.

Velioglu, S.; Curi, K , Camilar, S. (1992) "Activated Sludge Treatability of Olive Oil Bearing Wastewater" *Water Research*, Vo. 26, No 10, pp. 1415-1420.

Wakelin, N., Foster, C. (1998) "The Aerobic Treatment of Grease-Containing Fast Food Restaurant Wastewater" Institution of Chemical Engineers, Vol. 76, Part B, pp. 55-61.

Wiegant, M.; Hrnnink, M.; Lettinga, G. (1986) "Separation of the Propionate Degradation to Improve the Efficiency of Thermophilic Anaerobic treatment of acidified wastewater" *Water Research*, Vol. 20, No 4, pp 517-524

Saddlebrook Farms Groundwater Quality Study

There are five monitoring wells that record groundwater quality for selected parameters in the upgradient and downgradient areas at the Saddlebrook MRRS. The locations of the Monitoring Wells and Irrigation Rigs are presented in Figure 3. Wells 1 and 3 are upgradient and can therefore be compared to downgradient wells 2 and 5 to determine the effects (if any) of the MRRS on groundwater contaminant levels. The annual mean values of quarterly tests from 1989 through 2000 for fecal coliform, ammonia, nitrate/nitrite, sulfate, total dissolved solids (TDS), and chloride are presented in Table 1. Note that Saddlebrook began irrigating in 1995, from Center Pivot Irrigation Machine #1. Center Pivot Irrigation Machine #2 is scheduled to begin operation in 2000. Because Center Pivot Irrigation Machine #3 is a future installation, results from Monitoring Well #4 have been excluded from this study. The results demonstrate that the deep, heavily aerated treatment cells effectively reclaim wastewater. When followed by slow-rate irrigation, the MRRS at Saddlebrook Farms is shown a sound method of protecting the public health and the environment.

Table 2 compares the mean values for each test element in each well over the entire test period 1989 through 2000 with corresponding well and element testing from 1995 to 2000, the period in which Center Pivot Irrigation Machine #1 has been operating. This comparison shows that mean values have decreased since irrigation was initiated in 1995 for all contaminants but TDS. Further, the increase in TDS levels since 1995 applies to all wells, implying a cause external to the reclaimed water irrigation site Fecal coliform was not tested prior to 1995, and so its averages for both test periods are identical. Groundwater levels of ammonia, nitrate/nitrite, sulfate, and chloride have

decreased with the application of reclaimed wastewater through spray irrigation. These results confirm the high level of treatment produced by the reclamation and reuse system.

Table 3 compares the change in annual means over the twelve-year test period with the change in annual means since 1995. First, note the substantial decrease in chloride change. Another look at Table 1 confirms that substantial chloride-level decreases occurred in all wells from 1989-1992. Second, TDS levels, which show a sizable increase over the entire period, show a sizable decrease since 1995. Table 1 reveals that wells 1, 2, and 4 recorded abnormally high TDS amounts in 1995, accounting for the difference. Further, the fact that well 1 is among those high 1995 TDS readings suggests that factors unrelated to the MRRS were primarily responsible for this increase. TDS levels have declined since 1995, adding credence to this finding. Third, the reduced nitrate/nitrite and ammonia levels in upgradient wells after irrigation began were also observed in downgradient wells. Therefore, the MRRS has not increased groundwater nitrate/nitrite and ammonia levels.

Table 4 compares the sample standard deviation over the entire period (1989-2000) with the period under irrigation (1995-2000). Chloride, nitrate/nitrite, and ammonia records deviate much less when limited to the irrigation period than the entire period. This information, together with that of Table 2, means that not only are the mean levels of chloride, nitrate/nitrite, and ammonia lower since the MRRS irrigation has been operating, they are also more consistent than they were before irrigation with reclaimed water. When upgradient and downgradient wells are compared since initiation of irrigation, fecal coliform levels are notably lower in downgradient wells. Table 1 reports high fecal coliform levels for well 3 in 1995 and well 1 in 1997. In each of these

instances, this fecal coliform infiltration into upgradient wells was not manifest on similar levels in downgradient wells.[1]

The data from Saddlebrook Farms' 1989-2000 groundwater testing, therefore, reflects favorably on the performance of the MRRS. Mean levels of chloride, sulfate, nitrate/nitrite and ammonia have decreased in upgradient and downgradient wells since irrigation was initiated in 1995, and all test criteria record similar to favorable differences in upgradient and downgradient well mean values. Since 1995, chloride readings have stabilized, showing much less standard deviation and change in mean values than over the entire test period. Ammonia and nitrate/nitrite level fluctuations have also decreased since 1995 in all wells, and fecal coliform deviation since 1995 is lower in downgradient wells than upgradient. Average water quality (Table 2) since reclaimed water irrigation was initiated is similar to or better than that over the entire period for all parameters and deviates less from that higher quality for ammonia, nitrate/nitrite, and chloride. Therefore, groundwater flowing under the reclaimed water irrigation shows no negative difference from upgradient groundwater. The only significant differences, of ammonia, nitrate/nitrite, and fecal coliform, are favorable to downgradient wells.

[1] 1995 data shows a 1 50 fecal coliform level in well 2 as opposed to a 3 50 level in well 3, a 43% difference

Table 1: Annual Means of Quarterly Groundwater Sampling at Saddlebrook Farms.

Date	Monitoring Well	Fecal Coliforms /100 ml	Ammonia (N) mg/l	Nitrate/ Nitrite (N) mg/l	Sulfate mg/l	Total Dissolved Solids mg/l	Chlorides mg/l
1989	Well 1 Upgradient	NA	0 03	1 30	201 90	354 00	44 70
	Well 2	NA	0 01	1 60	216.60	294.00	37.60
	Well 3 Upgradient	NA	0 00	2 30	199 80	306 00	12.90
	Well 5	NA	0 02	1.90	194 80	276 00	28.10
1990	Well 1 Upgradient	NA	1 55	1 27	143 75	391 00	23.00
	Well 2	NA	0.38	0.89	247.93	343 50	20.03
	Well 3 Upgradient	NA	0 36	1 07	170 15	375 50	11 78
	Well 5	NA	0.44	1 04	296.58	412 50	23 85
1991	Well 1 Upgradient	NA	0 72	0.86	131 83	248 53	15 93
	Well 2	NA	0 73	0.62	158.20	588.10	14.97
	Well 3 Upgradient	NA	0 73	0.64	113 77	556 97	17 83
	Well 5	NA	0 75	0.58	331.50	731.87	20 43
1992	Well 1 Upgradient	NA	1 00	1 24	200 93	572 50	7 42
	Well 2	NA	1.00	NA	161 23	650.00	5.32
	Well 3 Upgradient	NA	1 00	0 89	209 52	540 00	7 95
	Well 5	NA	1 00	0 54	227.00	646.25	7.35
1993	Well 1 Upgradient	NA	1 00	1 05	116 45	333 00	7 82
	Well 2	NA	1 00	0.73	148.54	360.00	5.85
	Well 3 Upgradient	NA	1 00	0 90	139 75	439 60	6 00
	Well 5	NA	1 03	1.00	219.58	474.20	7.57
1994	Well 1 Upgradient	NA	1 00	2 13	174 18	572 50	7 45
	Well 2	NA	1.00	1.00	141 43	540.00	4.63
	Well 3 Upgradient	NA	1 00	0 68	110 85	465 00	4 68
	Well 5	NA	1.00	0.39	220.30	765.00	6.26
1995 Irrigation↓	Well 1 Upgradient	0 00	0 07	0 58	165 70	700 00	8 45
	Well 2	1.50	0 05	0 55	146 40	755 00	6.67
	Well 3 Upgradient	3 50	0 07	0 56	109 63	496 67	4 80
	Well 5	NA	0 10	0 85	200.80	770 00	4.32
1996	Well 1 Upgradient	0.00	0 09	0 30	141 78	585 00	7 30
	Well 2	0 00	0 05	0 36	166.75	634.25	6.84
	Well 3 Upgradient	0 00	0 05	0 30	156 13	751 50	7 74
	Well 5	NA	NA	NA	NA	NA	NA
1997	Well 1 Upgradient	18 00	0 07	0 21	135 97	593 33	7 91
	Well 2	0 00	0.06	0.33	171.67	740 00	7.15
	Well 3 Upgradient	1 00	0 06	0 94	141 90	570 00	6 69
	Well 5	0.00	0 05	0.24	84 20	440.00	4 12
1998	Well 1 Upgradient	0 33	0 22	0 40	188 48	725 00	7 37
	Well 2	0 00	0.11	0.32	136 66	656 00	6.66
	Well 3 Upgradient	0 00	0 06	0 30	72 10	440 00	4 24
	Well 5	0 25	0 07	0 30	94 36	484 00	4 46
1999	Well 1 Upgradient	0 00	0 05	0 31	118 25	475 00	8 56
	Well 2	0 50	0.05	0 30	24 03	375 00	9 20
	Well 3 Upgradient	0 00	0 08	0 49	69 68	395 00	2 64
	Well 5	0 00	0.05	0 50	112.08	660 00	5 76
2000	Well 1 Upgradient	0 75	0 06	2 69	115 83	490 00	8 03
	Well 2	50 00[1]	0 06	0.35	27 80	380.00	10 62
	Well 3 Upgradient	0 00	0 10	0 31	72 48	390 00	3 53
	Well 5	9 00	0 05	0.30	144 75	625 00	6 14

Source McHenry Analytical Laboratory, Inc., McHenry Illinois

[1] Well 2 Fecal Coliform Average is 50 fcu / 100 ml in 2000 due to a June 2000 test of 200 fcu / 100 ml February, September, and December tests all reported 0 fcu / 100 ml This suggests a) test error, or b) a temporary infiltration that was quickly eliminated and not recurrent.

Table 2: Saddlebrook Farms Overall Sample Means.[1]

Monitoring Well	Fecal Coliforms /100 ml	Ammonia (N) mg/l	Nitrate/ Nitrite (N) mg/l	Sulfate mg/l	Total Dissolved Solids mg/l	Chlorides mg/l
Well 1 Upgradient	3.18	0.49	1.03	152.92	503.32	12.83
Well 2	8.67[2]	0.37	0.37	145.60	526.32	11.29
Well 3 Upgradient	0.75	0.38	0.38	130.48	477.19	7.56
Well 5	2.31	0.41	0.69	193.27	571.35	10.76

Saddlebrook Farms Means of Samples Since Initiation of Irrigation.						
Well 1 Upgradient	3.18	0.09	0.75	144.33	594.72	7.94
Well 2	8.67[2]	0.06	0.37	112.22	590.04	7.86
Well 3 Upgradient	0.75	0.07	0.48	103.65	507.19	4.94
Well 5	2.31	0.06	0.44	127.24	595.80	4.96

Table 3: Change in Saddlebrook Farms Annual Sample Means.

Monitoring Well	Fecal Coliforms /100 ml	Ammonia (N) mg/l	Nitrate/ Nitrite (N) mg/l	Sulfate mg/l	Total Dissolved Solids mg/l	Chloride mg/l
Well 1 Upgradient	NA	+0.03	-1.39	-86.08	+136.00	-36.67
Well 2	NA	+0.05	-1.25	-188.80	+86.00	-26.99
Well 3 Upgradient	NA	+0.09	-1.99	-127.33	+84.00	-9.37
Well 5	NA	+0.04	-1.60	-50.05	+349.00	-21.96

Change in Saddlebrook Farms Annual Sample Means Since Initiation of Irrigation.						
Well 1 Upgradient	+0.75	0.01	-2.12	-49.88	-210.00	-0.42
Well 2	+48.50[2]	+0.01	-0.20	-118.60	-375.00	+3.95
Well 3 Upgradient	-3.50	+0.03	-0.25	-37.16	-106.67	1.27
Well 5	NA	-0.05	-0.55	-56.05	-145.00	+1.82

Table 4: Saddlebrook Farms Sample Standard Deviation, 1989-2000.

Monitoring Well	Fecal Coliforms /100 ml	Ammonia (N) mg/l	Nitrate/ Nitrite (N) mg/l	Sulfate mg/l	Total Dissolved Solids mg/l	Chlorides mg/l
Well 1 Upgradient	7.27	0.53	0.77	32.24	148.32	11.11
Well 2	20.26[2]	0.43	0.40	64.53	166.54	9.42
Well 3 Upgradient	1.41	0.43	0.55	47.74	117.36	4.50
Well 5	4.46	0.44	0.49	79.39	163.05	8.83

Saddlebrook Farms Standard Deviation Since Initiation of Irrigation, 1995-2000.						
Well 1 Upgradient	7.27	0.06	0.96	28.19	103.39	0.53
Well 2	20.26[2]	0.02	0.09	68.09	171.09	1.66
Well 3 Upgradient	1.41	0.02	0.25	38.40	137.53	1.93
Well 5	4.46	0.02	0.25	47.12	134.25	0.92

[1] Fecal Coliform Testing began in 1995

[2] Well 2 Fecal Coliform Average is 50 fcu / 100 ml in 2000 due to a June 2000 test of 200 fcu / 100 ml February, September, and December tests all reported 0 fcu / 100 ml This suggests a) test error, or b) a temporary infiltration that was quickly eliminated and not recurrent. This test is beyond 3 Standard Deviations from the Overall Well 2 Fecal Coliform test mean

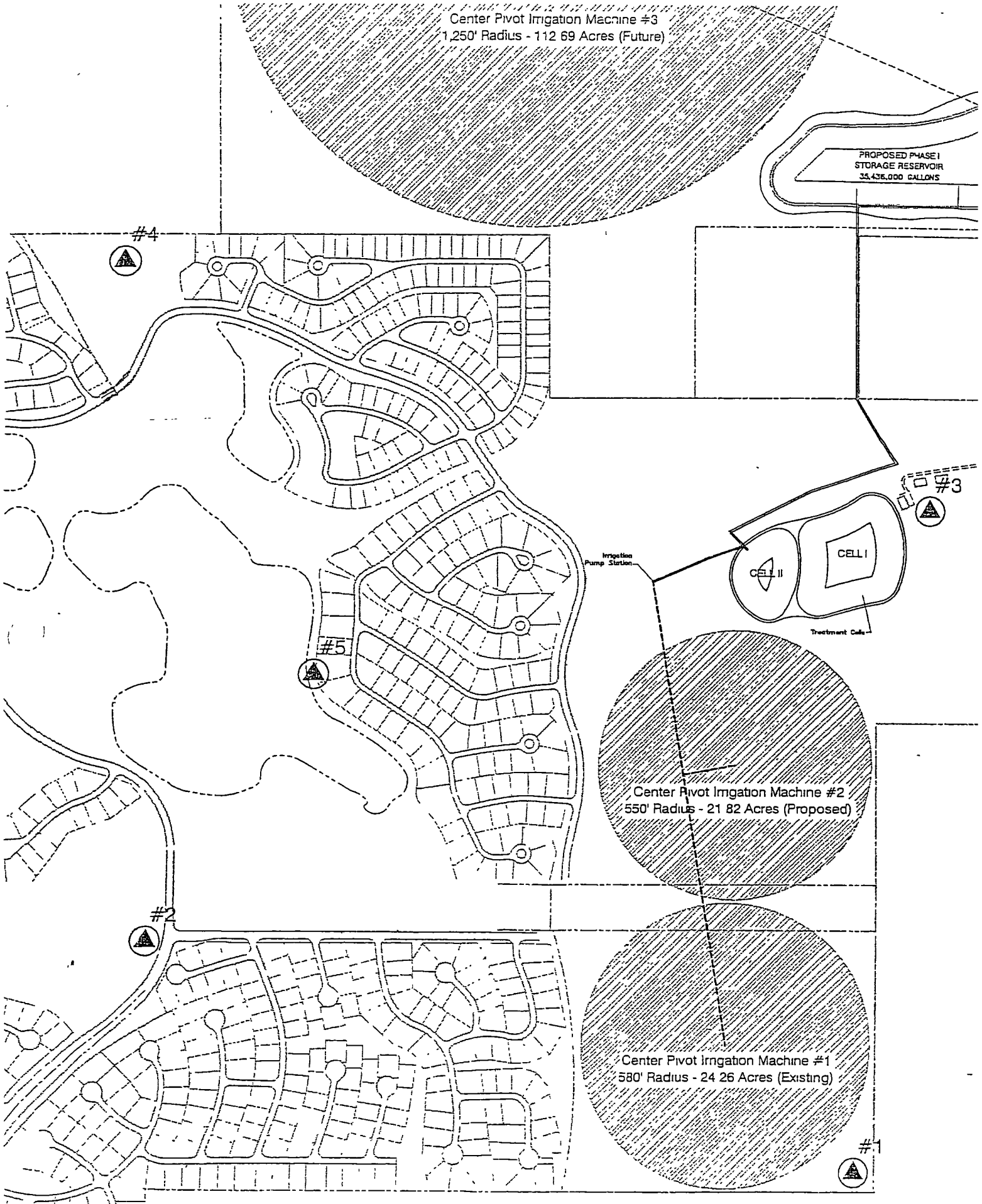


Figure 2: Location Of Monitoring Wells: Saddlebrook Farms

Table 4: Groundwater Sampling Results at Saddlebrook Farms

Date	Fecal Coliforms	Ammonia (N)	Nitrate/ Nitrite (N)	Sulfate	Total Dissolved Solids	Chlorides
03/19/99						
Well 1 upgradient	0	<0.05	0.35	122	520	8.04
Well 2	0	<0.05	<0.30	32.4	400	9.65
Well 3 upgradient	0	0.14	<0.30	69.2	420	2.6
Well 4	0	<0.05	<0.30	143	620	14.4
Well 5	0	<0.05	<0.30	152	680	6.44
07/06/99						
Well 1 upgradient	0	<0.05	<0.30	135	460	10.0
Well 2	0	<0.05	<0.30	25.8	360	9.22
Well 3 upgradient	0	0.06	<0.30	69.7	380	3.47
Well 4	2	<0.05	<0.30	255	820	9.77
Well 5	0	<0.05	<0.30	149	640	5.71
10/11/99						
Well 1 upgradient	0	<0.05	<0.30	105	480	8.03
Well 2	2	<0.05	<0.30	19.4	380	8.70
Well 3 upgradient	0	<0.05	1.01	65.2	400	1.96
Well 4	40	<0.05	<0.30	212	800	14 2
Well 5	0	<0.05	1.09	133	680	4.98

Source: McHenry Analytical Water Laboratory, Inc., McHenry, Illinois.

Table 2 Reduction in Pollution Parameters. Saddlebrook Farms

Test 1 October 1999

Parameter	Raw Influent	Cell I Inlet	Cell I Outlet	Cell II Inlet	Cell II Outlet	Irrigation Water	Reduction
Fecal Coliform (CFU/100 ml)	11,000,000	17,400	18,700	4,850	4,550	0	100%
Total Suspended Solids (mg/L)	95.00	6 00	7 20	20 00	20 00	16.00	83%
Total Volatile Suspended Solids (mg/L)	74 00	4 00	4 00	6 40	6 00	5 60	92%
BOD5 (mg/L)	150 00	14 00	16 00	7 40	7.20	<1 0	100%
Nitrogen Kjeldahl as N (mg/L)	32 00	10 00	10 00	3 00	3 00	3 00	91%
Ammonia as N (mg/L)	19 90	7 48	6 90	1 13	1 07	1 25	94%
Nitrate as N (mg/L)	0 33	0 66	0 68	2 48	2 45	2 44	NA
Phosphorus, Total (mg/L)	3 96	3 95	3 85	3 51	3 50	3 58	10%

Test 2 November 1999

Parameter	Raw Influent	Cell I Inlet	Cell I Outlet	Cell II Inlet	Cell II Outlet	Irrigation Water	Reduction
Fecal Coliform (CFU/100 ml)	8,000,000	29,600	30,600	3,280	2,880	1	99 99%
Total Suspended Solids (mg/L)	72 00	12 00	11.00	20 00	14.00	15 00	79%
Total Volatile Suspended Solids (mg/L)	54 00	5 20	4.00	5 60	5 60	4 80	81%
BOD5 (mg/L)	130 00	15 00	13 00	9 50	9 40	<1 00	99 99%
Nitrogen Kjeldahl as N (mg/L)	45 00	11 00	10 00	6 00	4 00	5 00	89%
Ammonia as N (mg/L)	24 40	8 45	8 32	3 71	3 64	3 57	85%
Nitrate as N (mg/L)	<0 30	0 79	0 79	2 00	2 00	2 09	NA
Phosphorus, Total (mg/L)	4 75	4 01	3 96	3 92	5 32	3 86	19%

Test 3· June 2000

Parameter	Raw Influent	Cell I Inlet	Cell I Outlet	Cell II Inlet	Cell II Outlet	Irrigation Water	Reduction
Fecal Coliform (CFU/100 ml)	2,600,000	9,500	10,300	3,110	490	0*	100%
Total Suspended Solids (mg/L)	43 30	6 70	6 70	7 30	6.70	9 30	79%
Total Volatile Suspended Solids (mg/L)	38 00	5 00	5.50	6 50	6 00	6 50	83%
BOD5 (mg/L)	95 00	24 00	24 00	11 00	12 00	NA*	NA
Nitrogen Kjeldahl as N (mg/L)	35 00	16 00	16 00	3 00	2.00	2 00	94%
Ammonia as N (mg/L)	13 20	13 20	13 40	0 45	0 44	0 43	97%
Nitrate as N (mg/L)	0 60	1 76	1 47	8.93	8 87	8.96	NA
Phosphorus, Total (mg/L)	3 38	4 02	3 90	3 84	3 89	3 87	NA

Test 4 October 2000

Parameter	Raw Influent	Cell I Inlet	Cell I Outlet	Cell II Inlet	Cell II Outlet	Irrigation Water	Reduction
Fecal Coliform (CFU/100 ml)	10,300,000	35,900	37,700	3,560	3,940	0	100%
Total Suspended Solids (mg/L)	65 00	32 00	32 50	31.50	28 00	24 50	62%
Total Volatile Suspended Solids (mg/L)	52 00	13 00	12.00	14 00	13 00	11 00	79%
BOD5 (mg/L)	110 00	20 00	14 00	22 00	22 00	15 00	86%
Nitrogen Kjeldahl as N (mg/L)	40 00	13 00	13 00	8 60	8 60	6 60	84%
Ammonia as N (mg/L)	26 50	10 20	9 95	5.79	5 61	4 68	82%
Nitrate as N (mg/L)	<0 020	0.94	0.94	1 80	1 90	2.70	NA
Phosphorus, Total (mg/L)	4.90	4 10	3 90	3 60	3 70	3 70	24%

* Irrigation line was not purged for the June 6, 2000 test Fecal Coliform was retested after purging the line on June 19 resulting in the level indicated

Source. McHenry Analytical Water Laboratory, Inc., McHenry, Illinois.

Table 2: The Chancellory SMRRS, Itasca, Illinois
BOD_5 (mg/L) Test Results

Date	Raw Influent	Influent / Cell II Reduction	Cell II	Cell II / Storage Reduction	Influent / Storage Reduction	Storage	Storage / Sprinkler Reduction	Sprinkler	Total Reduction
1981	307 0	43.9%	172.1			ND		2.0	99 3%
1983	275.3	93.5%	17.8	5.7%	99.3%	2 0	-1.3%	5.5	98 0%
1985	150 4	68.0%	48 2	28 1%	96.0%	6 0	2.7%	2 0	98 7%
1986	288 2	89.8%	29.5			ND		0 9	99 7%
1987	223.2	81 8%	40 7	13.8%	95 5%	10 0		ND	
1988	181 0	89 1%	19.8	5.4%	94.5%	10 0	4.4%	2 0	98 9%
1989	182.5	91 5%	15.5	5.2%	96.7%	6.0	3 0%	0.6	99.7%
1990	143.8	91.4%	12.4	3.2%	94.6%	7.8	4.7%	1.0	99.3%
1991	272.7	95 2%	13.0	1.2%	96.4%	9.7	3 2%	1.0	99 6%
1992	323.2	95 4%	15 0	1 6%	97 0%	9 8		<5 0	98.5%
1993	136.5	83 9%	22 0	15.0%	98.9%	1.5	-8.4%	13.0	90 5%
1995	172 0	75.6%	42.0	22.1%	97.7%	<4	0.0%	<4	97.7%
1997	117 5	78.3%	25 5	15 3%	93 6%	7 5	1.3%	6 0	94 9%
1998	180 0	92.8%	13.0	6.1%	98.8%	2.1	0 6%	<1 0	99 4%
Average	**211.0**	**83.6%**	**34.8**	**10.2%**	**96.6%**	**6.6**	**1.0%**	**3.4**	**98.0%**

Table 3: The Chancellory SMRRS, Itasca, Illinois
TSS (mg/L) Test Results

Date	Raw Influent	Influent / Cell II Reduction	Cell II	Cell II / Storage Reduction	Influent / Storage Reduction	Storage	Storage / Sprinkler Reduction	Sprinkler	Total Reduction
1981	272.0	-44.2%	392.1		-44.2%	ND		10.0	96 3%
1983	213 2	82 6%	37 0	11 7%	94.4%	12.0	2.3%	7 0	96 7%
1985	463.2	93.0%	32.6	4.1%	97.0%	13.7	-1 4%	20.0	95.7%
1986	108.6	73.3%	29 0		73.3%	ND		6 0	94.5%
1987	137 7	-9.9%	151.3	49 6%	39 7%	83.0		ND	
1988	136 7	66.5%	45.8	11 0%	77.5%	30 8	12 8%	13 3	90 3%
1989	162.2	75.5%	39.8	9 7%	85 1%	24.1	10.0%	7.8	95.2%
1990	119 6	77 8%	26 6	-3 5%	74.2%	30 8	17.4%	10 0	91.6%
1991	98 0	59 9%	39.3	9 8%	69.7%	29.7	20 1%	10 0	89 8%
1992	292 2	85.6%	42.0	9.9%	95.6%	13.0	1 9%	7 5	97.4%
1993	262 0	83.2%	44.0	7.8%	91.0%	23 5	7.1%	<5 0	98 1%
1995	130 0	93.8%	8 0	2 3%	96.2%	<5	0.0%	5	96.2%
1997	250 0	81.6%	46.0	-6.4%	75.2%	62.0	22 4%	6	98 0%
1998	180 0	92.2%	14.0	5.6%	97.8%	<4 0	-0 6%	19	97 2%
Average	201.8	65.1%	67.7	9.3%	73.0%	32.3	8.4%	10.1	95.2%

Table 4: The Chancellory SMRRS, Itasca, Illinois
TKN (mg/L) Test Results

Date	Raw Influent	Influent / Cell II Reduction	Cell II	Cell II / Storage Reduction	Influent / Storage Reduction	Storage	Storage / Sprinkler Reduction	Sprinkler	Total Reduction
1981	21.4	NA	ND	NA	NA	ND		ND	
1983	40.8	78.4%	8 8		78 4%	ND	14.5%	2 9	92.89%
1985	37 1	76.8%	8.6	15.6%	92.5%	2.8	4 0%	1.3	96.50%
1986	31.5	87.9%	3.8		87.9%	ND		ND	
1987	46 5	48 2%	24.1	47.5%	95.7%	2 0		ND	
1988	28.8	53 8%	13 3	26.7%	80 6%	5 6	11 5%	2.3	92 01%
1989	30 1	56 8%	13.0	17 9%	74.8%	7.6	8 3%	5.1	83.06%
1990	17.1	-8.2%	18 5	25.7%	17.5%	14.1	24.6%	9.9	42 11%
1991	10.7	-84.1%	19.7	36.4%	-47.7%	15 8	26 2%	13.0	-21.50%
1992	59 1	77.5%	13.3	8 6%	86.1%	8.2	-0 7%	8.6	85.45%
1993	38 7	46 0%	20 9	42 1%	88.1%	4.6	-2.8%	5.7	85.27%
1995	30 2	89.7%	3.1	-4.3%	85.4%	4.4	6.6%	2.4	92 05%
1997	43.9	76.5%	10.3	17 0%	93.5%	2.9	2.6%	1 8	96.01%
1998	21 0	-228 6%	69 0	285.7%	57 1%	9 0	14.3%	6 0	71 43%
Average	**32.6**	**29%**	**17.4**	**47%**	**68%**	**7.0**	**10%**	**5.4**	**74%**

Reduction in Pollution Parameters at the Wynstone SMRRS

Test 1: April 1997

Parameter	Raw Influent	Cell I Outlet	Cell II Outlet	Pumphouse (before chlorination)	Irrigation after chlorination
Number of samples tested	0	0	0	0	4
Fecal Coliform (CFU/100 ml)	NA	NA	NA	NA	0
Total Suspended Solids (mg/L)	NA	NA	NA	NA	26
Total Residual Chlorine (mg/L)	NA	NA	NA	NA	0.10
BOD5 (mg/L)	NA	NA	NA	NA	12.10

Test 2: Sep - Dec 1997

Parameter	Raw Influent	Cell I Outlet	Cell II Outlet	Pumphouse (before chlorination)	Irrigation after chlorination
Number of samples tested	0	0	0	6	5
Fecal Coliform (CFU/100 ml)	NA	NA	NA	NA	33
Total Suspended Solids (mg/L)	NA	NA	NA	65	60
Total Residual Chlorine (mg/L)	NA	NA	NA	NA	0 80
BOD5 (mg/L)	NA	NA	NA	3.27	2.28
Nitrate as N (mg/L)	NA	NA	NA	4.27	5.13
Phosphorus, Total (mg/L)	NA	NA	NA	1.10	1.10

Test 3: October 2000

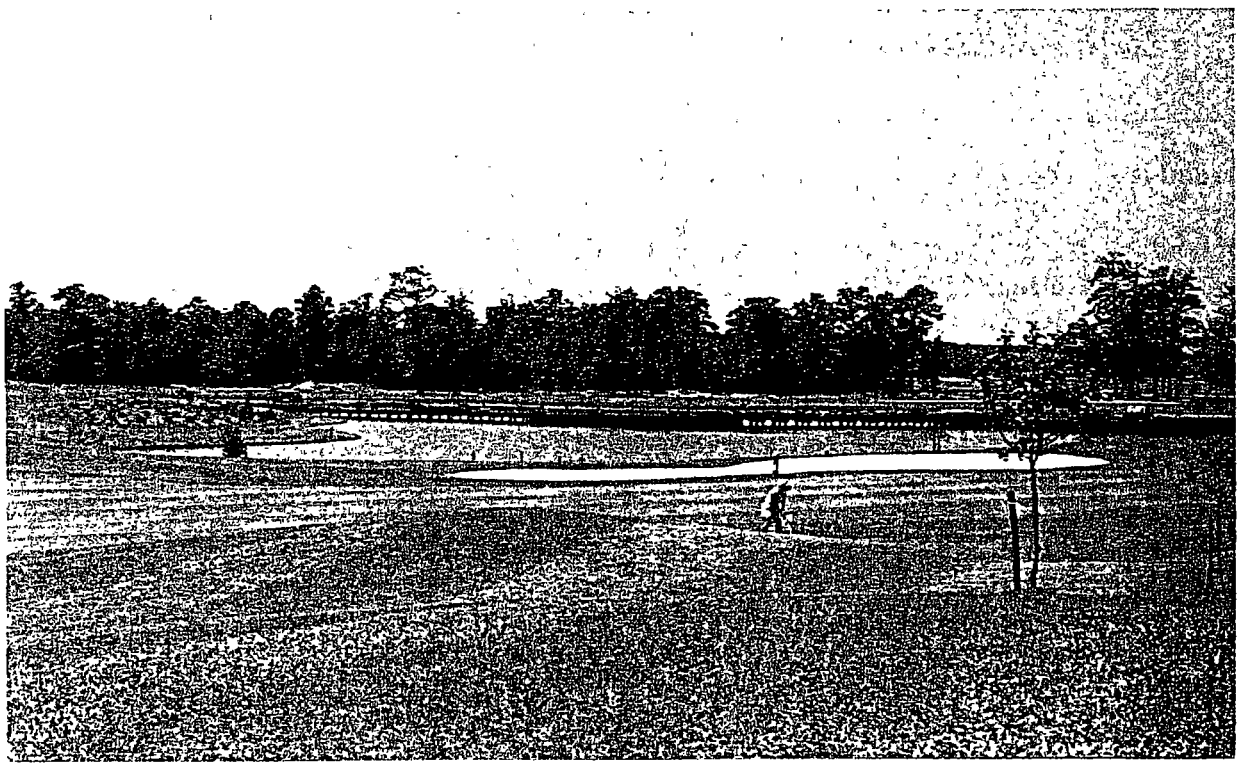
Parameter	Raw Influent	Cell I Outlet	Cell II Outlet	Pumphouse (before chlorination)	Irrigation after chlorination
Number of samples tested	1	1	1	1	0
Fecal Coliform (CFU/100 ml)	610,000	14,700	140	200	NA
Total Suspended Solids (mg/L)	72	14	8	17.50	NA
COD (mg/L)	130	37	24	23	NA
BOD5 (mg/L)	52	12	2.10	2.30	NA
Nitrogen Kjeldahl as N (mg/L)	14	3	1.70	1 70	NA
Ammonia as N (mg/L)	14.90	0.34	0	0.15	NA
Nitrate/Nitrite as N (mg/L)	0	4.30	5.64	5.64	NA
Phosphorus, Total (mg/L)	1.70	2.50	1.40	1.50	NA

BAYWOOD

Sheaffer Modular Reclamation & Reuse System

PROJECT	
Owner	Tunnell Companies, L.P.
Location	Sussex County, DE
Developer	Tunnell Companies, L.P.
River Basin	Coastal
Permit Issued	1998

FACILITIES	
Flow	200,000 gpd
Reclamation	17 days
Storage	Included in Cells
Filtration	Sand filters
Irrigation Area	120 acres
Use	Golf course turf



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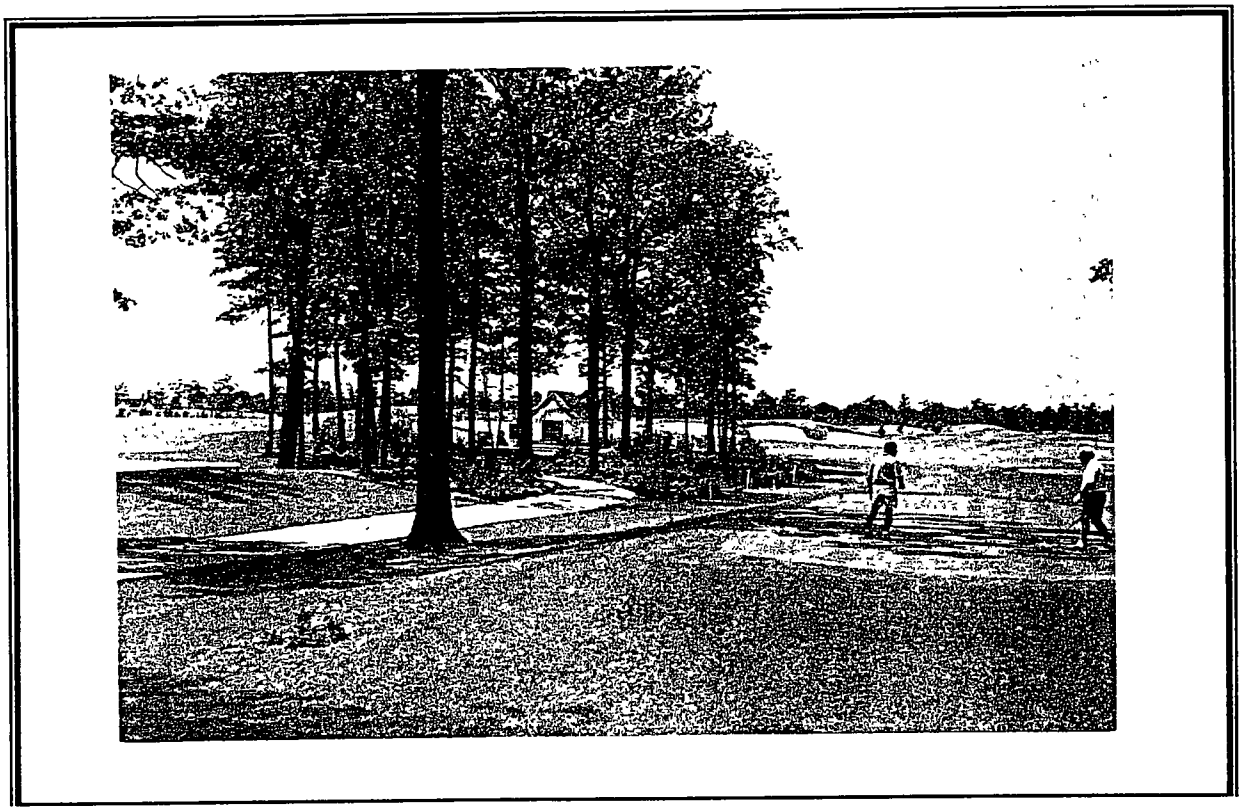
"Enhancing Land and Water, Naturally"

The hallmark of **The Tunnell Companies, L. P.** is affordable homes in a resort setting. The company has successfully developed several new communities along the beautiful Delaware coast.



Baywood is a 239-unit Golf-Residential Community planned in 1998.

Affordability and quality also are features of the deep-aerated, no-discharge **Sheaffer Modular Reclamation & Reuse System** (SMRRS). Baywood is the second Tunnell Community developed with a SMRRS. (Pots-Nets being the first),

In a SMRRS, wastewater is reclaimed in treatment cells to the level of high quality irrigation water using natural processes. The clean reclaimed water contains nutrients (N-P-K) in dilute solution form. Following filtration and disinfection, it is a resource that can be reused to irrigate and fertilize golf courses without restrictive conditions. The Delaware Department of Environmental Protection favors a SMRRS because the **discharge of pollutants into surface waterways is eliminated.**

A SMRRS enhances the environmental quality of both water and land resources. The operation of the deep aerated treatment cells allows flexibility in siting a SMRRS within a golf course. Odors are controlled because sewage enters the cell under 15 feet of water at the level of the subsurface aerators and is prevented from direct contact with the atmosphere. The wastewater is stabilized and oxygenated in this heavy aeration zone. The SMRRS is an amenity rather than a nuisance, which adds value to the golf course and the surrounding homes.

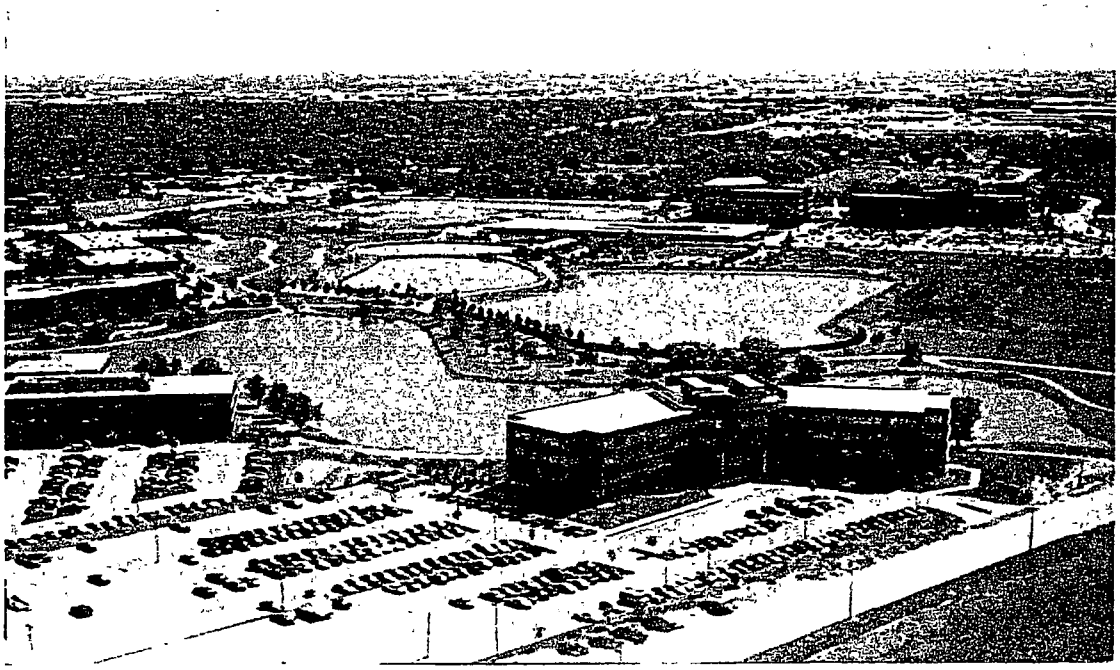
Affordability is achieved, for example, by limiting the handling of odor-ridden sludge to ***once every 20 years***. Prolonged treatment in the unique anaerobic/aerobic zones minimizes sludge production and assures complete decomposition of organics. Space is provided at the bottom of cells to store residual inorganic matter for 20 or more years

THE CHANCELLORY

Sheaffer Modular Reclamation & Reuse System

PROJECT	
Owner	Itasca Associates XII
Location	Itasca, DuPage Co., IL
Developer	Trammell Crow Company
River Basin	Salt Creek/Des Plaines
Permit Issued	June 11, 1980; Renewed: 1985,1990, 1995

FACILITIES	
Flow	254,000 gpd
Reclamation	40 days
Storage	140 days
Filtration	4 sand beds
Irrigation Area	128 acres
Use	Recreational/Athletic Fields



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The **Sheaffer Modular Reclamation and Reuse System** (SMRRS) that serves The Chancellory business campus is a landmark in the advancement of modern water resource management. The principle of managing wastewater as a raw material to be recycled beneficially lies at the heart of the **integrated Total Water Quality Management** system which distinguishes this first-class office and hotel center from all others in the nation. It is truly a self-sufficient development.

Self-sufficiency became the goal of The Trammell Crow Co. as it sought to overcome a sea of barriers preventing development of this prime 274-acre site strategically located on I-90 near O'Hare Airport. There was a moratorium on new sewer connections due to capacity constraints, over pumping of deep aquifers threatened water supply availability, and encroachment was not allowed into the large drainageway bisecting the site.

The Total Water Quality Management system is designed with the following features.

Drinking water is supplied from two on-site wells in the shallow dolomite aquifer (200') with underground pneumatic storage tanks and iron removal and lime-soda softening.

Reclamation of wastewater is achieved in the SMRRS with deep anaerobic/aerobic odor-free treatment cells with filtration and disinfection. Sewage solids (sludge) have been stored since 1980 in the space provided at the bottom of the cells. The reclaimed water is reused to irrigate and nourish landscape vegetation, creating a lush setting for the PGA practice range and buildings. It is applied at a slow rate so that plants beneficially utilize the nutrients throughout the growing season. The water then seeps through the soil's "living filter." Discharge of pollutants is eliminated to nearby Salt Creek.

Stormwater runoff from all paved surfaces is collected in slow-flow grassed swales that store and filter the first (dirtiest) inch of runoff, abating non-point sources of pollution. Five lakes meander through the drainageway and retain the waters of the 100-year storm. The lakes mitigate flooding and provide an aesthetic setting sought by Trammell Crow for The Chancellory.

Fire control is integrated into this system by using two of the lakes as the fire water source and interconnecting the irrigation pump and return lines to provide the highest level of protection.

The 6 million square feet of first-class offices and hotel located there prove the success of The Chancellory's system.

Comments: ***"I have personally escorted tours of the system for people from all over the world. I highly recommend this technology to any county or municipality."*** Shirley H. Ketter, Mayor of Itasca, IL.

"Trammell Crow is very pleased with the way the plant has performed over the years." Steve Gendusa, Engineering Director, Trammell Crow Co. (Now Town & Country Utilities, Inc.).

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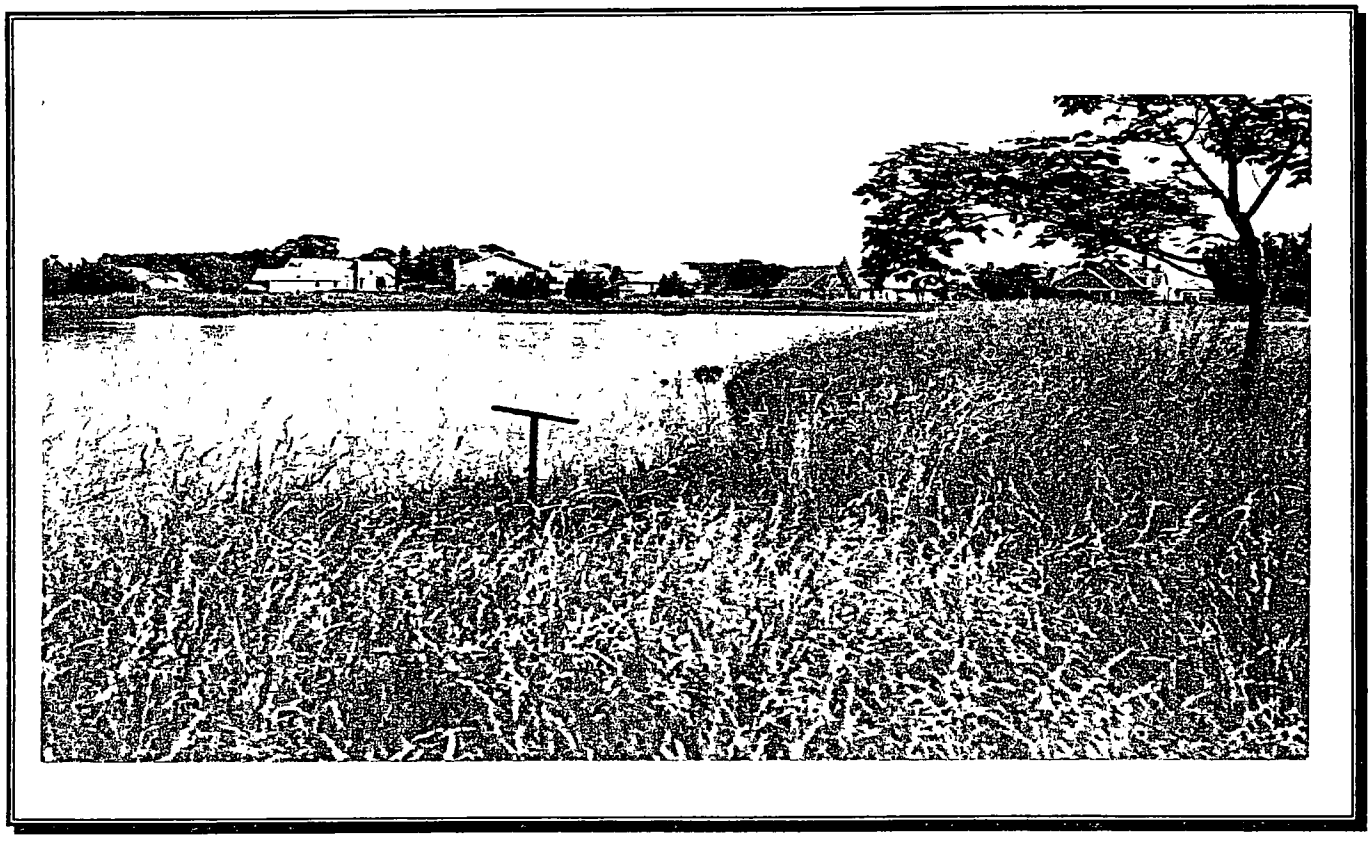
FIELDS OF LONG GROVE

Sheaffer Modular Reclamation & Reuse System

PROJECT	
Owner	Fields of Long Grove Homeowners Association
Location	Long Grove, Lake Co., IL
Developer	Windward Associates, Chicago, IL
River Basin	Des Plaines
Permit Issued	December 3, 1985, Renewed every 5 years

FACILITIES	
Flow	33,000 gpd
Reclamation	36 days
Storage	120 days
Irrigation Area	10 acres
Use	Horticulture cropland (prairie wildflower seeds)



AWARD: "You will be proud to know that The Fields of Long Grove has been awarded 'The **BEST IN AMERICAN LIVING** AWARD' of the East North Central Region of the country (1988), and that you were part of the team which made this possible." Jack Foreman, Project Manager

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The concept of The Fields of Long Grove was a community in harmony with its countryside setting. The solution was to cluster 87 homes on a 160-acre site and preserve 107 acres of open space. Natural environmental amenities on the site include woods, fields, wildfowl ponds, a lake with a beach, re-created wetlands, and restored native wildflower prairie. The spacious luxury homes are nestled in clusters of small lots of ¼ to ½ -acre each into this natural setting. The homes are sited so that backyards open onto the ponds, prairies, or woodlands.

The **Sheaffer Modular Reclamation and Reuse System** (SMRRS) is an integral part of this natural landscape. The 7 million-gallon treatment cell/storage reservoir was designed as a natural pond and waterfowl habitat. It is an amenity for the homes overlooking it.

Odors are prevented because sewage influent is injected at least ten feet below the surface and is heavily aerated. There is no direct contact between the influent and the atmosphere. And sewage solids are stored in the space provided at the bottom of the cells where they metabolize over 20 years. Solids are reduced to one-tenth their original volume, and are removed just once in 20 years.

The reclaimed water with its dissolved nutrient is used to irrigate and fertilize 10 acres of native prairie wildflowers on the site. The seeds are harvested and sold as a horticultural crop, providing cash flow which helps offset the operating and maintenance costs of the system. Installation was affordable: $300,000 (compared with engineer's estimate of $309,050).

COMMENTS: *"It's a natural form of using Mother Nature at its best. You put back what you take, and this is what it does It is perfect recycling of water, instead of dumping it downstream "*

"What people see is beautiful prairie, and for that reason, it demonstrates an excellent way to maintain rural atmosphere."

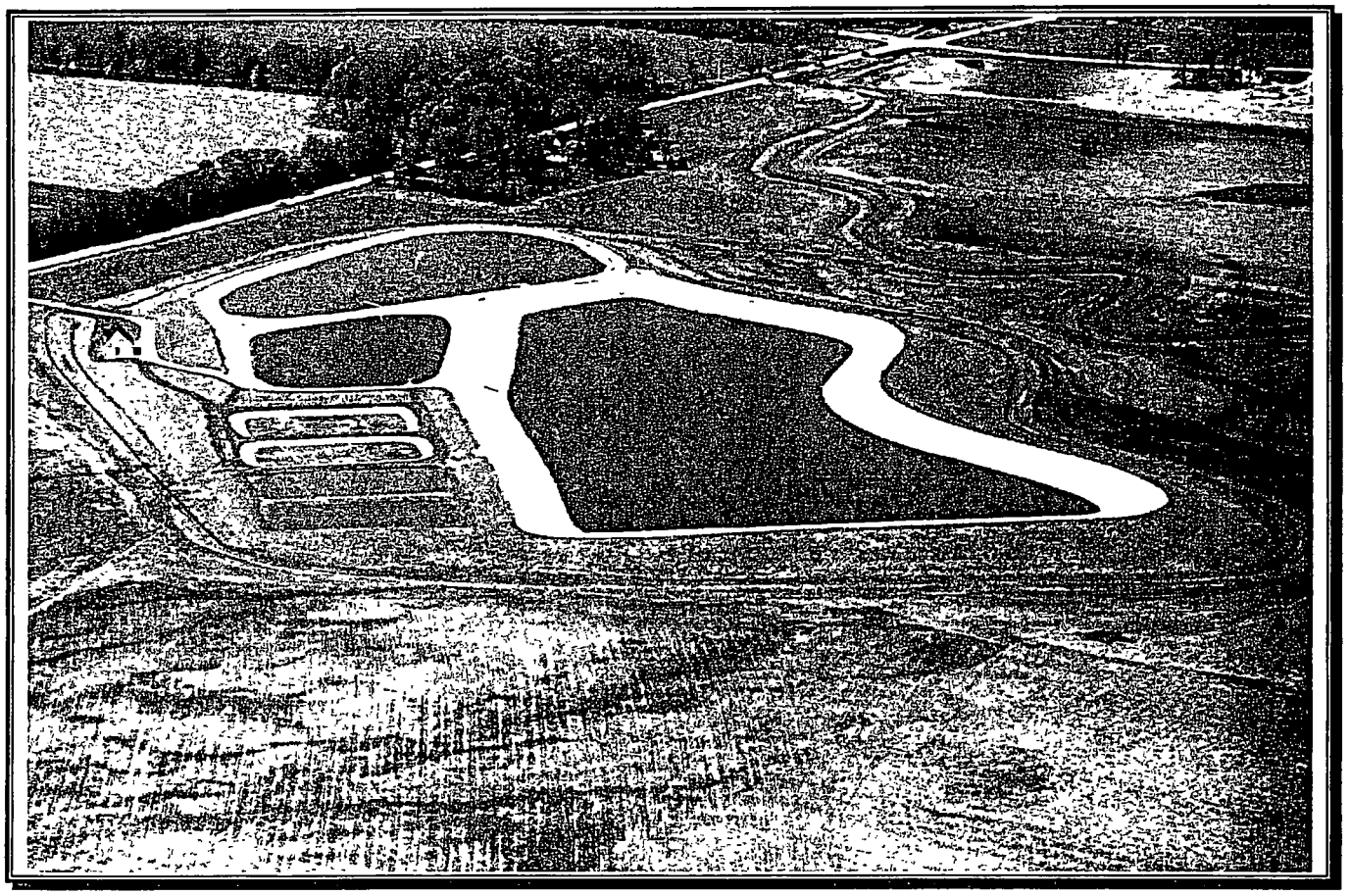
"Now that the project is completed, people who were opposed now see the green benefits of the project, and the valuable increases in assessed valuation in the area " Cal Doughty, Long Grove Village Manager.

FOX MILL

Sheaffer Modular Reclamation & Reuse System

PROJECT	
Owner	Wasco Sanitary District
Location	Campton Township, Kane Co., IL
Developer	Fox Mill Ltd. Partnership
River Basin	Fox River
Permit Issued	June 18, 1993

FACILITIES	
Flow	316,000 gpd
Reclamation	36 days
Storage	120 days
Filtration	4 sand beds
Irrigation Area	81 acres
Use	Landscaping & cropland



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The theme of "**City Life, Country Living**" distinguishes the 737-acre Fox Mill subdivision in rapidly developing Kane County Illinois. City life includes complete urban infrastructure for the new 603 single-family homes, 76 town homes and for the 50 existing homes and 10 businesses in the rural settlement of Wasco. An 18-acre commercial center and new school round out the city services at Fox Mill.

Country living is maintained by preserving large open spaces throughout the subdivision's 4 neighborhoods. Open space amenities include 6 lakes, many ponds, bike trails, walking paths, rolling hillsides and mature trees. Scenic vistas link the home sites with the surrounding rural countryside.

The **Sheaffer Modular Reclamation and Reuse System** (SMRRS) ties the two parts together. A cooperative approach was established between the Wasco Sanitary District and the Developer to provide municipal quality water supply and wastewater management services

Wastewater is reclaimed to a high quality level in deep anaerobic/aerobic treatment cells. Odors are prevented because there is no direct contact between raw sewage and the atmosphere. Sewage solids are minimized, stored in the space at the bottom of the cells and removed just once every 20 years.

Clean reclaimed water with its dissolved nutrients is used to irrigate and fertilize open space on the site. The discharge of pollutants into Mill Creek is eliminated. A "no-discharge" permit assures long-run compliance with Illinois standards. The ecological integrity of the site and its environs is protected when reclaimed water is reused as a resource. The SMRRS makes open space a functional feature of the urban service, while preserving the rural setting of Wasco.

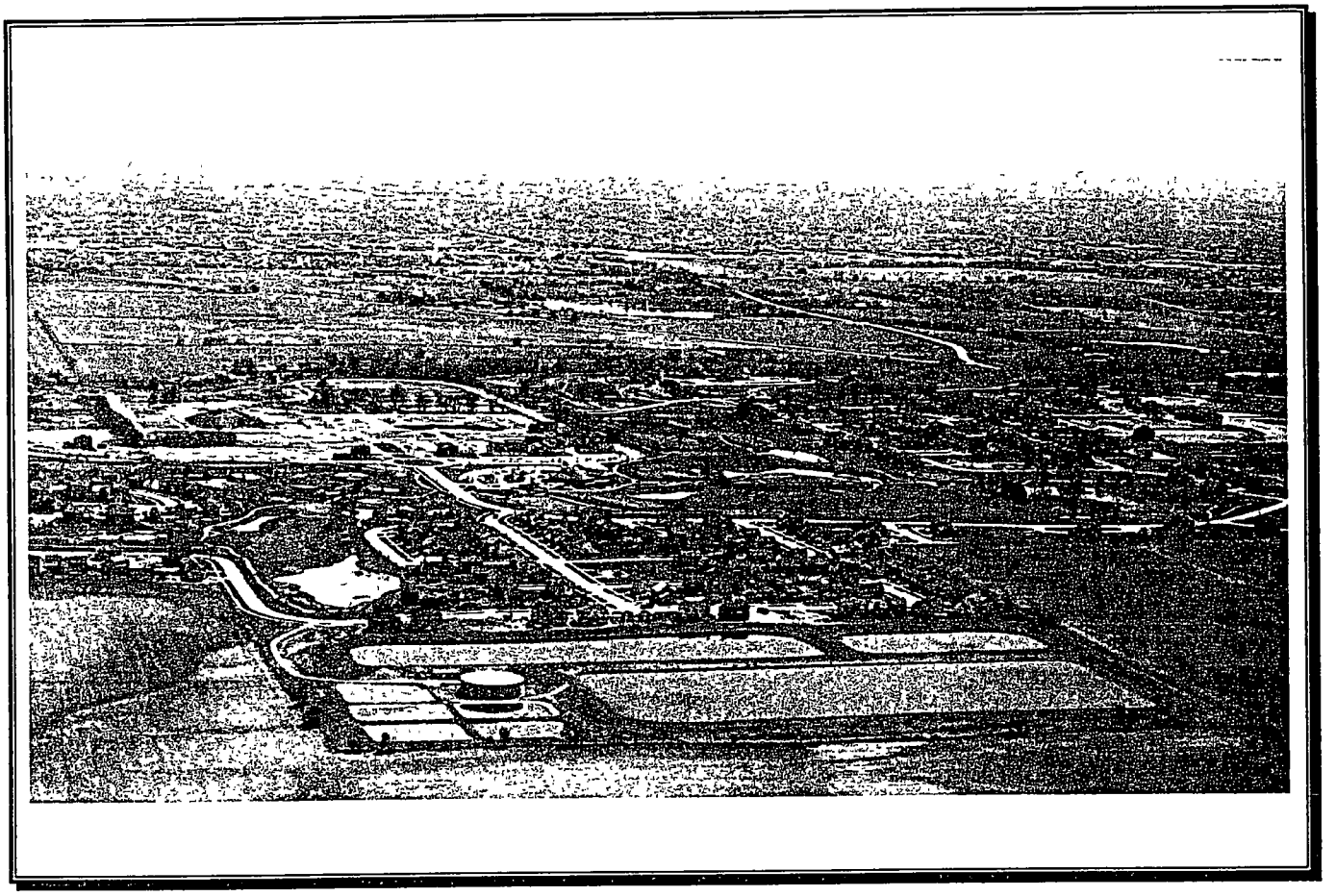
Thus, the SMRRS fulfills the **"City Life, Country Living"** theme at Fox Mill.

MILL CREEK

Sheaffer Modular Reclamation & Reuse System

PROJECT	
Owner	Mill Creek Water Reclamation District
Location	Batavia, Kane Co., IL
Developer	Sho-Deen, Inc
River Basin	Fox River
Permit Issued	July 21, 1994

FACILITIES	
Flow	650,000 gpd
Reclamation	36 days
Storage	120 days
Filtration	5 sand beds
Irrigation Area	167 acres
Use	Golf course & cropland



LANDSCAPE PLANNING AND ANALYSIS HONOR AWARD
Illinois Chapter, American Society of Landscape Architects

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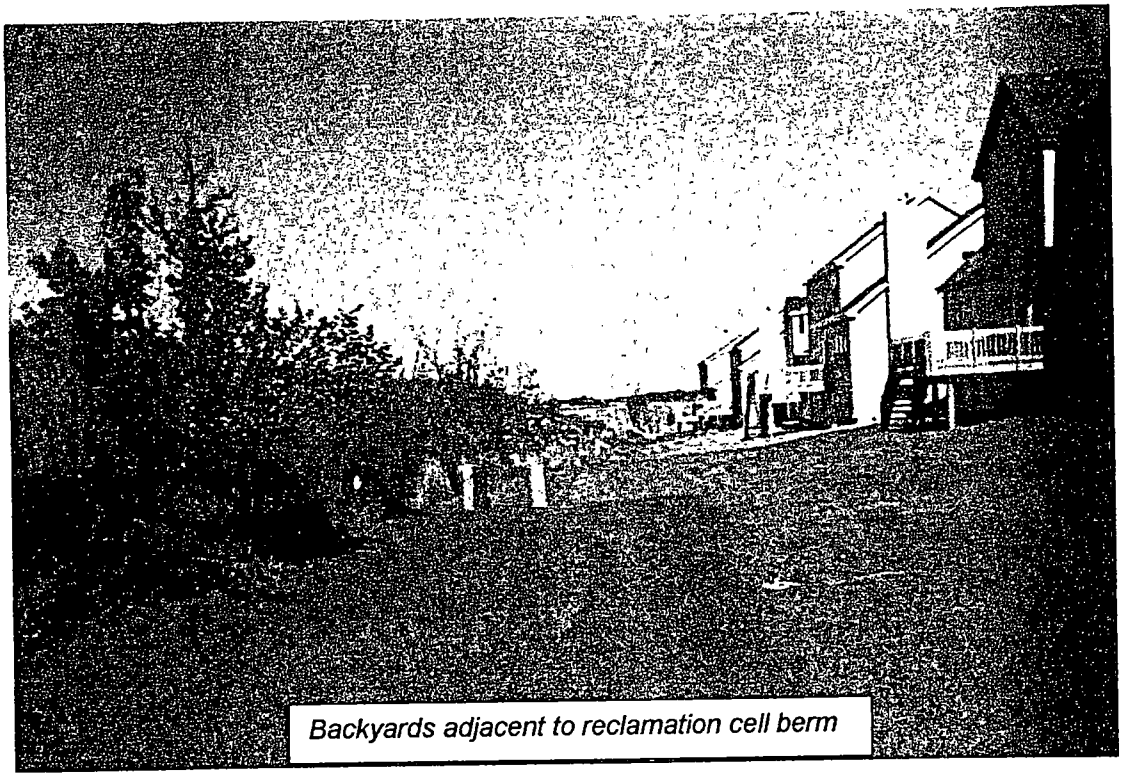
On a 1,374-acre gently rolling site, Sho-Deen, Inc. is developing a new town. Mill Creek includes 1,689 single family homes and 133 town homes clustered in 20 neighborhoods: a Village Center containing a mixture of residences, shopping, services and recreation, a new school; and a 27-hole golf course.

Extensive open space amenities give Mill Creek a distinctive ambiance. Amenities include over 40% open space, protection and enhancement of the Mill Creek greenway, development of a village core, golf courses irrigated with reclaimed water, adaptive reuse of existing rural structures, and extensive pedestrian and bikeway paths. County officials approved Mill Creek as a Planned Unit Development and gave density bonuses of 70 loft apartments and 20 carriage units in the Village Center.



Backyards adjacent to reclamation cell berm

The **Sheaffer Modular Reclamation and Reuse System** designed by Dr. Sheaffer is the heart of the ecologically sound plan, that is integrated with onsite water supply and nonstructural drainage systems.

County officials and staff found the results noteworthy and commendable:

- ***Eliminate the discharge of pollutants into Mill Creek***
- ***Minimize production of sewage solids by containing them for 20 years at the bottom of the cells***
- ***Filter, treat, and store non-point source pollution from stormwater runoff in the grassed swales, filter strips of native prairie, and recreated wetlands***
- ***Mitigate on-site flood hazards by preserving the Mill Creek floodplain as an open space greenway***
- ***Attenuate downstream flood peaks by storing the 100-year storm in onsite retention lakes and detention basins***
- ***Prevent sediment loading into Mill Creek by diverting stormwater into settling basins prior to release***

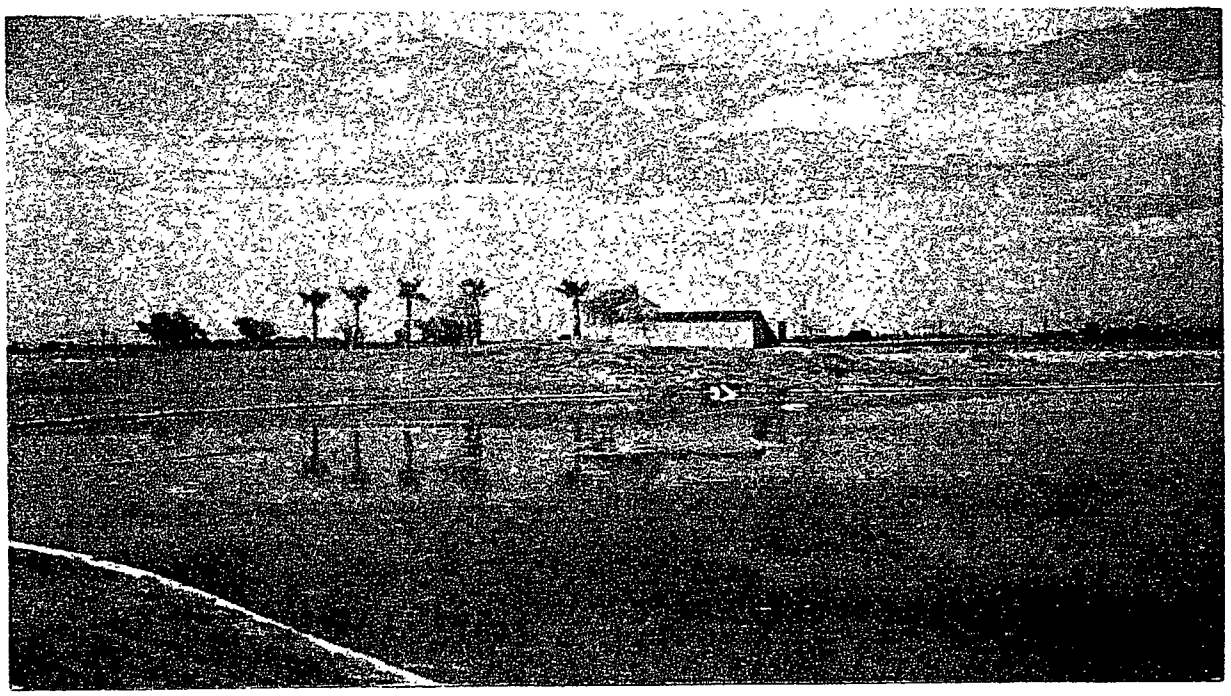
COMMENTS: *" . . . that the Mill Creek concept plan be encouraged . . .because of the unique and substantial benefits it offers, which include without limitation 41% of the site remaining predominantly public open space, the centralization and internalization of the higher density areas within the interior of the site, the open space buffers between the site and surrounding areas, and the land application [wastewater reuse] system."* Motion Approving the project by the Kane County Regional Planning Commission.

MOTOROLA, INC.

Sheaffer Modular Reclamation & Reuse System

PROJECT	
Owner	Motorola, Inc./Government Electronics Group (G.E.G.)
Location	Chandler/Price Campus City of Chandler Maricopa Co., AZ
River Basin	Gila
Permit Issued	March 16, 1988

FACILITIES	
Flow	5,750,000 gals.
Reclamation	
Storage	18 days
Filtration	Sand beds/Hydrokleen filter
Irrigation Area	160 acres
Use	Landscape/cooling system



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Water is an important factor in the quality of life in all communities. In water-scarce Arizona, it is crucial. Water conservation programs receive top priority among local and state officials. The Motorola Government Electronic Group (G.E.G.) perceived that it could contribute to conservation goals at its Chandler Price Road Campus. Architect Bernard Deutsch brought in Dr. John R. Sheaffer to consult on water management issues.

The result was an innovative industrial water reuse system that maximizes the use of treated effluent discharged from the existing Chandler Ocotillo Sewage Treatment Plant. The design is a variation of the **Sheaffer Modular Reclamation and Reuse System** (SMRRS). A new aerated effluent storage lake controls odors and reduces the level of pollutants in the effluent by natural biological and chemical processes. These attributes allow it to be a campus amenity. Filtration and disinfection complete the reclamation of the water. The high quality reclaimed water is available for many reuse purposes.

At the Chandler Price Road Campus, Motorola reuses the reclaimed water as a supply for:

1. Non-potable fixtures, e.g., toilets, in the buildings (known as "grey" water reuse)
2. Evaporative cooling towers that comfort-condition the buildings
3. Irrigating up to 160 acres of campus landscaping.

Water balance calculations showed that total reuse would be achieved after irrigation. The growing vegetation also recycles nutrients in the reclaimed water. The hallmark of the Sheaffer plan is the conservation of 116,800,000 gallons of water annually that otherwise would be required from fresh water sources.

The permit issued for the industrial water reuse system requires that all unused effluent remaining after reuse in the cooling towers and fixtures shall be rerouted to the sanitary sewer system. This starts the reuse process over again. The permit also mandates that no excess discharge be allowed from the irrigation site. This means that **the discharge of pollutants into the environment is totally eliminated.** And, this is the hallmark of Sheaffer systems.

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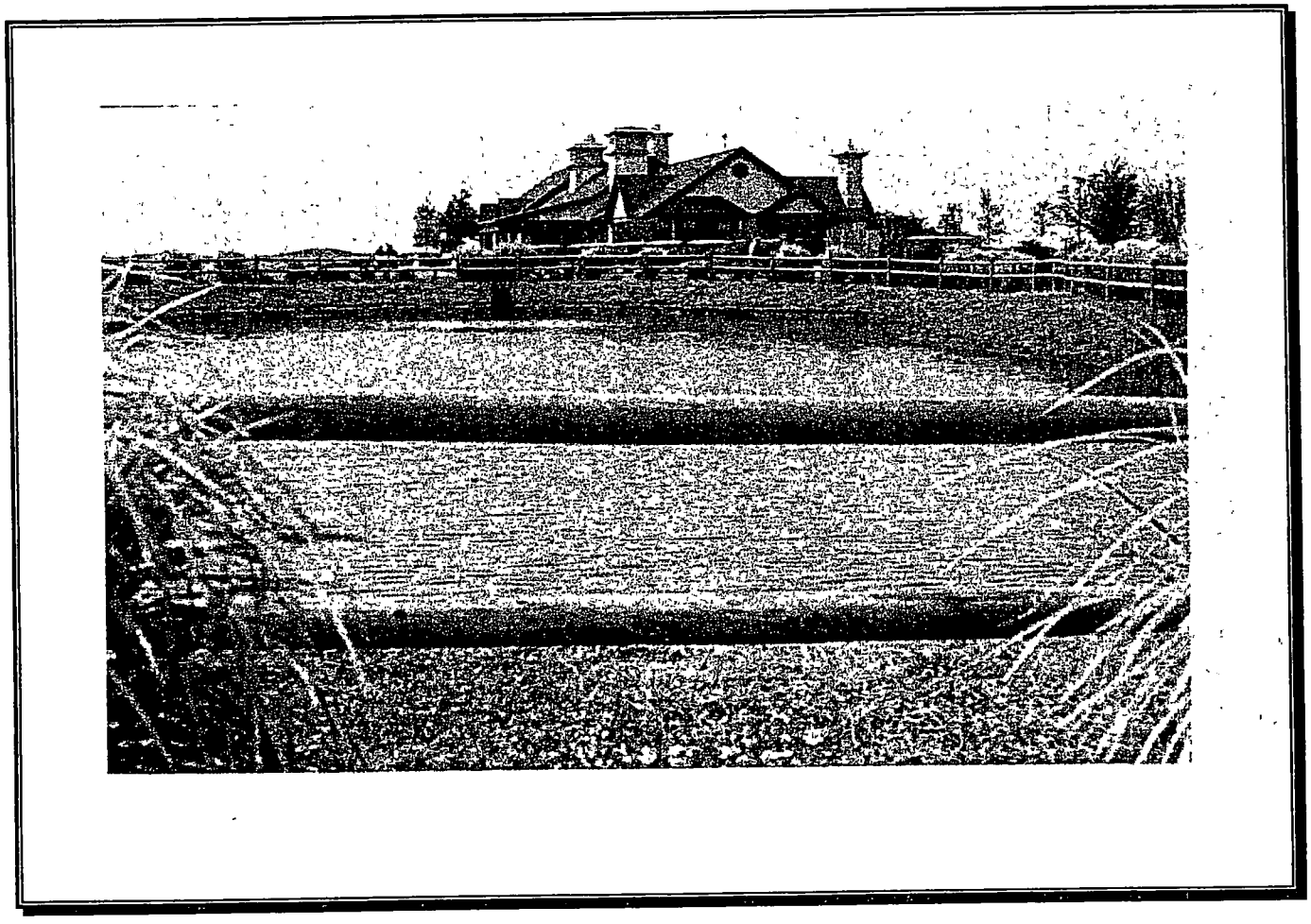
PRAIRIE BLUFF GOLF CLUB

Sheaffer Modular Reclamation & Reuse System

PROJECT	
Owner	Lockport Twp. Park District Crest Hill, Illinois
Location	Lockport Twp., Will Co., IL
River Basin	Des Plaines/Illinois
Permit Issued	May 21, 1998

FACILITIES	
Flow	1,400 gpd
Reclamation	36 days
Storage	120 days
Irrigation Area	0.275 acre
Use	Golf course landscape



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The Prairie Bluff Golf Club is a new "3-Tee" (out of 4) public golf club owned by the Lockport Park District. The site is neither prairie nor bluff, but a part of the former Stateville prison farm near Joliet. In fact, the guard towers are visible clearly from the luxurious Clubhouse. Golf course architects Roger Packard and Andy North succeeded in designing a challenging and playable course.

The Prairie Bluff site also was an environmental management challenge. Soils there are too "tight," or impermeable, for a traditional septic tank and leach field to serve the Clubhouse's fine restaurant, banquet room, and Pro shop. Extending a sewer transmission pipeline to connect with the nearest sewer main was estimated to cost $189,000.

The deep aerated, no discharge **Sheaffer Illinois Reuse System** (SIRS) was the affordable solution. It was planned, designed, permitted and constructed in less than 6 months, meeting the Park District's July Tee-Off goal. It cost only $45,000 to install.

The SIRS recycles the 1,400 gpd wastewater flow from the Clubhouse. The reclaimed water from the treatment cells meets the very stringent fecal coliform standard prior to irrigation. The SIRS has achieved this high performance standard since the outset.

The SIRS is well suited to Prairie Bluff's setting. It is housed in a naturally landscaped pond sized for the 11 feet deep, 36-day treatment cell in one part and the shallower 120-day storage reservoir in the other part. Because the **nuisance of odors is eliminated in a SIRS** and there is **no sludge** to handle (the cell contains the minimal amount of sludge produced for over 20 years), the pond serves as the entryway amenity for the luxurious Clubhouse. Not only were costs minimized, but value was added as well.

Wastewater is wholly managed within the site, thereby eliminating any discharge of pollutants into the Des Plaines River. As a **no-discharge** facility the SIRS is in full compliance with the most stringent water quality standards in these basins.

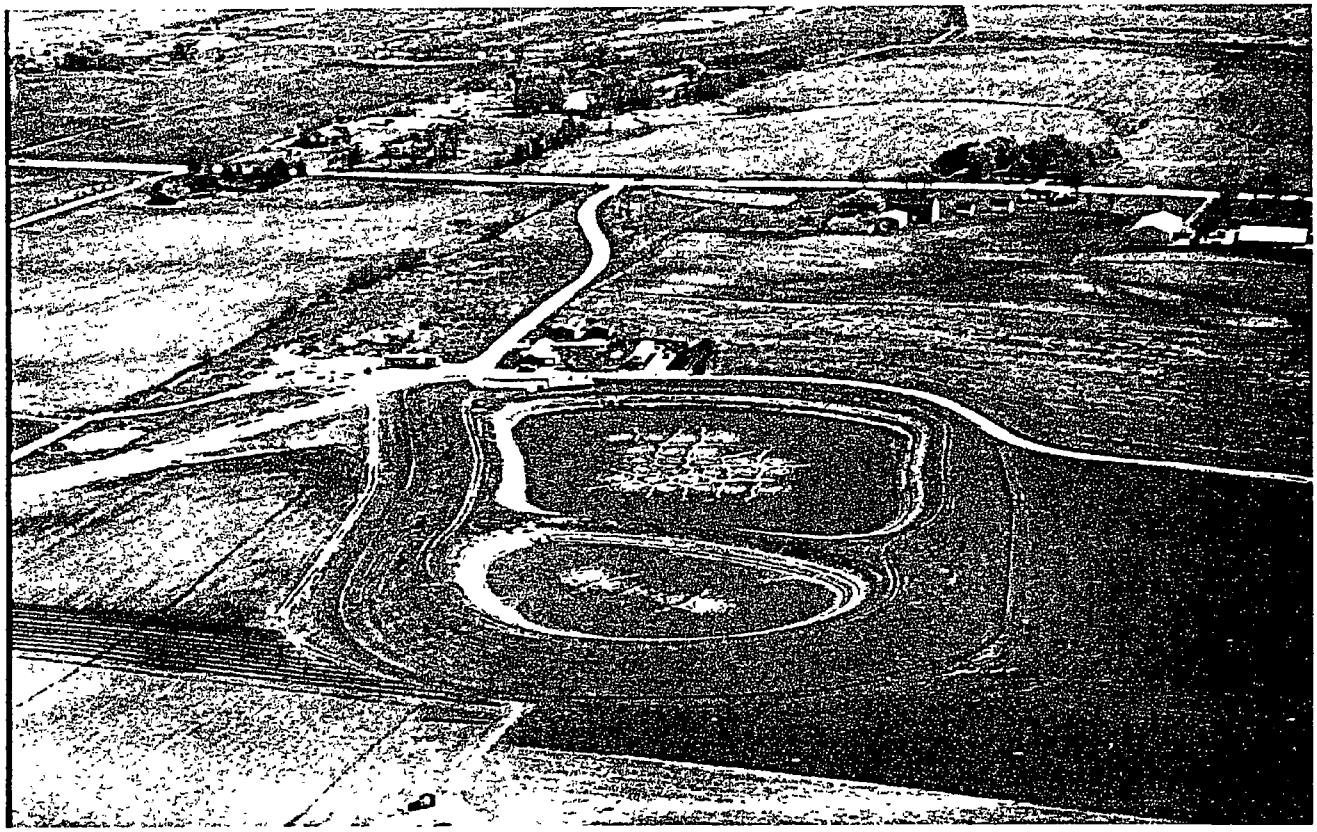
Comments: "Put Prairie Bluff in a fair fight against other park district-owned golf courses in the Chicago area and it belongs near the top of the leader board." Gary Relnmuth, Chicago Tribune

SADDLEBROOK FARMS

Sheaffer Modular Reclamation & Reuse System

PROJECT	
Owner	DWG, Inc., Grayslake, IL
Location	Round Lake Park, Lake County, Illinois
Developer	DWG, Inc.
River Basin	Fox River
Permit Issued	Jan. 27, 1987; Renewed every 5 years

FACILITIES	
Flow	595,000 gpd
Reclamation	47.5 days
Storage	130 days
Irrigation Area	120 acres
Application Rate	1.5 inches per week
Use	159 acres of farmland



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Saddlebrook Farms is a planned 3,800 home **adult life-style community** featuring affordable detached homes and many quality-of-life services. Saddlebrook Farms offers an alternative to condos and apartments for empty nesters. It provides parks, trails, gardens, lakes, and recreation halls for social life and individual homes for privacy. The homes are site-built using manufactured components for quality and affordability. There will be 40 acres of convenient shops and offices.

Almost half of the 700-acre site will remain as open space, with meadows, lakes, a wildlife refuge and a working farm. **DWG, Inc.** chose to recycle wastewater on the 159-acre farm, making it a multiple use open space. The Sheaffer International, L.L.C. designed **Sheaffer Modular Reclamation and Reuse System** (SMRRS) reclaims the wastewater in deep, heavily aerated treatment cells.

By injecting raw sewage 15 feet below the surface, near the static tube aerators, the nuisance of odors is prevented because direct contact between the influent and the atmosphere is eliminated. Warm, compressed air added at this depth assures effective biological treatment year-round. The ponds containing the treatment cells are amenities rather than nuisances. This gives developers great flexibility in planning the layout of a site.

The reclaimed water is reused to irrigate the farmland, providing nutrients and moisture for hay production. A slow rate of irrigation matches the ability of plants to absorb the nutrients. Revenue from the sale of hay offsets costs. Sewage solids (sludge) are stored for 20 years at the bottom of the cells, reducing operating costs.

An ecologically sound stormwater management system, also designed by Sheaffer International, L.L.C., serves Saddlebrook Farms. The 100-year floodplain of Squaw Creek is preserved as open space. A network of shallow grassy swales filter and treat the polluted urban runoff. Stormwater is stored in on-site retention ponds and detention basins.

In this rural retreat, discharges of pollutants into Squaw Creek and the Fox River are eliminated. The flooding of homes in Saddlebrook Farms as well as of downstream residences is mitigated. The environmental stewardship demonstrated at Saddlebrook Farms makes this new community a very good neighbor.

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WILLOWMERE

Sheaffer Modular Reclamation & Reuse System

PROJECT	
Owner	Willowmere Subdivision Homeowners Association
Location	South Barrington, Cook County, Illinois
Developer	Landmark Homes
River Basin	Fox River
Permit Issued	March 6, 1989

FACILITIES	
Flow	18,900 gpd
Reclamation	36 days
Storage	120 days
Filtration	2 sand beds
Irrigation Area	4.8 acres
Irrigation Rate	1.5 inches per week
Use	Landscaped park

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Willowmere is a 54 home subdivision planned and built by Landmark Homes. It is located on a 132-acre gently rolling site in South Barrington of Cook County, Illinois. The homes are situated around a central open space that includes lakes, natural wetlands and a park.

Landmark Homes chose the plan formulated by **Dr. Sheaffer,** which is a self-sufficient water resource management system to be owned and operated by the homeowners. The plan integrates a water supply system with a **Sheaffer Modular Reclamation and Reuse System** (SMRRS) to achieve sustainability. An on-site municipal deep well draws high quality water from a sandstone aquifer and stores it in an underground hydropneumatic tank for distribution. A second shallow well is available for emergency use and fire protection flow.

After use, the water is conveyed to the on-site treatment cells where it is aerated, filtered, and disinfected.

The classic principle of engineering is applied in the design of the treatment cells: put the forces of nature to work for mankind's benefit. The treatment cells are 20 feet deep rather than shallow. Raw sewage is injected 15 feet below the surface near the static tube aerators. The cells are amenities because direct contact between influent and atmosphere is eliminated which prevents odors.

The deep cells also store sewage solids for up to 20 years in the space provided at the bottom. Solids are contained here rather than being removed, dried, and relocated to a disposal site. Over this span of time, solids decompose to just 1/10 their original volume. In contrast, conventional activated sludge plants are designed to produce three times the original volume of solids. Sludge is a nuisance because of its odor and the cost of disposing of it safely.

The reclaimed water then is reused to irrigate and fertilize nearly five acres of parkland in the subdivision. The park provides a scenic setting for the homes, while the living filter of soil and vegetation beneficially reuses the nutrients in the reclaimed water. Once cleansed in this manner, the water seeps slowly back into the ground, replenishing the aquifers. This integrated system eliminates the discharge of pollutants to surface waterways. It functions in harmony with nature's circular ecosystem; what is taken out is used, renovated, reused, and returned.

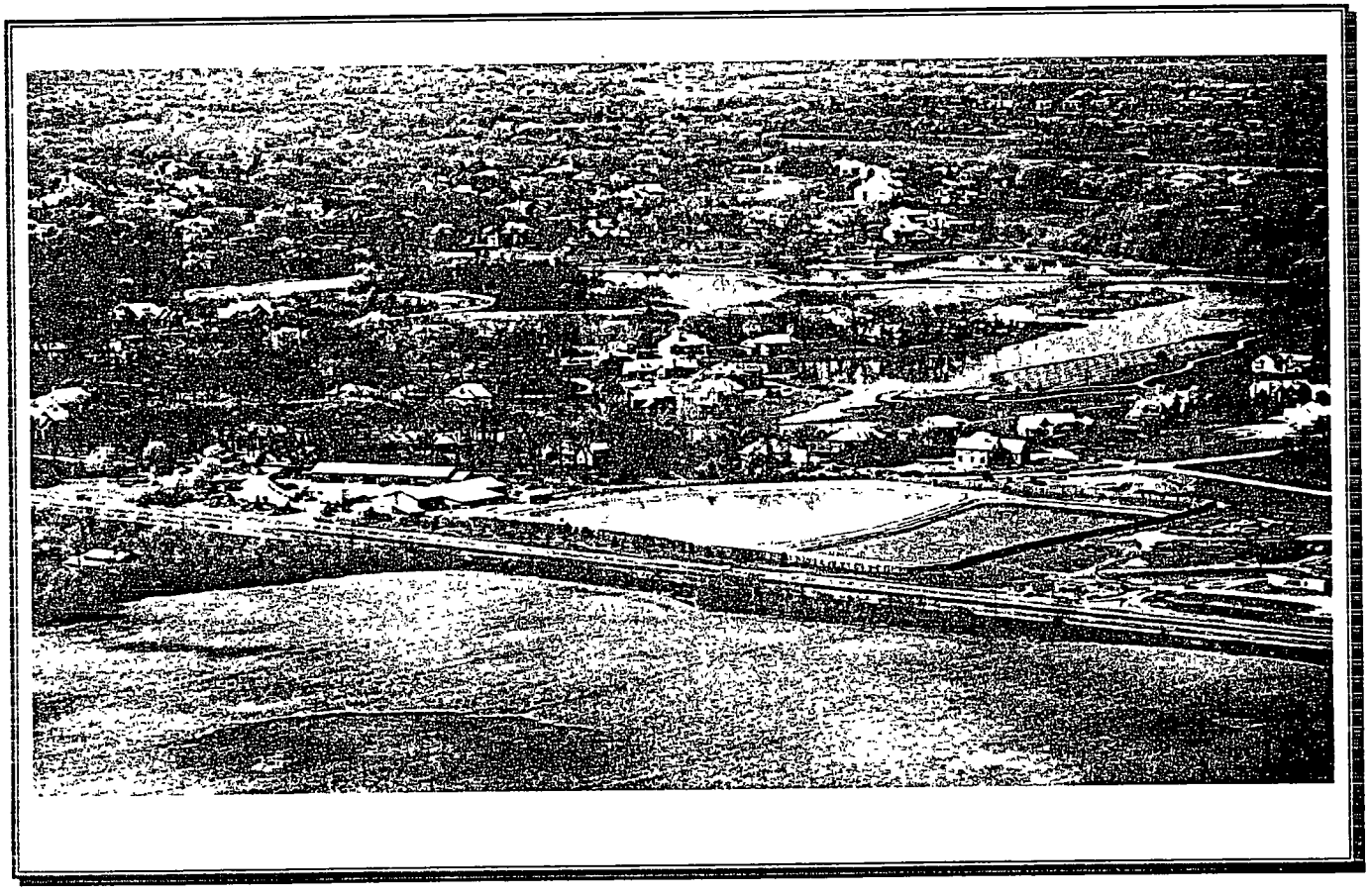
A SMRRS qualifies for a no-discharge permit issued by the Illinois Environmental Protection Agency (IEPA). The proven no-discharge performance of the SMRRS assures compliance with IEPA water quality standards in the future. This frees the Homeowners Association from future costs to upgrade, as discharging plants must do to comply with increasingly stringent discharge standards. The Homeowners Association also benefits by the simple, low-cost operation and maintenance of the SMRRS. These attributes enhance the affordability of a SMRRS for small subdivisions such as Willowmere.

WYNSTONE

Sheaffer Modular Reclamation & Reuse System

PROJECT	
Owner	Wynstone Property Owners Association, Inc.
Location	North Barrington Lake County, Illinois
Developer	Jack Nicklaus Development Corporation
River Basin	Fox River
Permit Issued	July 28, 1987; Renewed. Every 5 Years

FACILITIES	
Flow	189,000 gpd
Reclamation	36 days
Storage	130 days
Irrigation Area	76 acres
Irrigation Rate	1.0 inch per week
Use	18-hole golf course



Sheaffer INTERNATIONAL LLC

800 Roosevelt Road, Bldg B, Suite 200
Glen Ellyn, Illinois 60137
Tel (630) 446-4080
Fax (630) 446-4085

"Enhancing Land and Water, Naturally"

Wynstone is a luxurious Jack Nicklaus community of 450 homes fringing the 18-hole championship golf course and clubhouse. In partnership with W. Clement Stone, an environmentally sensitive plan was formulated for this 867-acre site in the Village of North Barrington, Lake County, Illinois The golf course and surrounding home sites wind through preserved woodlands, wetlands, and lakes. A blend of natural and man-made landscapes gives Wynstone a distinctive ambience as the setting for luxury homes of up to one million dollars in value

The developers recognized both the economic and environmental value of recycling wastewater. Choosing a **Sheaffer Modular Reclamation and Reuse System** (SMRRS) fulfilled the needs of the development: recycling wastewater from the homes and maintaining the golf course turf in championship condition

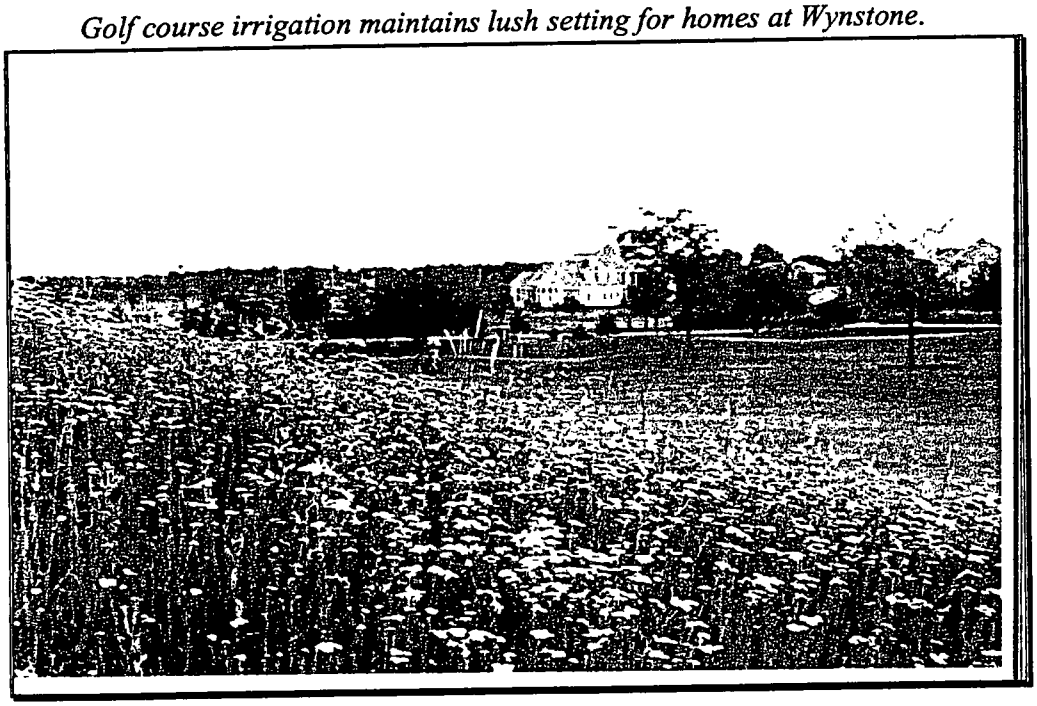
Wastes are managed as raw materials in a SMRRS. Wastewater is reclaimed in deep aerated treatment cells, followed by filtration, disinfection and storage. **Odors are controlled** by injecting raw sewage under ten feet or more of water, preventing contact with the atmosphere. This makes the cells amenities rather than nuisances. The reclaimed water is delivered to the sprinkler irrigation system covering the 140-acre golf course. Reusing the moisture and nutrients in the reclaimed water reduces purchased water and petroleum-based fertilizers. Applying the reclaimed water at a slow rate maintains a lush landscape each day of the golf season. This eliminates the discharge of pollutants into nearby high quality surface waters.

The classic engineering principal is applied to the system, *put the forces of nature to work for mankind's benefit*. Time is used as an asset in a SMRRS. The treatment cells reclaim the wastewater for 36 days vs. 8 to 10 hours in a conventional plant. This capacity automatically adjusts to wet weather flows and accommodates sudden surges of high BOD sewage. The cells cannot be overloaded or shut down, eliminating discharges of raw sewage allowed with 30-day averaging of discharge permits. This consistency assures the high quality of the reclaimed water.

Time is also used to **reduce sewage solids (sludge)** to 1/10 the original volume, rather than multiplying solids by three times, as in activated sludge plants. The deep cells store solids for up to 20 years in the space provided at the bottom where they decompose and stabilize.

The **Wynstone** golf course and the **SMRRS** fulfill the developers mission of environmental stewardship.

Golf course irrigation maintains lush setting for homes at Wynstone.



Quotes from Participants

"Any discharge of treated wastewater to surface waters has the potential to cause the quality of the receiving water to become degraded. Therefore, systems that do not discharge should be considered and must be deemed not feasible before a discharging system can be considered. Examples of non-discharging systems are golf courses, agricultural land, and other types of spray irrigation, seepage fields, and other types of subsurface discharges."
Thomas McSwiggin, P.E., Manager, Permit Section, Division of Water Pollution Control, IEPA.

"We have never removed any residual solids from the treatment cells during over 13 years of operation, and we have no plans for removal in the near future."
Steve Gendusa, Director of Engineering for the Chancellory SMRRS, in a letter dated September 20, 1993

"The project now includes a beautiful hotel, 15 office buildings, including one 27 story building, 7 man-made lakes and is altogether a beautiful park-like setting that includes paved walks, small bridges and outdoor patio dining for some of the offices. There has been no complaint from the EPA or from the users of the facility nor from the residents of the Village about odor, etc. I refer to the project as "a plum that fell in our lap."
Shirley Ketter, Mayor of Itasca, in a letter dated December 14, 1994 regarding the Chancellory SMRRS

"My overall evaluation of the system is that it is excellent. It meets or exceeds all of our expectations. We experience no odor problems and have never had to remove any sludge. We operate our system at a fraction of the cost of our standard-type wastewater treatment facility at our development in Florida."
Chuck Fanaro, Saddlebrook Farms, in a letter dated December 14, 1994

"These systems, when properly designed, constructed and operated, do not smell, do not disperse pathogens, are not unsightly, are cost-effective, recycle water and nutrients, and eliminate point source discharges."
Phillip S. Bus, Executive Director, Kane County Development

"I'm sure you will be very proud to know that The Fields of Long Grove has been awarded The Best in American Living Award for the East North Central Region of the country, and that you were part of the team that made this award possible."
Jack Foreman, Project Manager, Fields of Long Grove SMRRS, in a letter dated January 19, 1988

"We believe the project is an example of a type of cost-effective, environmentally friendly valuable technology which should be encouraged rather than deterred. It is not uncommon that innovative and unfamiliar technology, no matter how meritorious, encounters suspicion and prejudice."
James T.B. Tripp, General Counsel and Louisa C. Spencer, Staff Attorney, Environmental Defense Fund, in a letter dated May 20, 1993

"I understand that your imagination and dedication have led to the development of a new and promising approach to sewage disposal, and I want to commend you for your pioneering work in this vital field."
Richard Nixon in a letter to Jack Sheaffer dated April 8, 1970

REFERENCES FOR SMRRS

1. **Kent Shodeen**
   Shodeen, Inc.
   Mill Creek New Town [650,000]
   17 N. First Street
   Geneva, IL 60134
   (630) 232-8570

2. **Steve Gendusa, Manager**
   The Chancellory at Hamilton Lakes
   19W755 Pierce Road
   Itasca, IL 60143
   630/773-2802

3. **Steve Wilkins, Manager**
   Wynstone Golf Community
   133 North Wynstone Drive
   North Barrington, IL 60010
   847-304-2850

4. **Jack J. Bajor**
   Riverwoods Christian Center
   0 S. 670 Oak Lane
   Winfield, IL 60190
   (630)665-8103

5. **Charles ("Chuck") J. Fanaro, Owner**
   Larry Waco, Manager
   Saddlebrook Farms
   23000 W. Peterson Road
   Grayslake, IL 60030
   (847) 223-3721

6. **Frank Gorham**
   RHA&A
   Wasco Sanitary District (Fox Mill)
   Tiimbers Professional Center
   222 West River Drive
   St. Charles, IL 60174
   (630) 584-3530 ext. 245
   Operator: Charlie Folkes (630) 443-6270 ext. 224

Philip S. Bus, Director
Kane Co. Development Dept.
Mill Creek New Town [650,000] &
Fox Mill [316,000] Subdivision
719 Batavia Avenue
Geneva, Illinois 60134
(630) 232-3480

ILLINOIS ENVIRONMENTAL PROTECTION AGENCY

1021 NORTH GRAND AVENUE EAST, P.O. BOX 19276, SPRINGFIELD, ILLINOIS 62794-9276

RENEE CIPRIANO, DIRECTOR

217/782-0610

July 18, 2002

Re: Revisions in the Permitting Procedures for All New and Expanded Sewage Treatment Plants

Dear Design Engineer:

The purpose of this letter is to inform design professionals of recent changes to NPDES permit program administration within the Division of Water Pollution Control and how they relate to application documents submitted in support of a permit application. These changes pertain to new Illinois Pollution Control Board Regulations that place specific requirements upon the Agency for issuance of permits that authorize a new or increased discharge of wastewater into waters of the state. The Agency is adjusting its permit review and issuance process to comply with these new requirements with minimal additional time and burden upon both the permit applicant and Agency staff. In order to accomplish this, it is important for the engineering profession to understand the importance of early and comprehensive facility planning and engineering reports to the permitting process.

The Illinois Pollution Control Board adopted new anti-degradation regulations on February 21, 2002. These rules became effective on February 22, 2002 and can be downloaded from the Board at www.ipcb.state.il.us/Archive/dscgi/ds.py/Get/File-16619/R_01-013_022102_Opinion_and_Order.pdf using Adobe Acrobat®. Primarily, these regulations require that the Agency perform an analysis for all new and expanded discharges to surface waters (requiring NPDES permits). The primary purpose of the anti-degradation analysis is to ensure that new (or expanded) discharges do not cause degradation in the water into which discharge occurs unless absolutely necessary. If degradation is likely to occur, the degradation must be held to the smallest amount practically achievable and such degradation must be fully justified by the benefits of the project.

In times past, the permit applicant and their engineer have decided upon the method of wastewater treatment to be provided based primarily on cost and the requirements of the applicant. Review by the Agency took place primarily after design was completed (unless financial assistance was being provided by the Agency) and was based on whether or not the proposed treatment system would consistently meet effluent standards. It is now necessary for the Agency (and the public) to become involved in the process much earlier. The revised anti-degradation regulations focus less on the requirements necessary to meet water quality standards (although compliance with these standards is still necessary) and more on what kind of treatment system can be designed to have the least adverse impact on the receiving water.

Any discharge of treated wastewater to surface waters has the potential to cause the quality of the receiving water to become degraded. Therefore, systems that do not discharge should be considered and must be deemed not feasible before a discharging system can be considered. Examples of non-discharging systems are golf course, agricultural land, and other types of spray irrigation, seepage fields, and other types of subsurface discharges. Regionalization should also be considered for communities so located.

Potential environmental impacts should be examined and included in the preliminary engineering report (or facility plan if the project is to receive funding through the IEPA loan program, etc.) for each option considered. To expedite the review process, an NPDES permit application should be submitted with the engineering report/facility plan in cases there a discharging system is the recommended construction alternative. Plans and specifications should not be prepared until the engineering report/facility plan has been approved by the Agency.

The new Board rules essentially merge the engineering report/facility plan and NPDES permit application procedures into one process that must be completed before a state authorization to construct (state permit) can be issued. The items to be included in the engineering report/facility plan are attached.

As the Agency implements the Board's anti-degradation regulations, additional items may come to light. The Agency will attempt to keep the regulated community apprised of these as they develop. In the meantime, we have compiled a list of commonly-made errors in the processing of sewage treatment plant permit applications. To expedite the issuing of permits, the Agency has included these as an attachment to this letter. Ensuring that your staff does not make any of these common errors on submissions to the Agency should help reduce the burden and time that it takes the Agency to review the submittal.

The Agency thanks you for your continuing cooperation and patience in this matter as we begin implementing these new requirements. If you have questions or comments on these changes, please contact our municipal engineer at the phone number given above.

Very truly yours,

Thomas G. McSwiggin, P.E.
Manager, Permit Section
Division of Water Pollution Control

TGM:DJS:[redacted]

THE LAND CONSERVANCY OF McHENRY COUNTY

April 21, 2004

Jack Sheaffer
Sheaffer International LLC
800 Roosevelt Road, B200
Glen Ellyn, IL 60137

Re: Sheaffer water treatment systems

Dear Jack:

I have enjoyed speaking with your recently regarding your company's innovative waste water treatment systems, and their potential use for various development projects in McHenry County.

I am in full support of this option as an alternative to the traditional "wastewater treatment plants" that are in use across the country. The water treatment system you promote, with land application of the treated water, is especially valuable for an area like McHenry County where 100% of the water we use each day comes from groundwater sources.

As typically designed, developments treat water – stormwater and wastewater – as waste products to be dealt with as quickly as possible, and sent as far away as possible, typically through local creeks, streams and rivers. Given the large number of high quality streams in McHenry County, your land application systems provide the additional benefit of not adding excess nutrients to our local streams. The "waste" water from development is instead captured, treated to a very high standard, and then allowed to infiltrate into the ground through land irrigation.

As we have discussed, I will continue to talk with prospective landowners in the area who may be candidates for irrigation on farmland. The benefits of this are exciting, and could help to preserve farmland in the county, in addition to improving yields and the bottom line for local farmers.

I look forward to working together.

Yours very truly,

Lisa Haderlein
Executive Director

P.O. Box 352 Woodstock, Illinois 60098
815.455.4618
www.conservemc.org

COUNTY OF KANE

DEVELOPMENT DEPARTMENT

Phillip S. Bus, Executive Director

County Government Center
719 Batavia Avenue
Geneva, Illinois 60134
Phone: (708) 232-3480
FAX: (708) 208-2189

December 20, 1994

Ms. Evelyn W. Crane, Chairperson
Colebrook Planning & Zoning Commission
558 Colebrook Rd.
P.O. Box 5
Colebrook, CT 06021

RE: Water Reclamation Systems

Dear Ms. Crane,

I am writing in response to your 12/8/94 letter requesting information on water reclamation systems in Kane County. By way of response I am enclosing some background information about Kane County and a recent map to give you some idea of our geography and the planning and development issues we are trying to address.

Our county, with a population of about 350,000. is one of the fastest growing in the United States outside of the "sunbelt" or the coastal regions of the U.S. Our proximity to Chicago contributes to a healthy economy and significant new development. The year 2020 population forecast for Kane County is 500,000. As we grow we are placing a strong emphasis on implementation of a "blood-thirsty" greenway system and wise management of our water resources.

The primary water resource of Kane County is the Fox River flowing from north to south through the urban corridor along our eastern border. The water quality of this resource has improved significantly during the past two decades as the public has invested tens of millions of dollars in building and upgrading conventional sewage treatment systems. These systems, while usually meeting EPA discharge standards, still continue to discharge tremendous quantities of nutrients into the Fox River.

Our recent and future development to the west provides us with the opportunity to progress beyond these conventional discharge systems and incorporate recycling on the land of treated wastewater into a more holistic approach to managing our water resources. West of the Fox River communities we have a relatively undeveloped area

drained by 5 fairly pristine creeks. Our strategy as development moves into these watersheds is to rely primarily on water reclamation and recycling systems in order to minimize the adverse impacts of point source discharges from conventional treatment systems on these healthy streams.

We now have 5 systems either in operation or under construction. They are:

1) Mill Creek - a master planned recreation and residential community with a build-out population of 5000. This includes a 27 hole golf course, an important leg of our greenway system, a new village core area with convenience shopping, a health club, and a small hotel, etc. A new sanitary district (Mill Creek Water Reclamation District) has been created to own and operate the water supply system and the water reclamation and recycling system.. The reclaimed water is used for irrigating the golf course.

2) Fox Mill - a 750 acre mixed use, master planned community adjacent to the small hamlet of Wasco. Fox Mill has about 45% open space, both active and passive, a pedestrian friendly transportation system, diversified housing, school and church sites, a small commercial area, and many other amenities. The existing Wasco Sanitary District has been re-activated, the old discharge treatment system will be eliminated, and the water from the new treatment facility recycled on 80 acres of cropland.

3) Glenwood School for Boys - a private, not-for-profit institution for educating young males from troubled families is on 425 acres of rolling farmland. The wastewater treatment needs of the 110 acre new campus are provided by a Schaeffer-Roland designed system that recycles the water by farmland irrigation.

4) Riverwoods - a christian retreat and recreational facility along the Fox River on steep wooded hillsides. This camp was being expanded and remodeled and the existing septic tanks did not provide adequate wastewater treatment. The small aeration/storage cell relies on irrigation of the wooded area.

5) Silver Glen Estates - a prestigious 325 acre development of large homes with common open space areas. The $500,000 and up homes are on 1 1/4 acre lots overlooking the open space which is being reforested with 20,000 trees. The treated wastewater will be used to irrigate the reforested open space.

There are several other projects being proposed which could also use water reclamation and recycling systems similar to these 5 examples. All of the above are either under construction or in operation with the necessary local and Illinois EPA permits.

I should acknowledge that 8-10 years ago we had concerns about odor, sludge, pathogens, etc., that were very similar to those expressed in your recent letter. To become more knowledgeable with the Shaeffer-Roland alternative we did some research, hired a consultant from Pennsylvania to review a planned system design and most importantly, we organized a bus tour of several facilities in our area. The tour participants included representatives of the County Board, municipal officials, concerned citizens, public works personnel and county staff, and we drove to 4 operational systems in the Chicago area. At each facility the tour participants walked the site, reviewed the facility plans, talked to the operators and homeowners, and most importantly, conducted a "highly technical" nose test. Needless to say, at the end of the tour there was a general consensus that the water reclamation and recycling alternative was not only feasible in our 5 developing watershed, but in fact, preferable.

The conclusion at that time and confirmed in the intervening year is that these systems when properly designed, constructed, and operated do not smell, do not disperse pathogens, are not unsightly, are cost-effective, recycle water and nutrients, and eliminate point source discharges.

At this time I don't have any specific numbers concerning operating and maintenance costs for these systems versus more conventional systems. However, my general impression is that where land is available the construction costs are about the same as a conventional system but the operating and maintenance costs are less. From my experience, with the situation you have described, i.e., 500 acres, golf course, convention center, 53 lots, wooded area, etc., it would seem that a water reclamation and recycling system designed by Shaeffer and Roland is a viable environmental and financial alternative that deserves your close attention.

I would be willing to further discuss this matter with you so please feel free to call if you have additional questions.

Sincerely,

Phillip S. Bus
Executive Director
Kane County Development Dept.

PSB/scj
encl: 2

Village of Itasca

100 N. WALNUT STREET ITASCA, ILLINOIS 60143-1795

PHONE (708) 773-0835
FAX (708) 773-2505

December 14, 1994

Evelyn W. Crane, Chair
Colebrook Planning & Zoning Commission
588 Colebrook Road
P. O. Box 5
Colebrook, CT 06021

Dear Ms. Crane:

In response to your inquiry of December 8, 1994 regarding a waste water reclamation and reuse system designed by Sheaffer & Roland, Inc., I can only describe Itasca's experience in glowing terms.

To give you a little history, in 1973 I was elected to the Village Board as a Trustee. Itasca, at that time, was experiencing demands from developers to build in our town. We are located near O'Hare Airport and the plan, at that time, by the State of Illinois, was to build two major expressways through Itasca which would make us very geographically desirable. Unfortunately, during that period, Itasca was on restricted status from the EPA on our treatment facility, so we could not allow development.

It was also about this time that I became aware of Dr. Sheaffer and his plan for a system that did not require traditional facilities. Inasmuch as the cost to expand our treatment facility was estimated at 12 million dollars, we had to seek grants before we could begin construction with a potential of a very long delay.

One of the potential developers was the Trammell Crow Company, represented at that time by Alan Hamilton. I introduced Mr. Hamilton to Dr. Sheaffer and as they say, "the rest is history."

The Trammell Crow Company purchased 274 acres on the far north side of the Village proper. Development began after the EPA reviewed the plans and gave their approval. Obviously, the Village government had public meetings and hearings and extensive educational programs to overcome the natural resistance to something that seemed so radical.

The project, however, was finally approved and developed long before we could expand our traditional treatment facility. It now includes a beautiful hotel, 15 office buildings including one 27 story building, seven man-made lakes and is altogether a beautiful park-like setting that includes paved walks, small bridges and outdoor patio dining for some of the offices. We developed a new zoning classification called Regional Office Center (ROC) with a density of .06 which, of course, mandates extensive green area.

The assessed value of the acreage is in excess of one million dollars. Legally included on the tax bills is a levy for the bonds we sold to build the traditional plant even though we do not provide sewer or water to this development.

I served 12 years as a Trustee from 1973-85 and then was elected Mayor. I am now in my third term. In all that time, there has been no complaint from the EPA or from the users of the facility nor from the residents of the Village about odor, etc. There has been no sludge removal necessary thus far. I refer to the project as "a plum that fell in our lap".

The system has been run by the Trammell Crow Company. In the recent past Trammell Crow Company split into two with one half called Hamilton Partners. Trammell Crow retained control of the system. Trammell Crow now wishes to leave this area and the Village is currently negotiating to take over the maintenance and operation of the facility. We expect to own, and have Sheaffer and Roland operate and maintain the system for us.

All operational and maintenance costs are paid by the users at the development with rates which are competitive with costs of any other systems that you would be aware of. The Village incurs no cost because of this system and we expect to generate an income from this project once we own it.

I highly recommend that you adopt this system for your community. It is efficient, effective and sensitive to the environment. If I can provide any further information please feel free to call on me.

Best wishes for a happy holiday and a prosperous New Year.

Sincerely,

Shirley H. Retter
Mayor

SHK:jsd

VILLAGE OF IRIS

Saddlebrook Farms
23000 West Peterson Road
Grayslake, Illinois 60030
708-223-6000

December 14, 1994

Ms. Evelyn W. Crane, Chair
Colebrook Planning & Zoning Commission
558 Colebrook Road - P. O. Box 5
Colebrook, Connecticut 06021

Dear Ms. Crane,

I am in receipt of your letter dated December 8, this year. I am pleased to be invited to comment on our waste water treatment system, designed by the Sheaffer-Roland firm. My overall evaluation of the system is that it is excellent. It meets or exceeds all of our expectations We experience no odor problems and have never had to remove any sludge.

We operate our system at a fraction of the cost of our standard-type waste water treatment facility at our development in Florida. At our plant in Florida we have much higher costs both for personnel and operation, and have to have sludge removed and disposed of at rather substantial expense.

In my opinion, there is no question that the Sheaffer-Roland system is vastly superior to any other type of waste water treatment facility. The only possible negative would be that it requires that some land be available. It takes up more than a normal sewage treatment plant. For us, at Saddlebrook Farms, that is not a problem when the added benefit of being able to irrigate vegetation with this nutrient-rich water is taken into consideration.

I can think of no significant negative and would recommend both the system and Dr. John Sheaffer without hesitation.

In closing, I would invite your organization or representatives to visit our development which consists of 700 acres, zoned for several thousand houses.

Very truly yours,

Charles J. Fanaro, Jr.

THE FIELDS
Long Grove

2/9/94

Dr Sheaffer

In spite of having the worst winter since 1973 we had no trouble with our lagoon treatment facility. We have had weather 30 below zero with wind chill much lower.
Were very happy to have no trouble with our lagoon. The aeration units reacted as usual.
Being so cold we watched our lagoon very closely. We had no freezing or any other problems.

Roy Edwards

H.O.A. Manger

Town of Timberville

P.O. Box 102
392 S. Main Street
Timberville, VA 22853
703-896-7058
Fax 703-896-7055

February 11, 2004

Sheaffer International L.L.C.
800 E. Roosevelt Road,
Bldg.B, Suite 200
Glen Ellyn, IL 60137

Attention: Mr. Don Mizelle.

Dear Mr. Mizelle:

As we see the winter snow melting here in Timberville we wish to pass on our appreciation for the Sheaffer project.

Three years ago winter meant trouble for our old system. Icy working conditions, a change of seasons always brought on a change of chemistry in the system making it difficult to meet the B.O.D., etc.

Today we run with less manpower, and fewer worries in being a part of the joint Sheaffer system.

Thank you.

Respectfully,

C.W. "Mac" McCauley, Mayor
Town of Timberville, VA 22853