FEASIBILITY STUDY

FOR

WASTE DISPOSAL SYSTEM

SOUTHWEST SEWER CO.
BOX 859, RT. 1
BOIS D'ARC, MO.

PREPARED BY:

GORDON & MEITHAUS INC.
2244 S. CAMPBELL
SPRINGFIELD, MO., 65807

ENGINEERS - SURVEYORS - PLANNERS

TWIN HILLS SUBDIVISION

JASPER CO., MO.

JANUARY, 1980

PROJECT # 00106

Preliminary Copy

January 30, 1980

Exhibit No. 2
Date 10/24/80 Case No. SA-79-324
Reporter Phb

INTRODUCTION

This study has been prepared for Mr. Don Van Hooser, owner and developer, and Keith Newcomb, one of the incorporators of Southwest Sewer Company, for the purposes of Public Service Commission submittal for a publicly regulated sewer company. The attorney for the submittal is W.R. England, 312 Capitol, Jefferson City, Missouri. This report will examine the existing conditions of the soils and rocks at Twin Hills.

SITE DESCRIPTION

The projected area encompasses some acres which is to be developed under the ownership of Mr. Van Hooser. The area is designated as Twin Hills Subdivision. The site is located West of Joplin, Missouri. Direct site access is gained from W 20th Street and Country Club Road.

The site is further referenced as all of the East 1000 feet of the North Half of Section 18, Township 27, Range 33, Jasper County, Missouri. The site is open field and slopes to the North and East. No other collection or treatment system exists within several miles.

EXISTING AND PROPOSED FACILITIES FOR JOPLIN, MISSOURI

The closest city to the Twin Hills site which could provide gravity sewer service to the area is Joplin, Missouri. Their future plans for the area call for a new sewage treatment facility to be built West of the existing city limits in about six years. It will be sized to accomodate all new development in the area, but would still be an eight mile distance from the Twin Hills site. Of this eight miles, four miles would require a force main and pump stations which are not planned for another ten-fifteen years, and will depend upon availability of state and federal money for sharing construction costs. No proposed facilities are planned by the City of Joplin to sewer this area. The Public Works Department indicated the area is outside of their jurisdiction.

A second alternative would be to pump the sewage to the east and into existing city sewer lines 3,2000 feet away. The existing main and treatment plant for this adjacent water shed are of sufficient size to handle the additional sewage from Phase I, II and III of Twin Hills. However, the cost of this method, is too expensive for the initial use in Phase I. The area North and West of Phase I is currently served by the rural water district, and for this reason homes in the area are not using wells or cisterns for their water supply.

SITE CONDITIONS

A. SOIL CHARACTERISTICS - There are four basic soil types within the Twin Hills tract. These include Eldon (cherty silt loam), Chat piles, Gerald (silt loam), and Eldorado Stony Silt Loam (rocky, 8" - 14" total depth soil). The main soil found within Phase I is the Eldon (cherty silt loam). This soil is characteristically found on 2% - 7% slope. It is a medium dark reddish-brown textured soil of medium productivity. The surface is moderately permeable while the sub-soil is rapidly permeable. There is no occurance of a high water table and soil cover is usually 4' - 10' thick, with limestone bedrock immediately below. Soils are deeper in the more level or flatter areas.

PROPOSED FACILITY DESCRIPTION

As indicated in the attached Engineering Report the proposed method utilizes an individual treatment unit installed at each dwelling during construction. The waste is treated and settled before discharge to a collection line which flows to a polishing tank-chlorinator and filter. All construction is to be in accordance with the State Department of Natural Resources Rules & Regulations.

TWIN HILLS

This acre parcel is owned by Don Van Hooser, Joplin, Missouri. A sales contract would be included with each lot sale stipulating the responsibility of each lot owner to install an aeration device per agreement, in all sales contracts. Based upon final construction plans the cost of construction of the collection system would be amortized among all the lots and paid into an escrow fund. Initially a collection line would be installed with the holding tank, chlorinator and sand filter.

SUMMARY

Twin Hills Subdivision, if developed, should provide home units as indicated in this report.

Initially construction will consist of the necessary line and appurtenances to serve the 1st phase and should serve all lots. A holding tank is to be provided as well as chlorinator sand filters. As the project is developed the remaining improvements would be installed and connected. Additional holding capacity at the wet well to the sand filter can be added as required. All easements and access should be obtained at this time. It should be made part of the plat and/or contract agreement that all property owners check on sewer line elevations prior to commencing construction of homes or mobile hom pads to assure adequate servicing. Each home as built will be required to install a home unit and connect to the collection line prior to occupancy.

Maintenance of home units and collection unit to be responsibility of PSC approved company.

Projected figure indicates a charge of $13.40 to $16.21 for operation per lot over the 1st three (3) years based on 49 lots.

ANNUAL EXPENSE PROJECTION

TWIN HILLS SUBDIVISION

PLANT EFFLUENT QUALITY	
TESTING QUARTERLY	400.00
SAND FILTER & DOSING SYSTEM	400.00
MAINTENANCE & MONITORING (WEEKLY)	
$ 80.00 X 52 Visits	4,016.00
INDIVIDUAL UNIT	
MAINTAINING & MONITORING	750.00
CHLORINE TABLETS REQUIRED FOR	
EFFLUENT DISINFECTION	100.00
ACCOUNTING & LEGAL	600.00
INITIAL SET-UP COSTS ($1000)	
1000/3 Year	333.33
MOTOR REPLACEMENT	50.00
PUMP REPLACEMENT	50.00
TOTAL ANNUAL EXPENSE	6,649.33

FACILITY COSTS

FOLLOWING ARE THE ESTIMATED COSTS FOR 49 LOTS:

TWIN HILLS SUBDIVISION **EXHIBIT A**

COLLECTION LINE & APPURTENANCES

3660 lin. ft. @ $ 16.00	$ 58,560.00
TREATMENT PLANT	19,000.00
CHLORINATOR	1,200.00
LEGAL & ACCOUNTING	500.00
ENGINEERING PLANS & STUDIES	6,000.00
CONTINGENT	5,000.00
TOTAL	$ 90,260.00

$ 90,260.00/49 = $ 1842.00/Lot

REVENUE PROJECTION PHASE I (49 Lots)

		TOTAL EXPENSE & PROFIT		ANNUAL	MONTHLY
YEAR	1	6649.33	(49 Lots)	135.70	11.30
	2	7314.26		149.27	12.44
	3	8045.68		164.20	13.68

orig: James Fahrneier cc: DEQ, Springfield

ENGINEERING GEOLOGIC REPONT FOR SUBDIVISION-INDIVIDUAL HOME WASTE DISPOSAL SYSTEMS
MISSOURI GEOLOGY AND LAND SURVEY, P.O. Box 250, ROLLA, MO 65401
(314) 364-1752
TO BE SUPPLIED BY APPLICANT

Project Twin Hills, Phase I County Jasper Date
Engineer
Owner James W. Fahrneier Address 1501 West-port Road, Kansas City, MO 64111

Location ¼, NE ¼, NE ¼, Sec. 18, T. 27N, R. 33W, Quad. Joplin West

Request by Engineer. E. Sketch or describe location.

Type: septic tank X tile field ____ evapotranspiration mound ____ other X

Individual wells ____ public water supply X. H. Use frequency: intermittent ____ perennial ____
22 lots of about 3/4 acre in size.
Minimum lot size ____, Maximum lot size ____, No. of lots ____, total acres ____

To be filled in where applicable by the engineering geologist making the investigation

Slope: 0-5% X, 6-10% X, 11-15% ____, 16% or greater ____
Site: Prairie X, hilltop X, hillslope X, broad valley ____, narrow ravine ____
floodplain ____, terrace ____.

Type and general condition of bedrock Weathered limestone

Type and engineering characteristics of soil including thickness Soil type will vary from stoney clay (CL-CL) to very fat clays (CH). Estimate soil thickness at 8 to 10 feet.

Watershed: gaining ____, losing X.

Groundwater recharge: none ____, local perched X, local shallow X, regional ____

Density of existing dwellings: isolated ____, scattered X, numerous ____
locally intense ____.

Geologic limitations:

a. Majority of the lots have a geologic limitation related to groundwater of:

none ____, slight ____, moderate X, severe ____.

b. Majority of the lots have a geologic limitation related to surface water of:

none ____, slight ____, moderate ____, severe X.

8. Remarks and Recommendations:

Lots are less than 1 acre in size and situated on a sloping land surface. Surfacing of effluent will be a problem on many of the lots and because of their size and the sloping land surface, effluent will be able to cross property lines via surface flow. Larger lots or locating laterals well away from property lines will reduce the chance of effluent crossing property lines.

Bedrock is weathered and fractured. Soil thickness will vary due to the weathered bedrock surface, but is estimated 8 to 10 feet thick. Noted.

If aerators are run properly and effluent is upgraded an engineer proposes in his report, there would be only slight effect on the shallow and perched groundwater. If there is no upgrading of effluent, then local shallow and perched water would be severely effected.

These remarks apply only to Phase I. Engineer plans propose a central sewage system for Phase II, III, and IV.

*Guidelines — natural geologic conditions

No limitations — No evidence of groundwater pollution potential; no modifications needed to make site geologically suitable; factor rating of 1.5 or less.

Slight limitations — Local but minor groundwater pollution hazards, and effluent will not surface on adjoining property; minor additional expense needed to correct geologic limitations; factor rating of 1.6 to 2.5.

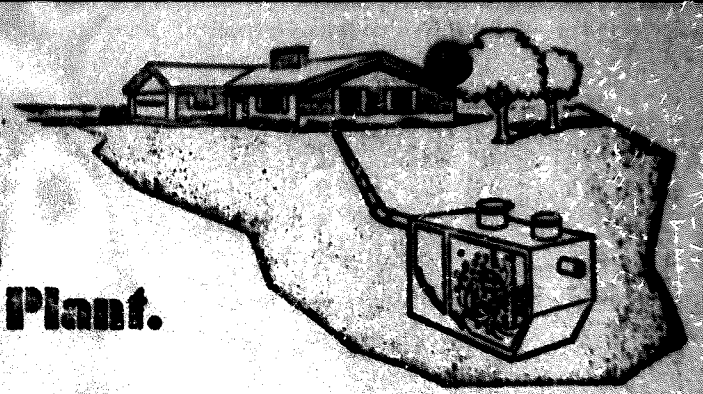
Moderate limitations — Significant geologic hazards and potential regional groundwater pollution. Effluent may flow onto adjoining property. Hazards correctable with established engineering procedures but anticipated substantial cost increase. Factor rating of 2.6 to 3.5.

Severe limitations — Regional groundwater pollution likely. Effluent will flow onto adjoining property. Hazards so severe that elaborate and costly engineering techniques may not be totally successful. Factor rating 3.6 or greater.

THIS REPORT IS VALID ONLY AT THE ABOVE LOCATION AND BECOMES INVALID ONE YEAR AFTER THE DATE OF ISSUANCE.

Missouri Geology and Land Survey Report by John W. Whitfield, Geologist, 3-7-78 Date

■ Control pollution
■ End septic tank odors
■ Raise health standards
...with a Jet Plant.



WHAT IS A JET PLANT?

The Jet pollution control plant for individual homes is a giant step into a clean new world — out of the old-fashioned world of the septic tank.

The Jet plant is designed to serve homes beyond city sewers . . . anywhere. In just 24 hours it reduces all household wastewater to a clear odorless liquid.

Developed as a replacement for the inefficient septic tank, the Jet treatment plant uses the same purification process as large central sewage treatment plants — with comparable results. Jet simply adapts the process to a small compact underground installation sized to serve a single home.

Local health departments often insist on home aeration plants instead of septic tanks, especially where the water table is high or the soil has poor percolation.

The Jet plant is self-contained, automatic, odorless. Designed for modern living, it easily handles wastewater from multiple-bath homes with all modern appliances—automatic laundries, dishwashers, garbage grinders. And yet it is a practical plant. It does not cost a fortune to buy, operate, or maintain. Most important, it requires little maintenance.

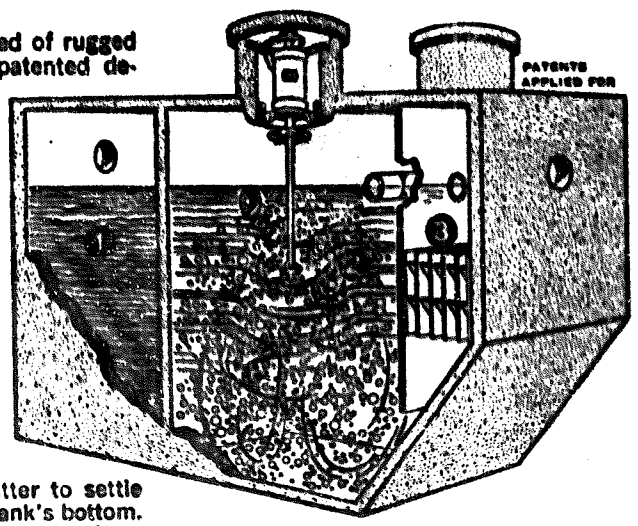
HOW DOES IT WORK?

The treatment process — called extended aeration — is a speeded-up version of what happens in nature when a river tumbles through rapids and over waterfalls, purifying itself by capturing oxygen. The Jet plant brings oxygen to the wastewater by injecting streams of air into its underground treatment tank and bubbling this air through the wastewater. The air is injected by a patented, electrically operated Jet aerator. A control panel conveniently installed in the home's basement or garage automatically regulates operation of the aerator, which runs only part of the day.

The clear liquid discharged by a Jet plant is odorless, colorless, and ecologically acceptable. According to some scientific opinion, the high dissolved oxygen content in an aeration plant's oxygen-laden effluent actually contributes to the betterment of nearby streams, helping support aquatic life.*

A Central Treatment Plant In Miniature.

The Jet plant is constructed of rugged permanent concrete. Its patented design incorporates three separate compartments, each performing a specific function in the total purification process.



❶ The Primary Treatment compartment receives the household sewage and holds it long enough to allow solid matter to settle to the sludge layer at the tank's bottom. Organic solids are here broken down physically and bio-chemically by anaerobic bacteria — those bacteria that live and work without oxygen. Grit and other untreatable materials are settled out and held back. The partially broken down, finely divided material that is passed on to the aeration compartment is much easier to treat than raw sewage. This, of course, is the reason for Jet's primary compartment. It's one of the steps that make it possible for Jet plants to reduce incoming sewage to a clear effluent within the short period of 24 hours.

❷ In the Aeration chamber the finely divided, pre-treated material from the primary compartment is mixed with activated sludge and aerated. The patented Jet aerator injects large quantities of fresh air into this compartment to provide oxygen for the aerobic digestion process, and it thoroughly mixes the compartment's entire contents.

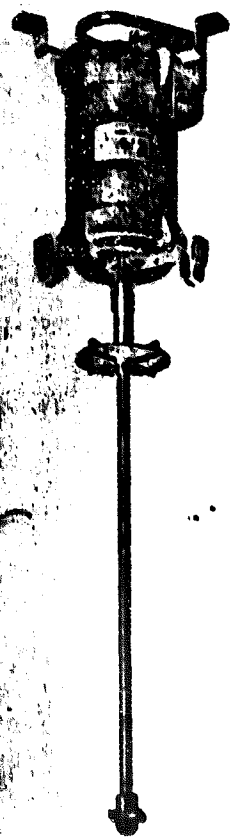
The aerator is mounted in a concrete housing that rises to ground level to give it access to fresh outside air. In injecting air into the liquid, the aerator breaks up the air into tiny bubbles so more air comes in contact with the liquid, thus hastening the aerobic digestion process. Aerobic bacteria, which are bacteria that live and work in the presence of oxygen, then use the oxygen in solution to completely break down the sewage and convert it to odorless liquids and gases.

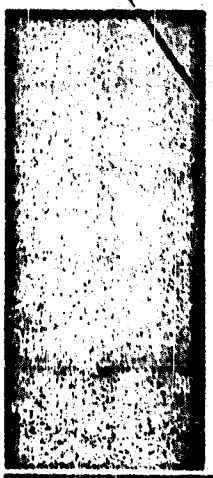
The Aeration compartment has a 50% greater capacity than is required in the National Academy of Sciences–National Research Council Criteria. This extra capacity gives a Jet plant a more-than-adequate safety factor to handle shock loads from weekend guests, multiple baths, automatic laundries, and dishwashers.

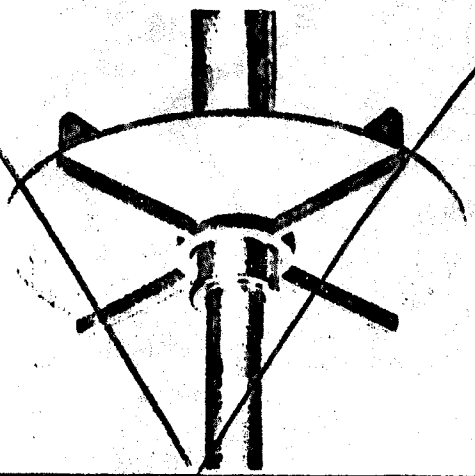
❸ The final phase of the operation takes place in the settling/clarifying compartment. In this compartment a tube settler eliminates currents and encourages the settling of any remaining settleable material which is returned, via the tank's sloping end wall, to the aeration compartment for further treatment. A non-mechanical surface skimmer, operated by hydraulics, skims any floating material from the surface of the settling compartment and returns it to the aeration compartment. The remaining odorless, clarified liquid flows into the final discharge line through the baffled outlet.

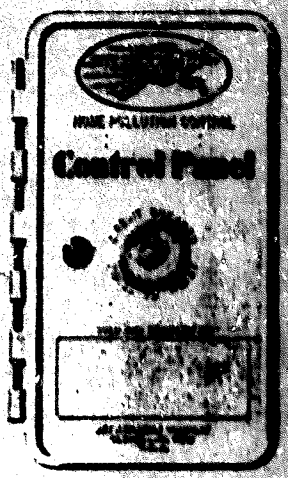
*"Evaluation of the Suburban STP," Stanley T. Kappe, Sanitary Engineer, from Water and Sewage Works, Reference Number, 1963.

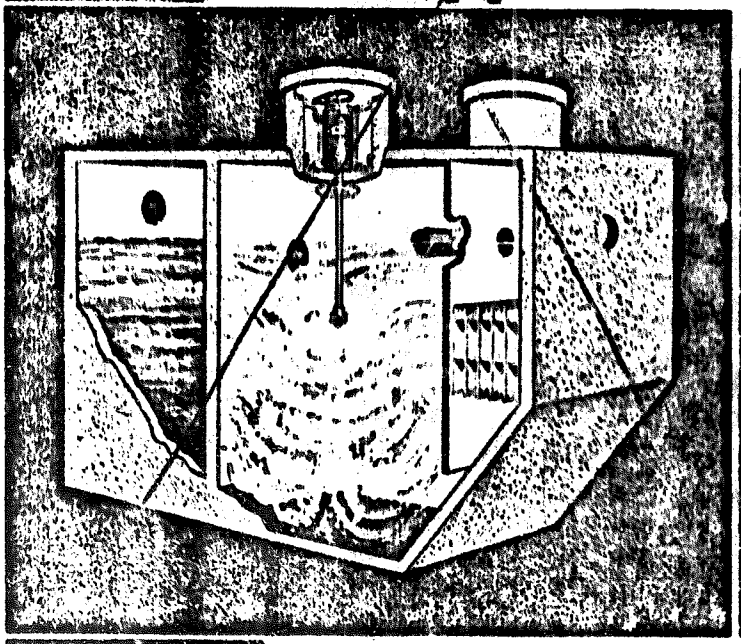
Individual Home Sewage Treatment



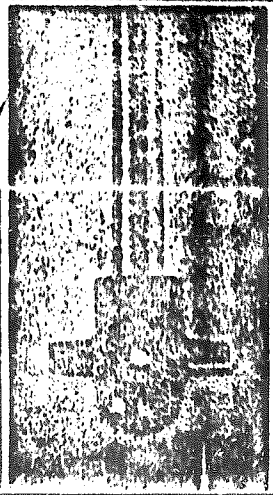








NSF TESTING LABORATORY
NSF
ANN ARBOR, MICH.



- Automatically reduces all household sewage to clear odorless liquid in just 24 hours.
- Same process used by central treatment plants.
- Recommended by health officials across country.
- Two-year limited warranty, 20-year exchange program
- Backed by local licensed factory-trained Jet distributor.
- Product of the pioneer and leading company in field.
- NSF Seal of Acceptance.

A Jet Plant will benefit you... and your environment.

■ **NO ODORS.** The most noticeable benefit of the Jet aeration plant is that it eliminates the embarrassing, offensive sewage odors that are a problem with septic tanks.

■ **OUTSTANDING TEST RESULTS.** During a comprehensive 7-month testing program conducted by an internationally recognized foundation, the Jet plant produced an effluent with a median 5-day BOD concentration of only 19 ppm and suspended solids concentration of 25 ppm — average reductions of 89% and 87%.

■ **ENVIRONMENTAL PROTECTION.** The highly treated effluent discharged from a Jet plant is normally colorless and odorless, and meets standards of larger plants. This is natural, since Jet's watertight, self-contained plant treats sewage in the same manner as a central sewage plant with comparable results. Where clay soil, rock, shale, or high water tables exist, many homes simply cannot be built without Jet aeration. Gross pollution of ditches and streams is eliminated by Jet and, of course, this protection extends to ground water supplies . . . especially important to homeowners with water wells on their properties.

■ **EFFLUENT DISPOSAL SIMPLIFIED.** Effluent disposal in any area is controlled by the health authorities. Many authorities have found the highly treated Jet effluent eliminates the need for leaching fields or subsurface filters. Most health officials in areas where subsurface disposal is required have found Jet's effluent extends the life of the fields or filters. In a great many areas, Jet's aerated effluent is discharged directly to a storm sewer, flowing stream, or any well-defined line of drainage.

■ **LARGE CAPACITY.** Total net holding capacity in a Jet plant's three-compartmented tank is 1200 gallons. Primary Treatment compartment holds 475 gallons; Aeration compartment 600 gallons; Settling/Clarifying compartment 125 gallons.

■ **HANDLES ALL MODERN APPLIANCES.** Automatic laundries, dishwashers, and garbage grinders present no problems to a Jet plant because of its sophisticated treatment process and its large capacity. Septic tanks cannot offer this benefit.

■ **AUTOMATIC OPERATION.** A control panel automatically cycles the Jet aerator's operation for proper treatment. The homeowner does not concern himself with operation.

■ **BACKED BY A LOCAL JET DISTRIBUTOR.** The local factory-trained Jet distributor, who installs the plant, is always available if service is ever needed. His name and phone number are clearly displayed on a nameplate attached to the control panel.

■ **NO OWNER MAINTENANCE.** Absolutely no periodic maintenance is required by the homeowner. Other than perhaps pressing a re-set button on the control panel in the event of an electrical overload, there is nothing for the owner to do. If ever needed, service will be taken care of by the local factory-trained Jet distributor.

■ **FREQUENT TANK PUMPING ELIMINATED.** A Jet plant can go five times as long as a septic tank — or longer — before it needs pumping. The Jet plant's primary chamber is designed to pre-treat organic material and pass it on for final treatment, not hold it back as septic tanks are supposed to do.

■ **ONLY A SMALL SPACE REQUIRED.** Because of Jet's highly treated effluent (final liquid discharge), most health authorities either greatly reduce the requirements for sub-surface filters and leaching devices (commonly used with septic tanks) or eliminate the requirement for these altogether. Naturally, this results in a great savings to the home buyer, in both original cost and maintenance.

■ **ECONOMICAL TO INSTALL.** Installation cost for a modern Jet aeration plant is no more than for the old-fashioned septic tank. In many instances it is even less.

■ **LOW OPERATING COST.** The Jet aerator's fractional horsepower motor is automatically cycled to run only part of each day. A Jet plant costs the homeowner less to operate than his refrigerator, TV, or most other major home appliances.

■ **OPTIONAL CHLORINATION AVAILABLE.** Where local health regulations require it, a simple effective chlorinator can be easily added to the plant. Non-mechanical, the Jet chlorinator works by gravity flow, uses easy-to-handle disinfectant tablets, requires little attention other than restocking with tablets about twice a year.

■ **OPTIONAL TERTIARY TREATMENT FILTER.** Practical tertiary treatment can be provided, where required, by the optional Jet upflow filter. The filter is housed in a separate concrete tank through which the plant effluent flows. The effluent receives further biological treatment from bacterial growth on the filter medium. In independent tests, the Jet filter produced effluent averages of 11 ppm BOD and 10 ppm SS — reductions of more than 94% and 90% respectively! If chlorination is also desired, a Jet chlorinator can be installed within the filter.

Jet Obsoletes the Septic Tank.

Operating Characteristics	Jet Plant	Septic Tank
Odor	no odor	smells bad
Pumping	usually 3-5 years	usually 6-24 months
Garbage grinder	fine	causes problems
Automatic dishwasher	fine	not recommended
Automatic laundry	fine	not recommended
Multiple baths	fine	causes problems

Effluent Quality	Jet Plant	Septic Tank
Biological Oxygen Demand (should be low)	usually 10-40 ppm	usually 200-430 ppm
Dissolved Oxygen (should be high)	usually 4-6 ppm	always 0 ppm
Suspended Solids (should be low)	usually 9-60 ppm	usually 180-380 ppm
Coliform Count (should be low)	usually under 50,000/100ml; with Jet chlorination, 0-100/100ml	usually over 400,000/100ml

The Aerators with the Lowest Repair Rate in the Industry!

...'S UNIQUE PATENTED DESIGN, QUALITY CONSTRUCTION ASSURE MANY LONG YEARS OF LIFE AND TROUBLE-FREE SERVICE.

The Jet aerator mixes and oxygenates the liquid in the plant's aeration compartment.

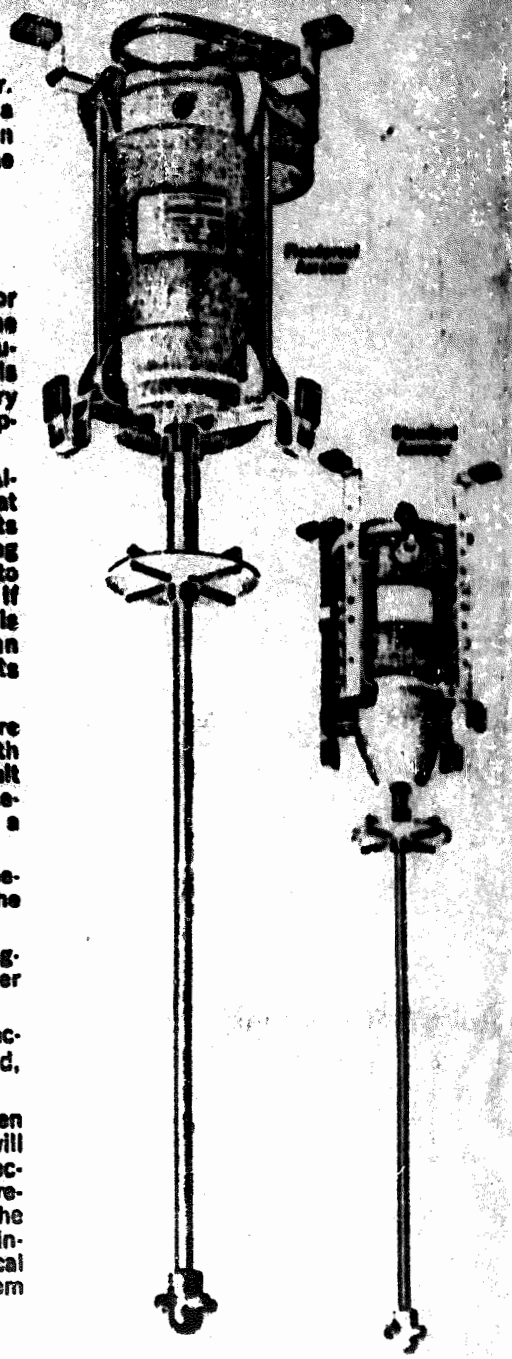
Fresh outside air is drawn into the unit by the action of aspirator tubes on the shaft turning in the water. As they rotate they leave a cavity or pocket in the water into which the air is drawn. This air travels down through the aerator, into the hollow shaft, and out the aspirator tubes. The air bubbles are then reduced in size by the shearing action of the rapidly turning aspirator tubes.

These tiny bubbles are dispersed radially. The rapid rotation of the aspirator induces circulation and mixing throughout the aeration compartment. As air is injected into the fluid, turbulence is increased, and the entire contents of the compartment are drawn into circulation, broken down, and aerated. Because the air bubbles are small and uniformly dispersed, the Jet aerator's oxygen transfer efficiency is exceptionally high.

Two Aerator Models...Floodproof & Standard.

Top-of-the-line Floodproof model:

Running seals protect this completely waterproof unit from any damage by water backing up in tank from flash floods or temporary storm sewer overloads. Five years of careful research, design, and testing went into Jet's development of the Floodproof aerator. The field-proven Floodproof model is a major step forward in home aeration plants and the most versatile home aerator available.



Both models have all these quality features:

- **Careful engineering and construction.** Everyone at Jet is proud of turning out the finest product in the field. This company pride results in top quality . . . consistently superior aerator design and construction.
- **Corrosion-proof or protected materials.** Stainless steel or special plastics are used on all submerged parts. Parts above water line are either of similar corrosion-proof materials or are protected by heavy plating or baked enamel finishes.
- **Corrosion-proof foam restrictor.** Positively protects unit from the foam created by mixing and aeration. It throws foam to tank sides and breaks it up, protecting the aerator.
- **Ball-bearing construction.** Bearings are extra large for longer life, pre-lubricated and permanently sealed for life of the unit . . . no greasing or oiling ever needed.
- **Totally enclosed motor.** Especially designed and produced for Jet by one of America's largest motor manufacturers.
- **Low power requirements.** The fractional horsepower motor is automatically cycled at the factory to run only part of each day. When cycled "on" it uses less electricity than most other major household appliances.
- **"U.L. Approved"** cable. Furnished for each installation by Jet distributor.
- **Close-tolerance coupling.** Automatically centers shaft to assure smooth [illegible] running characteristics and long life.
- **Strict production tolerances.** Aspirator shaft and coupling are produced to tolerances within 3/10,000".
- **Complete testing.** Every Jet aerator is thoroughly tested before it leaves the factory. All critical parts such as coupling, shaft, bearing bores, and journals are inspected before assembly. Every assembled unit is run under actual operating conditions before shipping.
- **Completely versatile operation.** Although the control panel is pre-set at factory to cycle the unit for best results under normal conditions, the setting can be changed by the distributor to compensate for unusual situations. If conditions demand it, the Jet aerator is so sturdy that it can even be run continuously without decreasing its long life.
- **Quiet operation.** All rotating parts are precision-balanced. This, together with the close tolerances that are held, result in an aerator that is practically noiseless and vibration-free—running like a Swiss watch.
- **No adjustment by homeowner.** No periodic adjustment or lubrication by the homeowner is required.
- **Positive air injection.** There's no clogging when the unit is cycled off or power interrupted.
- **Jet circuit breaker.** Opens the electrical circuit in the event of an overload, protecting the aerator from damage.
- **Lowest repair rate in industry.** Even the finest mechanical equipment will some day require repair, but two decades of experience have shown the frequency of repair for Jet aerators is the lowest in the industry. When these infrequent repairs are needed, the local Jet distributor is there to handle them promptly and professionally.

AN EVALUATION OF THE JET HOME SEWAGE TREATMENT PLANT WITH THE NATIONAL ACADEMY OF SCIENCES — NATIONAL RESEARCH COUNCIL CRITERIA AS GIVEN IN REPORT 586.

To aid Federal, State, and local health authorities in evaluating home aerobic sewage treatment plants, the U.S. Public Health Service arranged and financed a study of these plants which was conducted by the National Academy of Sciences — National Research Council. This study developed criteria for evaluating and testing home aerobic sewage treatment plants and established conditions of their use. The findings, set forth in NAS-NRC Publication 586, provide a firm basis on which health authorities may make an intelligent evaluation of these plants and their potential in disposing of sewage from individual residences without creating either public health hazards or nuisance conditions.

This paper reviews the "Criteria for Evaluating and Testing," given in the NAS-NRC report, and details how these criteria are either met or exceeded by the Jet home plant.

Report 586 lists seven main criteria for evaluation of individual home aerobic sewage treatment plants. They are: Design; Influent Characteristics; Operation; Aesthetic Features; Maintenance; Effluent Characteristics; and Effluent Disposal. These criteria are reviewed here and the Jet home plant is compared with them.

Design

PIPING

The Jet plant contains no internal piping, shrouds or confining structures which may clog or jam — and conforms to the National Plumbing Code of The American Standards Association (ASA A40.8).

TANK

Jet tanks conform to the criteria both as to location and materials. All tanks are constructed of precast concrete, adequately reinforced with steel mesh and rod according to American Concrete Institute standards. All requirements of design recommended for home sewage treatment tanks by the Public Health Service are met.

CAPACITY

Capacity of Jet tanks meets the requirements for flow-through plants and exceeds the minimum recommended capacity (400 gal.) by 50%. The criteria call for an aeration compartment with a volume not less than 400 gal. per pound of influent B.O.D. applied per day. In the Jet tank the aeration compartment alone has a 600 gal. capacity, with a total tank net holding capacity of 1200 gals.

OTHER DESIGN FEATURES

As is specified, the shape, inlet and outlet arrangements, compartmentation, and baffling in the Jet tank are designed to prevent short-circuiting of flow; prevent deposition of sludge in the aeration chamber; prevent the excessive accumulation of scum in the settling compartment; and provide a continuous, positive return of sludge to the aeration compartment. The drawing on the specification sheet shows that the Jet tank is designed to meet all these requirements. You will note that: 1) The primary treatment compartment removes the principal scum-forming material (grease) before it reaches the aeration compartment. This primary compartment also removes the grits and other high specific gravity materials, which interfere with proper circulation and scouring of the aeration compartment floor by weighing down the activated sludge and sewage solids. 2) Design makes short-circuiting impossible. 3) The Jet settling compartment is designed as a still chamber to effectively settle out the solids. Maximum settling is accomplished through use of a tube settler, which stills all incoming currents. 4) Slope of the settling compartment end wall is 1:1.75, which is adequate to insure the return of settled solids to the aeration compartment and to prevent a build-up of these solids on the sloping surface. Another factor facilitating the return of sludge and shortening the required settling time is that the activated sludge produced from sewage which has undergone primary treatment has a higher apparent specific gravity than that produced by aeration of fresh sewage.

REDUCTION OF GROSS SEWAGE SOLIDS

Gross sewage solids entering the Jet plant settle to the ripe sludge layer of the primary treatment compartment where they are degradated both physically and chemically by anaerobic decomposition. Unlike with a septic tank it is years before this compartment needs to be pumped because the sludge layer will rise to a predetermined point and no farther. At this point the solid removal is nil as influent gross solids settle to the ripe sludge layer and displace an approximately equal amount of broken down, pre-treated solids into the aeration compartment. These displaced solids are a finely divided, flocculent material exhibiting an exceptionally large surface area compared with that of fresh sewage.

AERATION

The Jet Aerator introduces many times more than the recommended 1000 ft.³ of air per pound of influent 5-day B.O.D. Although the operation of the aerator is normally cycled, it is so constructed that it may operate either continuously or intermittently. When it is cycled, aerobic conditions are maintained at all times.

By means of a specially designed aspirator, the Jet Aerator introduces fine air bubbles below the surface. The tiny bubbles are dispersed radially from the aspirator. Because of the fine bubble size and the fact that the bubbles are uniformly dispersed throughout the chamber, the oxygen transfer efficiency of the Jet Aerator is exceptionally high.

MIXING

Mixing accomplished by the Jet Aerator is not only sufficient to prevent deposition of sludge but keeps the entire liquid

(over)

...ment of the aeration chamber evenly mixed and in a constant state of turbulence. Rapid rotation of the aspirator induces circulation and mixing throughout the compartment. As air is injected into the fluid, turbulence is enhanced, and the entire contents of the compartment drawn into circulation.

SURFACE SKIMMING

The uniform tank roll created by the Jet Aerator also operates the non-mechanical settling compartment surface skimmer which removes any floating material from the settling compartment surface and returns it to the aeration compartment for further treatment.

ELECTRICAL COMPONENTS

As the criteria require, the electrical components of the system comply with the National Electrical Code.

MECHANICAL COMPONENTS

The Jet Aerator — which has only one moving part — is the sole mechanical component of the system. Only ball bearings are used and these bearings are pre-lubricated and sealed for the life of the unit. No periodic lubrication is necessary. In addition the unit is clog-proof and has no belts, pulleys or other parts which need periodic adjustment or lubrication. Every part of the aerator exposed to the mixed liquors is constructed of stainless steel and equally resistant materials, thus eliminating the serious corrosion factor encountered with the use of ordinary carbon steel or iron.

The entire unit is easily inspected from the ground surface. If necessary, it may be removed in a matter of minutes without any digging, dismantling or draining of the tank. Although continuous operation of the aerator is not normally required, it can be run continuously with no ill effects. High power costs (as often an objection of the home owner) are not encountered since the Jet Aerator consumes less power than other major home appliances.

SAFETY FEATURES

The Jet plant is operated by a control panel which automatically programs the aerator "off-on" cycles. An overload protector with warning light is also standard equipment. As there is no belt drive, the warning light, when it is glowing, gives a positive indication that the aerator is inoperative and does not merely indicate whether or not the motor alone is operating.

Influent Characteristics

ORGANIC AND VOLUMETRIC LOADING

The Jet plant is designed to comply with the NAS-NRC recommendations for loading for individual household systems — an organic loading of 0.250 pound of 5-day B.O.D. per bedroom or 0.375 pound of 5-day B.O.D. per bedroom if the home is equipped with a food-waste grinder. These figures are increased by a factor of 50% to allow for unusual conditions such as the presence of guests, etc.

Operation

Operating characteristics of Jet plants, as the criteria suggest, should be determined by actual tests and observation of properly installed, well-operated Jet installations. These observations will show: 1) No deleterious effects of climate. 2) No development of odors. 3) No development of excessive foam or scum. Actually, the combination of anaerobic and aerobic biochemical action produces a partial breakdown of the syndets, which limits and in some cases eliminates their foam-producing characteristics. 4) No release of aerosols to the atmosphere. 5) No clogging. 6) No material impairment of treatment because of short-term interruption of power. Aerobic conditions persist in the Jet [illegible] even after 12 hours of shutdown and are quickly re-established no matter how long the power interruption or period of inoperation may be.

Aesthetic Factors

The Jet home sewage treatment plant complies with all the requirements which apply to flow-through type systems. There is no noise or odor and no special plumbing fixtures are required.

Maintenance

The NAS-NRC report suggests that either a manufacturer's warranty or a replacement policy be made available on the aerating device. Jet has both. The Jet Aerator is warranted for two years against defective parts and workmanship, after which time a pro-rated replacement policy is in effect for aerators up to 50 years old. All licensed Jet distributors offer an inspection-service policy free of charge for the first two years. After this it may be renewed indefinitely at a nominal cost.

Jet can offer such protection because Jet home plants have the lowest repair and maintenance rate of any plant on the market today.

Effluent Characteristics

NAS-NRC publication 586 recommends the following effluent criteria:

- Concentration of 5-day B.O.D. shall not exceed an average of 50 mg./l.
- Concentration of suspended solids shall not exceed an average of 150 mg./l.
- Microbiological quality of effluent should average less than a million coliforms per 100 ml.

Jet plant effluent has been tested and shown to average only 50,000 coliforms or less per 100 ml. Other test data, shown here, proves that effluent characteristics of the Jet plant more than meet the B.O.D. and suspended solids requirements.

TEST RESULTS — JET HOME PLANT

		Median ①	Minimum	Maximum	Interquartile Range ②
Biochemical Oxygen Demand mg/l	Influent	160	160	750	[illegible]
	Effluent	19	7	48	[illegible]
Suspended Solids mg/l	Influent	172	68	1140	[illegible]
	Mixed Liquor	28	3	180	[illegible]
	Effluent	28	2	134	[illegible]
Dissolved Oxygen 12:00 noon mg/l	Mixed Liquor	7.2	2.0	10.6	[illegible]
	Effluent	5.7	0.7	8.9	[illegible]
pH	Influent	7.3	7.1	7.6	[illegible]
	Mixed Liquor	7.6	7.3	8.3	[illegible]
	Effluent	7.6	7.2	8.0	[illegible]

① MEDIAN: 50% of the values are equal to or less than this value.
② INTERQUARTILE RANGE: The range of variability about the median which is sufficient to contain 50% of the observations; it lies between the upper and lower 25% of the observations.

Effluent Disposal

The highly treated Jet effluent is of such excellent quality that it may be satisfactorily disposed of in conformity with recommendations of the controlling health authority or any of the methods suggested in the NAS-NRC report.

Methods of disposal which are reviewed include soil absorption, coarse sand filters, covered storm sewers or drains, natural drainage, properly maintained dry ditches and aerobic stabilization ponds.

Specifications
Individual Home Sewage Treatment Plant

1200 GALLON EXTENDED AERATION PACKAGE PLANT J-153

General

Furnish and install one (1) Jet individual home sewage treatment plant consisting of tank, aerator, approved underground electrical cable, and control panel with automatic time control device, overload protection, and warning light. The plant shall be used for treatment of all sewage and waste flow from the plumbing fixtures of a single-family dwelling structure, including automatic washers and garbage grinders.

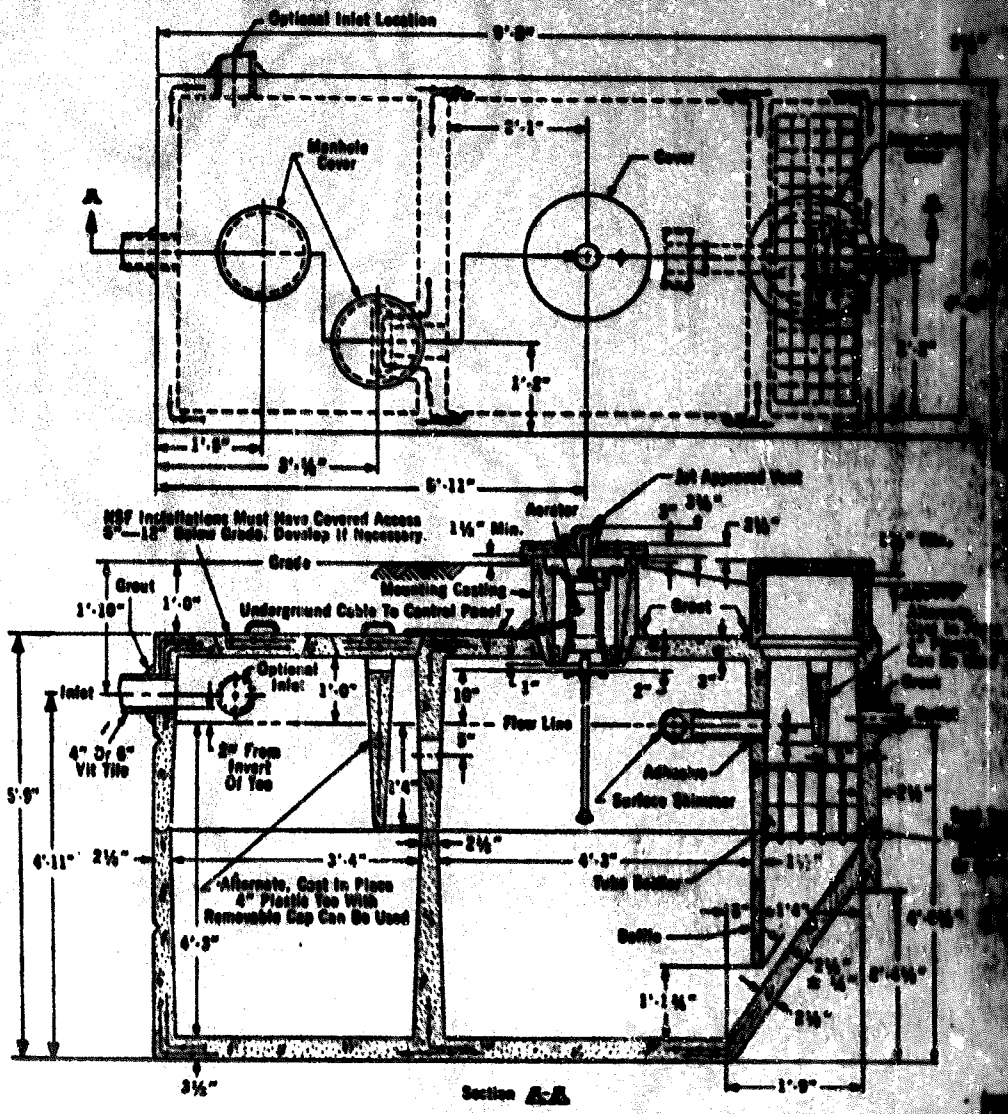
Aerator

☐ **460-FP:** The aerator mechanism shall be a Jet Model 460-FP, complete with ⅓ HP, 115 volt, 60 cycle, split-phase motor (totally sealed against the entrance of outside water and filled with dielectric oil for cooling windings and lubricating bearings) and stainless steel shaft with a PVC plastic aspirator, corrosion-proof foam restrictor and direct, close-coupled stainless steel drive mechanism as manufactured by the Jet Aeration Company, Cleveland, Ohio.

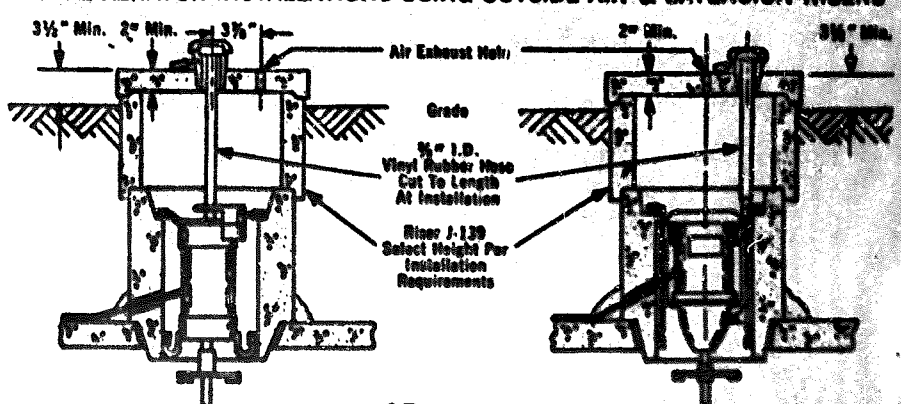
☐ **360-S:** The aerator mechanism shall be a Jet Model 360-S, complete with ⅙ HP, 115 volt, 60 cycle, split-phase motor (totally enclosed, non-ventilated, ball-bearing construction) and stainless steel shaft with a PVC plastic aspirator, corrosion-proof foam restrictor and direct, close-coupled, ball-bearing, stainless steel drive mechanism as manufactured by the Jet Aeration Company, Cleveland, Ohio.

Plant Capacity

The net holding capacity of the plant (3 compartments) shall be not less than 1200 gallons. The aeration and clarification compartments shall have a combined net holding capacity of 725 gallons.



OPTIONAL AERATOR INSTALLATIONS USING OUTSIDE AIR & EXTENSION RISERS



Tank

The three-compartment reinforced concrete tank shall be furnished complete with all baffles, partition walls, aerator, surface skimmer, tube settler, mounting casting, riser (if needed), access openings, covers and fittings as manufactured under license and specifications of the Jet Aeration Company, Cleveland, Ohio. Tank reinforcing shall be according to ACI Standard 318-71.

Control Panel

Each unit shall be furnished with one 30-ampere capacity control panel, factory pre-set to automatically program the aerator off-on cycle. The controls shall also contain motor overload protection and a neon operation indicator light.

Installation

Installation of the plant and its components shall be performed under the supervision of a technician employed by the local licensed factory-trained Jet distributor.

The system shall be installed so that water softener backwash and roof drain runoff does not enter the plant.

FIELD PROVEN AND NSF TESTED

The Jet plant has been thoroughly proven in the field and tested by private and governmental organizations including The National Sanitation Foundation. During extensive tests the plant produced an effluent with an median 5 day BOD concentration of 19 PPM and suspended solids concentration of 25 PPM.

The NSF Seal Of Acceptance listing number is 8092. Detailed test results are available upon request.

HOW PLANT FUNCTIONS

The Jet plant employs a bio-chemical action in which aerobic bacteria, using the oxygen in solution, break down and oxidize household sewage. Its patented design incorporates three separate compartments, each performing a specific function in the total purification process.

The primary treatment compartment receives the household sewage and holds it long enough to allow solid matter to settle to the sludge layer at the tank's bottom. Here anaerobic bacterial action continuously breaks down the sewage solids, both physically and bio-chemically, pre-treating and conditioning them for passage into the second or aeration chamber.

In the aeration chamber the finely divided, pre-treated sewage from the primary treatment compartment is mixed with activated sludge and aerated. The Jet Aerator circulates and mixes the entire content while injecting ample air to meet the oxygen demand of the aerobic digestion process.

The Jet control panel is factory-set to automatically cycle the aerator's running time each day. This setting will handle the normal range of plant conditions. If unusual conditions or health regulations require it, the aerator's running cycle can be increased to full-time operation with no loss of unit life. When running, the Jet aerator uses significantly less power than that consumed by most other home appliances such as a TV, refrigerator, etc.

The final phase of the operation takes place in the settling/clarifying compartment. In this compartment a tube settler eliminates currents and enhances the settling of any remaining suspended material which is returned, via the tank's sloping end wall, to the aeration chamber for further treatment. A non-mechanical surface skimmer, operated by tank roll, continuously skims any floating material from the surface of the settling compartment and returns it to the aeration compartment. The odorless, clarified liquid flows into the final discharge line through the baffled outlet.

EFFLUENT DISPOSAL SIMPLIFIED

Effluent disposal must conform with the requirements of the Health Authorities having jurisdiction. Normally, the highly treated Jet effluent eliminates the need for leaching fields or subsurface filters. In most areas, Jet effluent is discharged to a storm sewer, flowing stream, or any well-defined line of drainage.

OPTIONAL TERTIARY FILTER

In areas where the unusually high treatment level of the Jet Plant is not enough, effective tertiary treatment can be provided by the Jet Upflow Filter. Tests have shown the Jet filter, when used with the Jet home plant, produces effluent averages of 11 PPM BOD and 10 PPM SS. See the "Jet Home Plant Upflow Filter" brochure for additional information and filter specifications.

OPTIONAL CHLORINATION

Effluent chlorination is available for all Jet Home Plants. The separate Jet Chlorinator can be added after the plant alone or, if the filter is used, a chlorination option can be included in it. See the "Jet Home Plant Effluent Chlorination" brochure for additional information and chlorinator specifications.

LOCATION

The Jet plant may be located in the same position relative to the house and water supply as any sewage treatment plant. It must be located so that ample fall is provided to the point of discharge, and there is no possibility of the outlet becoming blocked. Normally the tank is placed below the finished grade. Riser tops should extend two inches above the finished grade.

CUSTOMER PROTECTION PROGRAM

2-Year Guarantee: The Jet Models 360-S and 460-FP Aerators are guaranteed against defective material and workmanship, under normal service, for 2 years from date of installation.

The Jet Model 460-FP Aerator is further guaranteed against damage by flooding for 2 years from date of installation.

Free 2-Year Inspection Policy: For the first 2 years after installation, the Jet distributor provides a free Inspection Policy. This extra assurance is simply a follow-up to make sure the plant is "off on the right foot," since there is no need for periodic lubrication, adjustment, or owner maintenance. After the first two years, this policy may be renewed annually for a nominal charge.

50-Year Warranty: Jet's 50-year warranty program sets a ceiling on repair charges. After the initial 2-year guarantee period, any unit up to 50 years of age, regardless of condition may be exchanged for a newly guaranteed aerator for a fixed cost.

Questions to ask before choosing a Home Aeration Plant.

Q.	JET PLANT	OTHER PLANT
Is plant backed by a national company?	Yes. Jet sells its plants throughout the U.S. and in foreign countries.	?
How does company rank in home sewage treatment plant field sales?	No. 1.	?
Has company had sufficient field experience with its plant?	Yes — the Jet plant is field-proven in tens of thousands of installations since 1955.	?
Is the company reputable?	Yes. Jet was established in 1955, pioneered development of home sewage treatment plant, is a strong company, well-regarded by health officials, distributors, customers.	?
Has plant been tested by National Sanitation Foundation?	Yes. Jet plants carry NSF Seal of Acceptance No. 8092.	?
Does plant have simple trouble-free design?	Yes.	?
Is plant sold and serviced by a dependable local businessman?	Yes. And local Jet distributors are licensed, factory-trained, always available.	?
Is plant reasonably priced?	Yes — about the same or less than a septic tank system, depending on area.	?
Is plant economical to operate?	Yes.	?
Must owner perform plant maintenance?	No.	?
Does mechanical unit have long, maintenance-free life?	Yes. Jet aerators have by far the lowest maintenance and repair rate of any plant on market.	?
Does company stand behind its product?	Yes. The Jet aerator has a two-year limited warranty, 20-year exchange program.	?
Is the company financially sound enough to stand behind its warranty?	Yes. Check our Dun & Bradstreet rating — we're proud of it.	?

The Company Behind The Products.

From its founding in 1955, Jet has developed steadily at a high annual growth rate. The company is solidly established as a leader in the pollution control field. Forward-looking as well as fast-growing, Jet adds new patents and products each year, broadening its lines as its research points the way with new developments. Jet has the longest successful experience of any company in the home plant field.

YOUR LOCAL JET DISTRIBUTOR IS . . .

LICENSED DISTRIBUTOR

RESIDENTIAL SEWAGE TREATMENT CO.
801 Broadway, Kansas City, Mo. 64105
Phone: 816 / 421-2983
HOME AERATION SYSTEMS, INC., Managing Partner

SINCE 1955...
QUALITY-PLUS POLLUTION CONTROL

JET QUALITY . . . PLUS LOCAL SOURCE, LOCAL SUPPORT, LOCAL SERVICE

Jet Aeration Co. • 750 Alpha Drive • Cleveland, Ohio 44143 • U.S.A. • Phone 216/461-3100
Cable: JET

Field-Proven, Accepted.

The patented, carefully engineered Jet plant with its advanced treatment process has been providing dependable sewage treatment for individual homes since 1955, when Jet pioneered the home plant field. The plant has been field-proven in tens of thousands of installations across the U. S. and in foreign countries, and has won enthusiastic approval from health officials, builders, and homeowners.

Jet plants meet or exceed all criteria for evaluating and testing household aerobic sewage treatment systems as recommended in the National Academy of Sciences–National Research Council Report 586. This report gives the results of a study made for the U. S. Public Health Service. The purpose of this study was to develop criteria for evaluating and testing individual household aerobic sewage treatment systems.

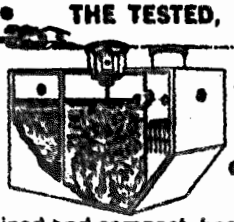
The plant underwent a 7-month test by the National Sanitation Foundation and received the NSF Seal of Acceptance.

The Veterans' Administration has declared the Jet home plant acceptable for its insured home loans. FHA approval is secured regionally; when FHA previously issued central approval from Washington for aeration plants, the Jet plant had blanket FHA eligibility. In addition, Jet plants have been sold to the U. S. Army Corps of Engineers, U. S. Navy, U. S. Post Office, and many other state and federal agencies where top quality specifications are strictly adhered to.

Health Authorities Want Complete Dependability.

Health authorities want complete dependability in a home aeration plant and Jet supplies it! Lots of home aeration plants can look good on the drawing board and in the laboratory, but health authorities need to know that the plant and the plant backup are completely dependable in the field — year in, year out. Jet's history, product record and policies have convinced health officials that Jet is a plant they can really depend on.

1. THE TESTED, FIELD-PROVEN JET PLANT.



• **Since 1955.** The carefully engineered Jet plant, self-contained and compact, has been providing homeowners with dependable sewage treatment since 1955 — a statement no other home plant manufacturer can make.

• **Consistent, High Quality Effluent.** Tests and field experience have proven that Jet plants consistently produce a high quality effluent under a broad range of loadings and temperatures.

• **Comprehensive Owner's Manual.** Even though plant operation is automatic and the homeowner is required to do nothing about plant maintenance, he is given an informative owner's manual so he will understand the workings of his plant, be aware of its guarantees and warranties, and know the importance, to himself and the community, of keeping his plant in top condition.

• **Product of Established Company, Pioneer and Leader in Field.** Because of its proven quality and dependability more health authorities and consumers choose a Jet plant each year than all other makes combined.

2. THE LOCAL LICENSED FACTORY-TRAINED JET DISTRIBUTOR.

He sells, installs, stands behind, and services the Jet plant.

• **Reliable Source.** Jet plants are sold only through licensed distributors — established, carefully selected local businessmen who meet the high standards of workmanship and service set by Jet Aeration Company. These businessmen have an interest, investment, and reputation in the community. They stand behind their Jet plants.

• **Factory-Trained Servicemen.** Local servicemen receive in-the-field training by Jet's factory engineers. In addition, Jet holds a Factory Training School at its Cleveland, O., factory several times each year. Attendance at one or more school is required of distributors.

• **Businesslike Backup.** The Jet distributor keeps careful records of installations, inspections, and service. He maintains a stock of parts for maintenance and emergency repairs. He provides prompt service whenever needed.

3. JET'S STRONG OWNER PROTECTION PROGRAM. Backing by the No. 1 company in the industry.

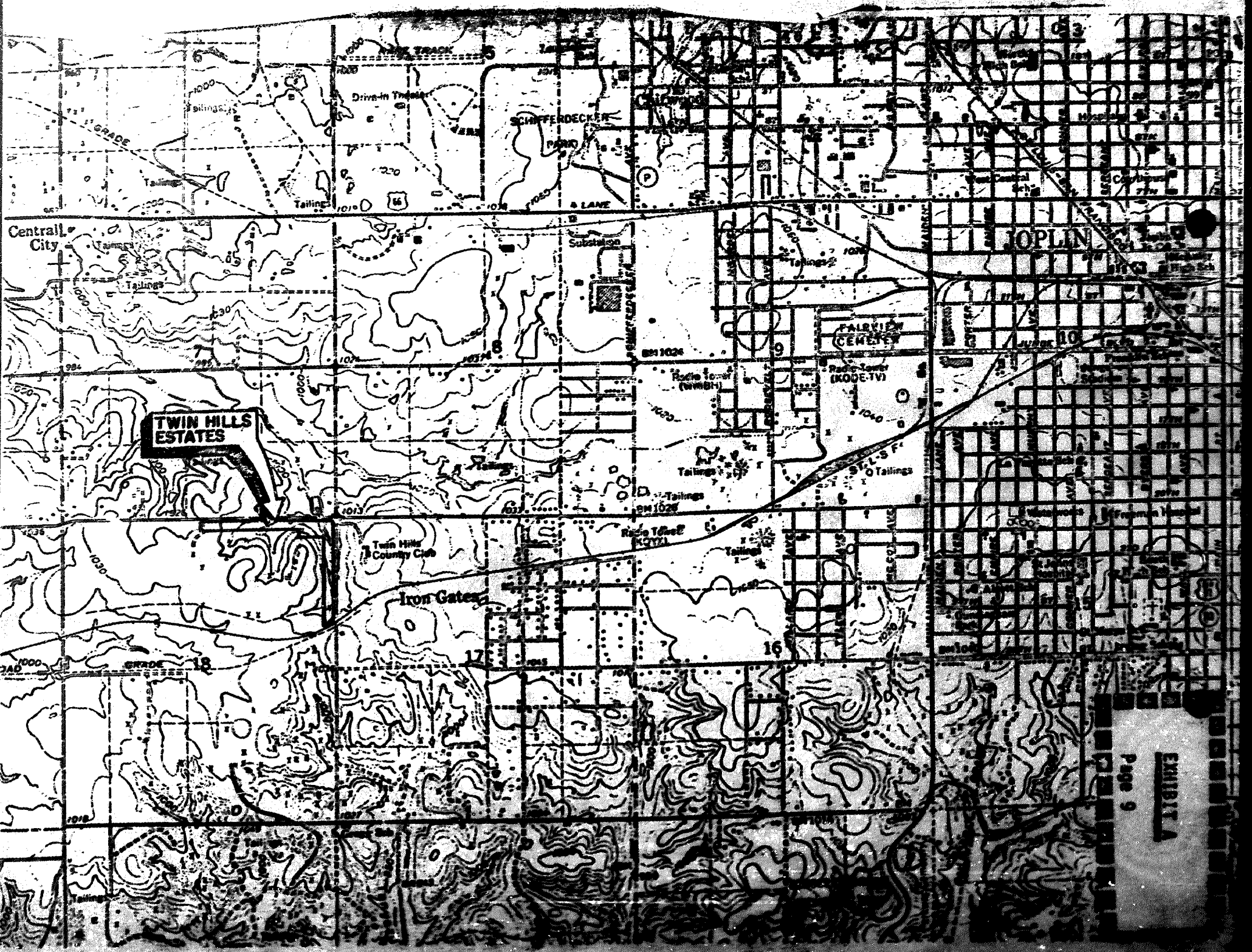
• **Two-Year Limited Warranty.** The Jet aerator carries a limited warranty against defective material and workmanship, under normal service, for two years from installation. It will be repaired or replaced without charge during this period.

• **Twenty-Year Exchange.** Sets a ceiling on aerator replacement cost for 18 more years after initial warranty expires. For a fixed cost, any aerator up to 20 years of age, regardless of condition, may be exchanged for a newly warranted replacement aerator. The price for this exchange is pro-rated against the unit's length of service at a cost the homeowner can afford.

• **Free Two-Year Inspection Policy.** For the first two years, the Jet distributor regularly inspects the new plant without charge. No charge is made for labor or service if required during this time.

• **Continued Inspection Policy.** After the initial two years, the homeowner can take out an annual inspection policy with the distributor for a nominal charge if he wishes.

4. TO SUM UP, OVER 20 YEARS OF EXPERIENCE HAS SHOWN THAT A SOLID HOME SEWAGE TREATMENT PLANT BACKED UP BY A CONCERNED LOCAL DISTRIBUTOR CAN PROVIDE AN EFFECTIVE, DEPENDABLE SEWAGE TREATMENT PROGRAM FOR THE COMMUNITY.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SCHIFFERDECKER PARK
FAIRVIEW CEMETERY
Radio Tower (KODE-TV)
Twin Hills Country Club
Iron Gate
Substation
Tailings
EXHIBIT A