Valley Center Municipal Water District

DESIGN GUIDELINES AND SPECIFICATIONS FOR PRIVATE ON-SITE LOW PRESSURE WASTEWATER COLLECTION SYSTEM FACILITIES

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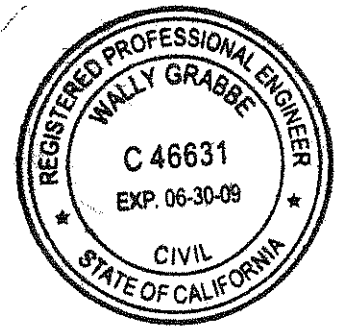
The following "Design Guidelines and Specifications for Private On-site Low Pressure Wastewater Collection System Facilities" was approved by the Board of Directors on August 20, 2007, by Resolution No. 2007-37, and replaces the "Standard Specifications for Construction of S.T.E.P. Systems" adopted June 1996.



VALLEY CENTER MUNICIPAL WATER DISTRICT

By: _____
Gary T. Arant, General Manager

By: _____ 8.21.07
Wally T. Grabbe, District Engineer

By: _____ 8/21/07
A. Gregory Hoyle, Director of Operations

Valley Center Municipal
Water District's

Design Guidelines and Specifications For Private On-site Low Pressure Wastewater Collection System Facilities

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INTRODUCTION

Valley Center Municipal Water District (VCMWD) requires the use of a low pressure wastewater collection system in specific areas. Due to the advancement in available technology, these design guidelines and specifications have been created to replace the Standard Specifications for Construction of S.T.E.P. Systems, adopted June 1996. This manual provides requirements for the application and installation of the private pump systems required for connection to the District's low pressure wastewater collection systems.

WASTEWATER SERVICE AREAS

(VCMWD) has two different types of wastewater service areas within the district limits, the Gravity Wastewater Collection Systems and the Low Pressure Wastewater Collection Systems (LPCS). The Gravity Wastewater Collection Systems include Woods Valley, Circle R, Lawrence Welk Resorts, Champagne Village, Hidden Meadows, and the Islands developments (see section 2). The Low Pressure Wastewater Collection System includes the areas known as Rimrock, Welcome View, High Vista and High Mountain as shown in the public service area maps (see section 2).

With anticipated development within the district, these service areas will be modified and expanded accordingly. Future developments such as Orchard Run, which will expand on the Woods Valley gravity system and treatment facilities and Live Oak Ranch which will construct its own treatment facility for the gravity system to be installed. As well, Lilac Ranch will install a treatment facility for its anticipated gravity collection system.

LOW PRESSURE WASTEWATER COLLECTION SYSTEMS (LPCS)

Within the Valley Center Municipal Water District (VCMWD) certain portions of the service area have been designated for use of a Low Pressure Wastewater Collection System (LPCS) consisting of public and private facilities. In these designated areas each home is required to have an on-site pumping unit with a small diameter collection line connecting to the VCMWD system. The District has determined that the Environmental One (EOne) system which contains a grinder pump, a wet well (squat), and a control panel will be utilized in the designated LPCS areas (see section 3-5). VCMWD requires each system to be obtained and installed through a licensed contractor which must be approved by the District. For information on purchasing this system please contact Engineering Services at (760) 749-1600. Each installation will be made in accordance with these specifications and will be inspected by VCMWD staff. Each installation shall be accomplished as shown in the manufacturer's instructions, except as modified in this specification. Hydraulic design shall be in accordance with E/One Corporation recommendations.

OWNERSHIP AND CONTROL

Within the LPCS areas, the wastewater treatment plant and wastewater collection mains, generally in the public rights-of-way and utility easements, are owned and operated by VCMWD. The wet well, pump, electrical facilities, and discharge line on private property are owned by the individual property owner. VCMWD requires these privately owned facilities to conform to their specifications to assure the continued safe, sanitary, and economical operation of the VCMWD system. The owner will be responsible for making arrangements for the cost of installing, maintaining, and repairing these facilities in accordance with the VCMWD Administrative Code.

INITIAL PROCEDURE

I. The property owner or his agent must pay wastewater fees to VCMWD in accordance with the District's Administrative Code. Normally this is done at the same time water and wastewater service is arranged. There will be a wastewater capacity charge and Low Pressure Wastewater Collection System Administration and Inspection Fee for a new installation.

II. The applicant shall provide two copies of the plot plans for the property reflecting the on-site facilities to be installed.

III. After installation and inspection of on-site facilities has been completed, the current monthly service will be charged.

A. ***Plot Plan:*** *(Owner / Applicant Responsibility)*

1. Plans shall be accurately scaled drawings that contains the following information:
   - Topography of the lot or building area.
   - All proposed improvements, buildings, underground piping and surface features that may impact the installation of wastewater facilities (i.e.) (Walls, Driveways, Patios, Pool, Electrical, Water, wastewater facilities & Drains).
   - Wet Well: The Owner / Applicant shall install the required size of the wet well based on VCMWD requirements and all pertinent information should be shown on the plot plan (see section 4).
     (1) The tank must be accessible, such as, near a driveway
     (2) Landscaped area is acceptable
     (3) 2% minimum gravity flow from the home to the tank
     (4) 10 foot clearance from permanent structures, drainage swales, cut or fill slopes and fences
     (5) 5 foot clearance from property lines and easements
     (6) Line from home to tank should be as short as practical
   - Private Service Line:
     (1) 10 foot minimum clearance from potable water lines

(2) 5 foot minimum clearance from fences, property lines, easements or other utilities (if approved by the Utility Co.)
(3) 5 foot minimum clearance from permanent structures
(4) May be installed under a driveway, but if leak occurs, the driveway must be dug up to fix the pipe at the owners expense

- Electrical Panel / Alarm Disconnect:
  (1) Must be accessible and located within 5 feet of the pump on a permanent fixture (i.e., 4x4 wood post or wall)
- Meet at site with a VCMWD Inspector (If Needed)
- Changes:
  (1) All changes must be approved in advance and shown on a revised plot plan

B. ***Equipment and Materials:*** (Owner / Applicant Responsibility)

1. The Owner / Applicant will purchase the following materials:
   - Wet well - Owner / Applicant to determine size based on VCMWD requirements
   - Alarm / Disconnect Panel - The panel shall be ordered with a push to silence switch feature
   - Pumping Unit

C. ***Construction and Inspection:*** (Engineering Construction & Inspection)

1. Owner / Applicant shall hire a private contractor that has been pre-approved by the District.
2. No inspection can be made until:
   - All fees are paid
   - The completed application along with the county traffic control plan, the excavation permit, and the contractor's proof of insurance has been received
   - A plot plan drawing has been approved by VCMWD
3. The connection between the home and the tank will not be permitted until all construction work is completed and the as-built plot plans have been received. If unauthorized connection is made, the tank will be required to be pumped out and cleaned of construction debris prior to activation of the pumping unit. Upon written approval of the VCMWD Inspector, connection of the private line from the house to the wet well can be made by the contractor.
4. Owner / Applicant must contact VCMWD at least 24 hours in advance for inspection of the following:
   - Tank and backfill material
   - Service line location when trench has been excavated and line has been constructed but not backfilled
   - Pump has been installed
   - System is ready to operated
5. Owner / Contractor shall notify a VCMWD Inspector 24 hours prior to testing. The Inspector must witness a successful pressure test on the service line and a start-up of the system.

ACTIVATING THE SYSTEM

For proper activation of the system make sure all gate valves are fully open. Turn the pump on to measure and record the pressure on the discharge of the pump. Add water to the tank for at least one cycle of pumping to verify proper operation of all components. Upon written approval of the VCMWD Inspector, connect the house line to the wet well or grinder pump. Upon completion, a copy of the data sheet is to be provided to VCMWD as well as the signed and dated warranty information to be filed with the district.

CONTROL PANELS

Each grinder pump station shall include a NEMA 4X, UL-listed alarm panel suitable for wall or pole mounting. The NEMA 4X enclosure shall be manufactured of thermoplastic polyester to ensure corrosion resistance. The enclosure shall include a hinged, lockable cover with padlock, preventing access to electrical components, and creating a secured safety front to allow access only to authorized personnel. The following manufacturer installed option shall be provided:

- Environment/One Sentry Simplex PreStat Panel including:
  - 240 V service
  - Programmable Auto Dialer

- Protection Package, consisting of:
  - Run Dry Protection w/ Trouble Indication
  - High System Pressure Protection w/ Trouble Indication

VCMWD WASTEWATER MAIN LINE INDEX MAP

TO TEMECULA

PAUMA VALLEY

ESCONDIDO

The Treasures

The Meadows

Woods Valley Ranch

Escondido Woods

MAP 1

MAP 2

Gravity Pressure Wastewater

Low Pressure Wastewater

Valley Center Municipal Water District

July 31, 2007
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Source: SanGIS(Base Layers), VCMWD

MAP 1

N
W E
S

PRIVATE RD
GORDON HILL RD
WELK HIGHLAND LN
GORDON HILL RD
VISTA ALETA
GORDON HILL RD
CALLE DE LA REINA
PRIVATE RD
MTN MEADOW RD
PRIVATE RD
WELK VIEW DR
WELK VIEW DR
CANYON COUNTRY LN
MTN MEADOW RD
RESORT SUMMIT DR
AMBERGLEN DR
MOONWIND CR
RIMROCK SUMMIT LN
CRESTRIDGE CT
LENNON LN
MEADOW MESA DR
OAK RIDGE RD
MEADOW MESA LN
FAIRWAY HILL CR
MISTY MEADOW LN
WELK HIGHLAND DR
CIELO VISTA
CHAMPAGNE BL
PRIVATE RD
PRIVATE RD
PRIVATE RD
YELLOW PINE CT
LAN LN
SYCAMORE LN
PRIVATE RD
ESQUIRE
PRIVATE RD
W MEADOW GLEN WY

Gravity Pressure Wastewater
Low Pressure Wastewater

Valley Center Municipal Water District

July 31, 2007
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Source: SanGIS(Base Layers), VCMWD

MAP 2

N
W E
S

CHAMPAGNE BL
SYCAMORE LN
PRIVATE RD
ESQUIRE
PRIVATE RD
YELLOW PINE CT
PRIVATE RD
PRIVATE RD
PRIVATE RD
PRIVATE RD
PRIVATE RD
CHAMPAGNE BL
PRIVATE RD
I-15 NB
W MEADOW GLEN WY
MEADOW MESA LN
ANDERSON CT
ROCKY RIDGE RD
ROYAL RIM DR
W MEADOW GLEN WY
HAPPY LILAC TL
BOULDER KNOLLS RD
W MEADOW GLEN WY
WELCOME VIEW
PRIVATE RD
SAGE HILL WY
GIANT ROCK LN
SANDHURST WY
GLENMEADE WY

Gravity Pressure Wastewater
Low Pressure Wastewater

Valley Center Municipal Water District

July 31, 2007
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Source: SanGIS(Base Layers), VCMWD

DATA TAKEN FROM PLANS AND DRAWINGS
BY PIRO ENGINEERING,
SAN MARCOS, CA.

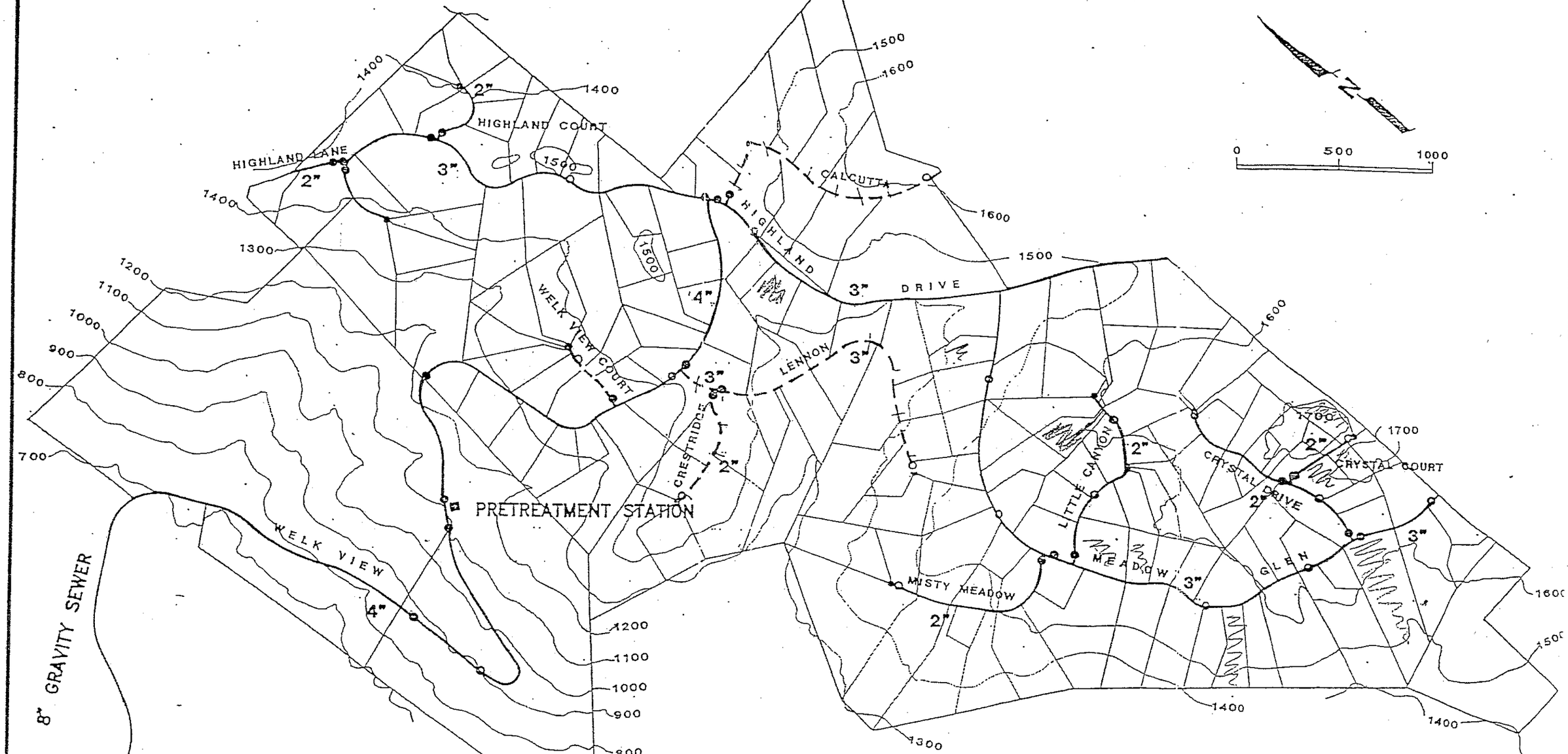


Figure 2

RIMROCK	VALLEY CENTER MUNICIPAL WATER DISTRICT	W.C. BOWNE CONSULTING ENGINEER EUGENE, OREGON AUG. 1989	SYSTEM ANALYSES PLAN	sheet 1 of 4

DU 30
Q 45gpm
S 0.6%
V 2.0fps

DU 109 — Number of dwelling units
Q 85 — Discharge, gpm
S 2.0 — Slope of energy gradient, %
V 3.9 — Velocity of flow, fps

Q = DU/2 + 30 gpm

Hazen–Williams C = 140

Energy gradients shown do not account for head losses due to air.

Velocities shown are based on full pipe flow.

o — Air release station

DU 49
Q 55gpm
S 0.90%
V 2.5fps

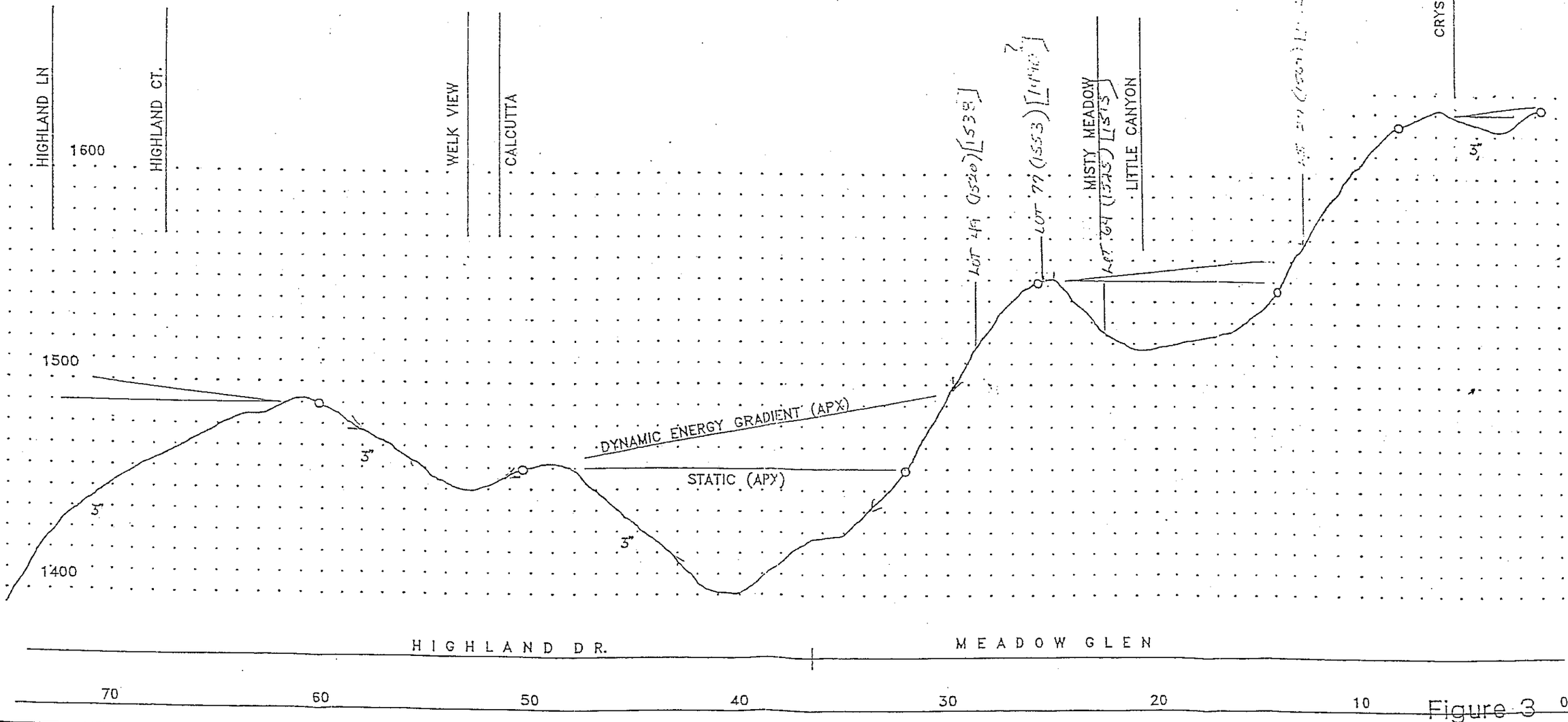
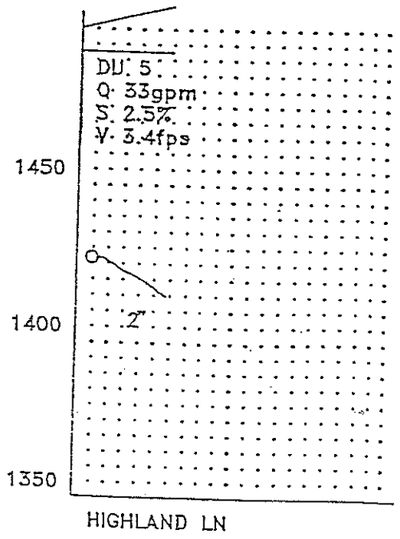
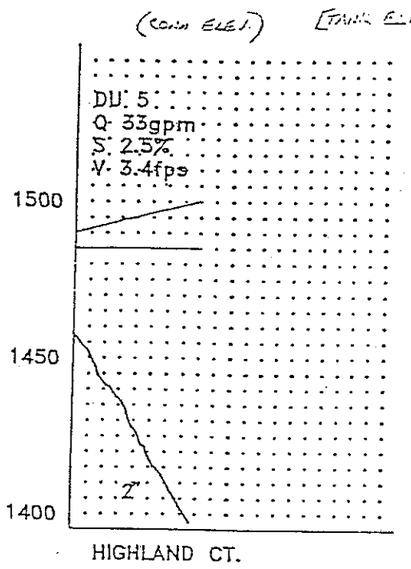
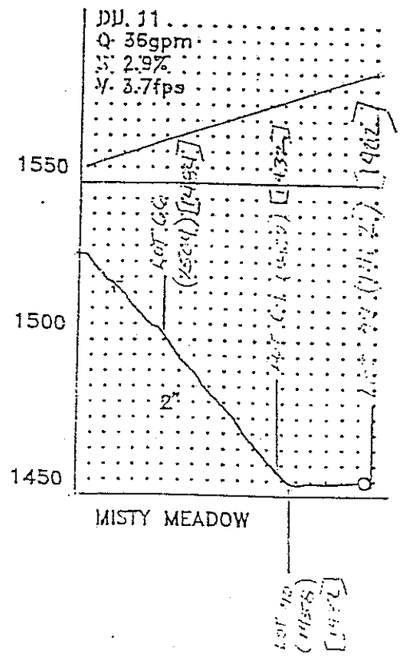


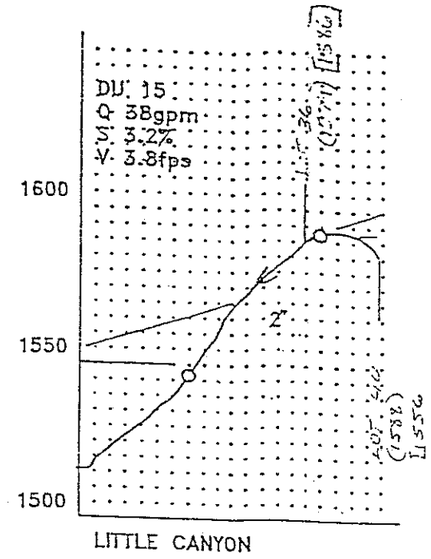
Figure 3

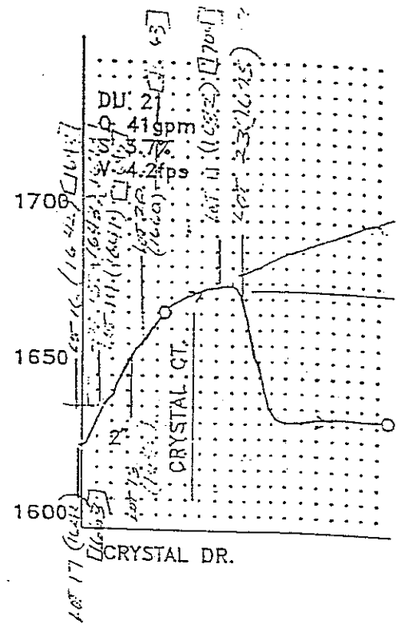
RIMROCK	VALLEY CENTER MUNICIPAL WATER DISTRICT	W.C. BOWNE CONSULTING ENGINEER EUGENE, OREGON	AUG. 1989	SYSTEM ANALYSES PLAN	sheet 2 of 4

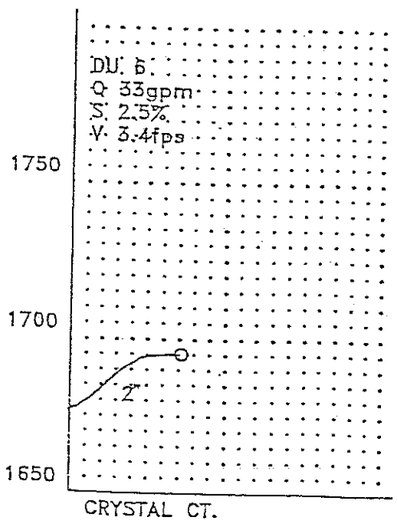


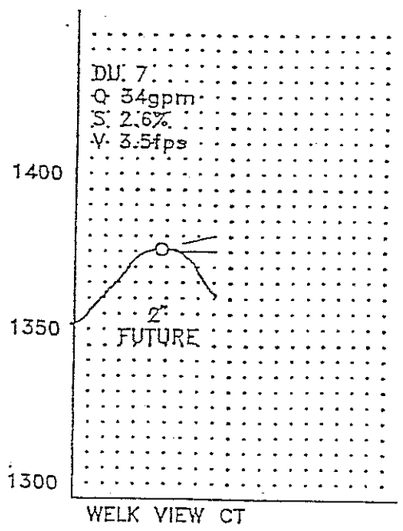


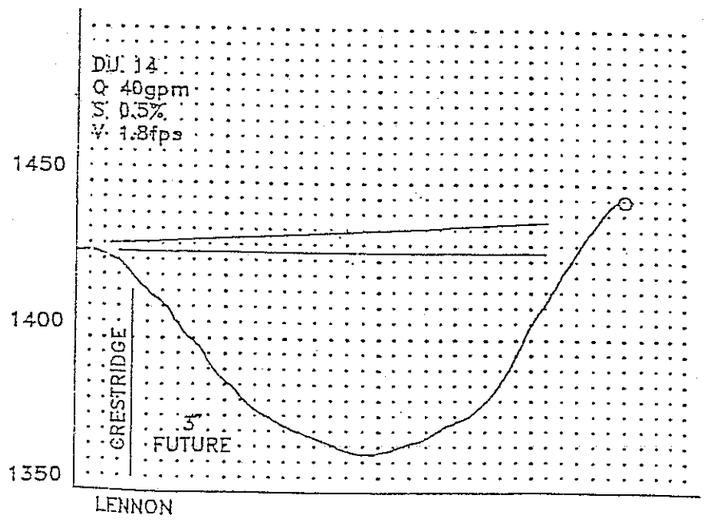


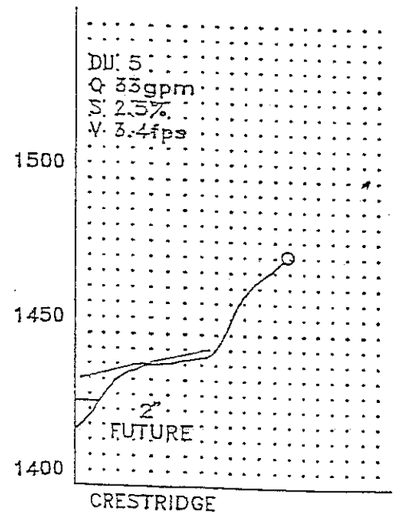












RIMROCK	VALLEY CENTER MUNICIPAL WATER DISTRICT	W.C. BOWNE CONSULTING ENGINEER EUGENE, OREGON	AUG, 1989	SYSTEM ANALYSES PLAN	sheet 3 of

Figure

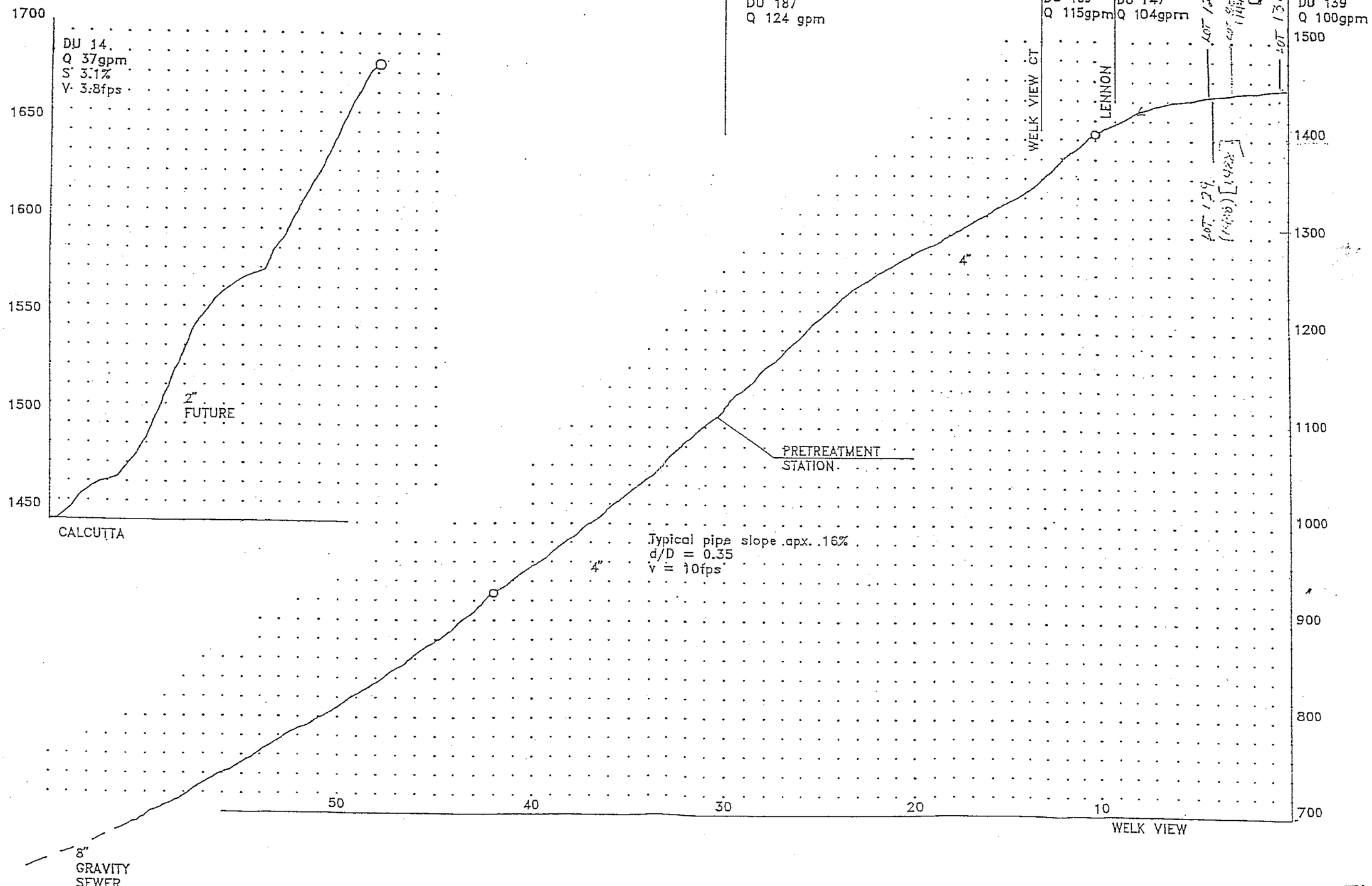
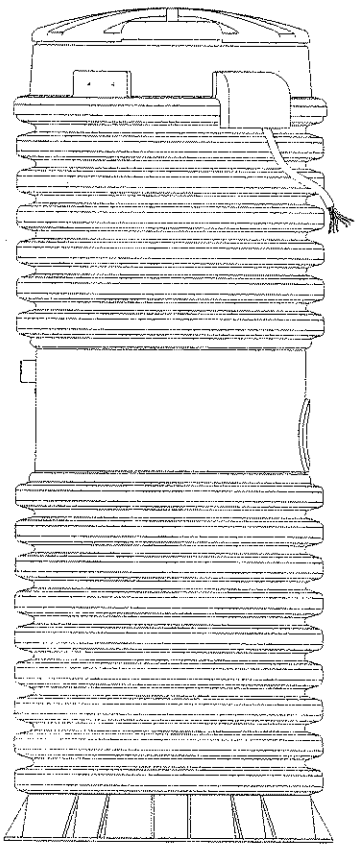


Figure 5

RIMROCK	VALLEY CENTER MUNICIPAL WATER DISTRICT	W.C. BOWNE CONSULTING ENGINEER EUGENE, OREGON AUG. 1989	SYSTEM ANALYSES PLAN	sheet 4 of 4

E/ONE EXTREME SERIES



Low Pressure Sewer Systems Using Environment One Grinder Pumps

Contents

Introduction

E/One low pressure sewer (LPS) systems offer the designer new freedom in solving many problem situations that have defied reasonably economical solutions using the conventional approach.

Each LPS system design should be considered on the basis of its own unique circumstances. On such a basis, a sound choice between gravity and low pressure systems can be made.

General criteria aid the engineer in making a preliminary choice between several alternative systems: entirely low pressure, entirely gravity, entirely vacuum or a combination of systems. These criteria are presented and are intended to serve as a general guide. The final decision and design are the responsibility of the project consulting engineer, whose knowledge of local conditions, including construction costs, regulatory requirements and the client's particular needs, become vital to the preparation of the final designs and specifications.

Advantages of LPS Systems

LPS systems have low initial (front end) cost compared to gravity systems, which have nearly all the total investment allocated in the first stage. With the LPS system, grinder pump costs are incurred only as construction progresses. These costs will be deferred for many years in certain types of development programs.

An LPS system is not subject to infiltration from ground water or from surface storm water entering through leaking pipe joints and manholes. With zero infiltration, treatment plants need not be sized to handle the peak flow rates caused by infiltration. Treatment efficiencies can be more consistent, and treatment plant operating costs decrease.

An LPS system may become the critical factor in determining whether "marginal" land can be economically developed. Many attractive sites have been considered unsuitable for development because of the excessive costs typically associated with conventional sewer systems — sites with hilly terrain, land with negligible slope, high water tables, poor percolation characteristics, rock, seasonal occupancy or low population density.

Many communities are planning to convert from septic tanks to central sewage collection and treatment systems to minimize health hazards and/or environmental deterioration. The major reduction in cost and the simplicity of installation of an LPS system have strong appeal for such community improvement programs. Small-diameter pipe pressure mains can be laid along existing roadways with minimum disruption to streets, sidewalks, lawns, driveways and underground utilities. Surface restoration costs are similarly minimized. Sewage delivered to the treatment plant (because it contains no infiltration) is more uniform in "strength," the volume is smaller, and peaks are greatly reduced.

Description and Operation

Grinder pumps of approved design accomplish all pumping and sewage-grinding processes for small-diameter LPS systems.

The system consists of conventional drain, waste and vent (DWV) piping within the residence connected to the grinder pump inlet. The grinder pump may be installed above or below grade, indoors or outdoors. Depending on flow factors and model used, it may serve one or more resi-

dences, or several families in the case of apartment buildings.

Grinder pumps discharge a finely ground slurry into small–diameter pressure piping. In a completely pressurized collection system, all the piping downstream from the grinder pump (including laterals and mains) will normally be under low pressure. Pipe sizes will start at 1 1/4 inches for house connections (compared to 4 or 6 inches in gravity systems) and will be proportionally smaller than the equivalent gravity pipeline throughout the system. All pipes are arranged as zone networks without loops.

Depending on topography, size of the system and planned rate of buildout, appurtenances may include valve boxes, flushing arrangements, air release valves at significant high points, check valves and full-ported stops at the junction of each house connection with the low pressure sewer main.

Pump Operation

Low pressure sewer systems have become feasible with the availability of the Environment One grinder pump, the reliability of which has been proven in almost 40 years of service. The grinder pump station provides adequate holding capacity, reliable grinding and pressure transport of a fine slurry to an existing gravity sewer, pump station or directly to a wastewater treatment plant.

In operation, the grinder pump station will handle sewage and many items that should not, but often do, appear in domestic wastewater. For example, plastic, wood, rubber and light metal objects can be routinely handled without jamming the grinder or clogging the pump or piping system. The grinder pump will discharge this slurry at a maximum rate of 15 gpm or 11 gpm at a pressure of 40 psig. Transporting sewage several thousand feet to a discharge point at a higher elevation is possible as long as the sum of the static and friction losses does not exceed design limits of 185 feet TDH (80 psig).

The grinder pump is actuated when the depth of the sewage in the tank reaches a predetermined "turn-on" level, and pumping continues until the "turn off" level is reached. The pump's running time is short, power consumption is low, and long pump life is ensured. The unit is protected against backflow from discharge lines by an integral check valve. Several grinder pump station models are available to satisfy various total and peak demand conditions.

Pump Type

The semi-positive displacement pump in the grinder pump station has a nearly vertical H-Q curve. This is the best type of pump for successful parallel operation of many pumps into a system of common low pressure mains. Since each pump will be located at a different point along common low pressure mains and at various elevations, each pump should operate in an efficient and predictable manner, whether one pump or numerous pumps are operating at a given moment; the pumps in such a system do not have a single fixed "operating point," but must operate consistently over a wide range of heads that are continually, and often rapidly, changing.

The Environment One grinder pump has the capability of operating above the LPS system design criteria of 80 psig, or 185 feet (Figure 1). Based on the maximum daily number of pumps operating simultaneously (Table 3) versus the number of pumps connected to the system at the design pressure of 185 feet, the capability to operate significantly above the system's design pressure is mandatory in order for the system to operate properly during the approximately bimonthly peaks when

the "absolute maximum" numbers of pumps are operating. This feature also ensures that pumping will continue under those conditions when higher–than–normal pressure occurs in the pipeline.

System designs with calculated heads approaching the upper limits of recommended heads should be reviewed by Environment One application specialists. Contact your local Environment One Regional Sales Office or authorized distributor for a no-cost, computerized review of your design.

Occasionally during "normal" operation, there will be short periods when higher-than-design pressures will be experienced. These can result from a variety of causes including solids buildup (obstructions) or air bubbles.

Deposits of solids or air accumulation will be purged from the line since the pump continues to produce an essentially constant flow, even though the cross section of the pipeline has temporarily been reduced. Higher velocities through the reduced cross section will provide the scouring action needed to correct such conditions as soon as they start to appear.

These higher–than–expected pressure conditions are transitory occurrences. The only requirement is that no damage be done to the pumping equipment, pipelines or appurtenances during these occasional short periods. Environment One grinder pumps are driven by motors rated for continuous operation at 104 F/40 C above ambient temperature. They can operate at 50 percent above rated pressure for at least 5 minutes without excessive temperature rise. Based on the Albany, New York, demonstration project[4], for this type of overload to last even as long as one minute would be rare.

Motor Selection

A grinder pump station is an electromechanical system that depends on electric power for its operating, control and alarm functions. The design and selection of Environment One's pump, motor, grinder and level–sensing controls were accomplished by optimizing the wastewater transport function of the unit within the necessary constraints for unattended, trouble–free operation in a residential environment.

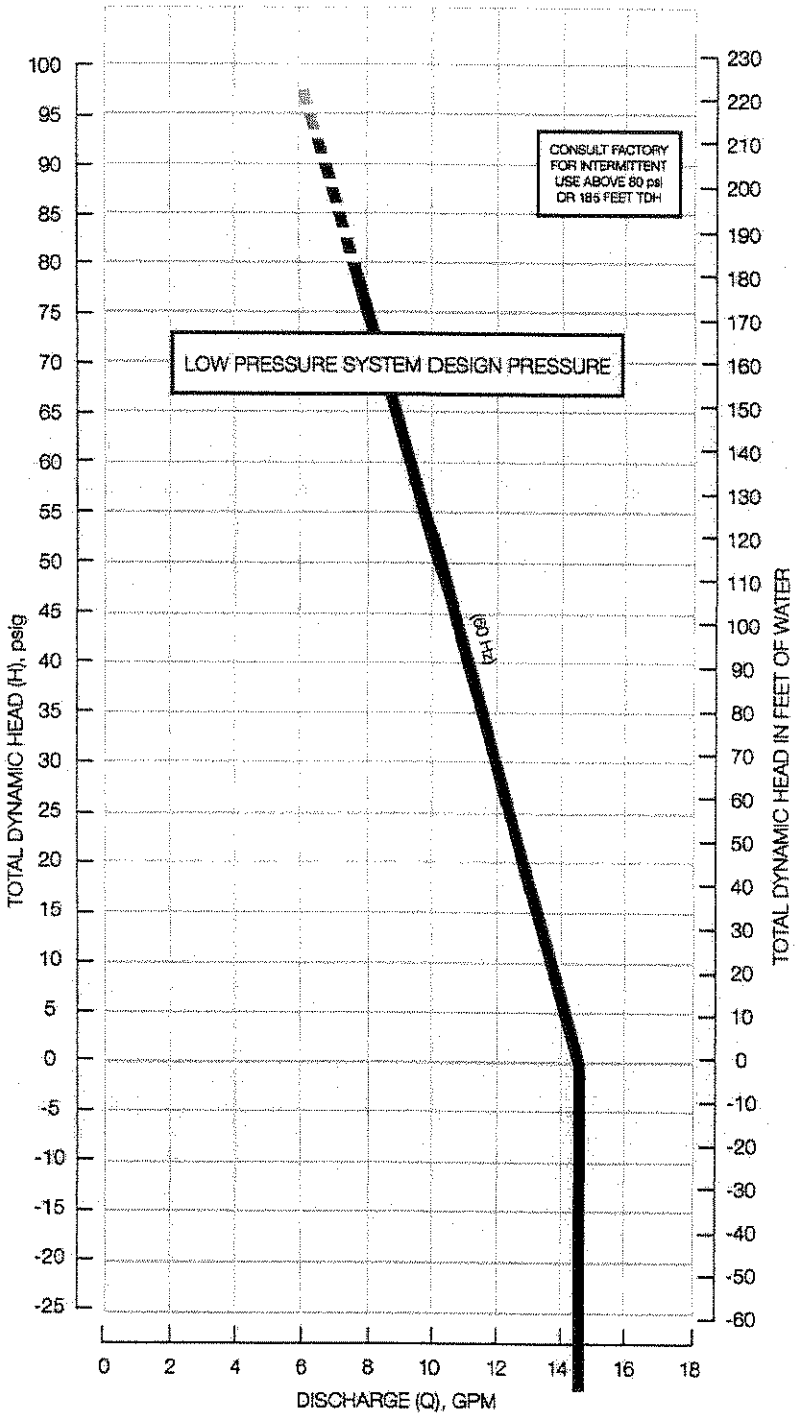
A single grinder pump core is common to all models of Environment One grinder pumps (models DH071, DH151, DH152, DH272 and DH502). This central core contains all of the working and control elements of the unit and is powered by a 1 hp, 240v (or 120v), 1,725 rpm capacitor start, thermally protected induction motor. Each of these motor features was carefully considered in the design of the grinder pump station.

The pump should be considered as a residential appliance. For this reason, performing the grinding and pumping functions using no more than 1 hp to permit occasional use at 120v in older homes not wired for 240v is desirable. In order to achieve the high heads desired and provide constant flow at varying heads, the 1-hp motor is coupled to a pump of semi-positive displacement design (Figure 1).

At a rating of 1 hp and 1,725 rpm, the Environment One grinder pump develops more than 8.4 foot-pounds of torque. Motors used to drive centrifugal pumps are often rated at 2.0 hp at 3,450 rpm and may produce less torque. When handling residential sewage, grinding torque may be demanded during any portion of the starting or running cycle. When the pump stops (controlled by level) in the midst of grinding hard objects (e.g. tongue depressors, plastic items, etc.), it must, upon restarting, be able to provide sufficient torque to the grinder to overcome the resistance of any object remaining from the previous cycle.

Figure 1

Grinder Pump Performance Characteristics



Power Outages

Environment One grinder pump stations have adequate excess holding capacity to provide wastewater storage during most electrical power outages (Figure 2). This excess holding capacity is shown on curve A. Data from the Federal Power Commission on national electrical power outages is plotted as a cumulative distribution function (curve B). Note that only volume above the normal "turn-on" level was counted as available storage. The average flow of 1.54 gallons/hour/person is based on the actual measured flow over a one-year period at the Albany Demonstration Project[4].

The local electrical power utility should be contacted to obtain a history on the power interruptions of the feeder(s) scheduled to serve the low pressure sewer site. From this data, curve B should be replotted to reflect local conditions. In those rare local areas where the frequency and/or the duration of outages exceed 7.5 hours, the use of Model DH151, with its greater holding capacity than that of the DH071, could be considered.

When power has been restored after a power outage, it is likely that nearly all the pumps in the system will try to operate simultaneously. Under these conditions, the dynamic head loss component of the total head will rise significantly. A number of pumps in the system would see a total back pressure high enough to cause the thermal overload protectors to automatically trip in a few minutes. Operation under conditions that could cause damage to the pumps or the system would be avoided. While these pumps are offline, other pumps in the system would be able to empty their tanks. After one to two minutes, the group that tripped off on thermal overload would cool and restart. The system back pressure would have been reduced and the group would be able to pump down normally. This process repeats itself automatically under the influence of each unit's own thermal protector, reliably restoring the system to normal operation.

Power Consumption

Monthly power consumption of a residential grinder pump station is substantially less than that of other major appliances. At 250 gpd per residence, power cost of $0.11 per kwhr and a 1 hp, 75 percent efficient motor pumping at 15 gpm, the cost per month may be calculated as:

$$\text{Cost} = (1*746*0.11*250*30)/(0.75*1000*15*60) = \$0.91 \text{ per month}$$

To this is added the cost of running a 12-watt condensation heater:

$$\text{Cost} = (30*24*0.11*12)/(1000) = \$0.95 \text{ per month}$$

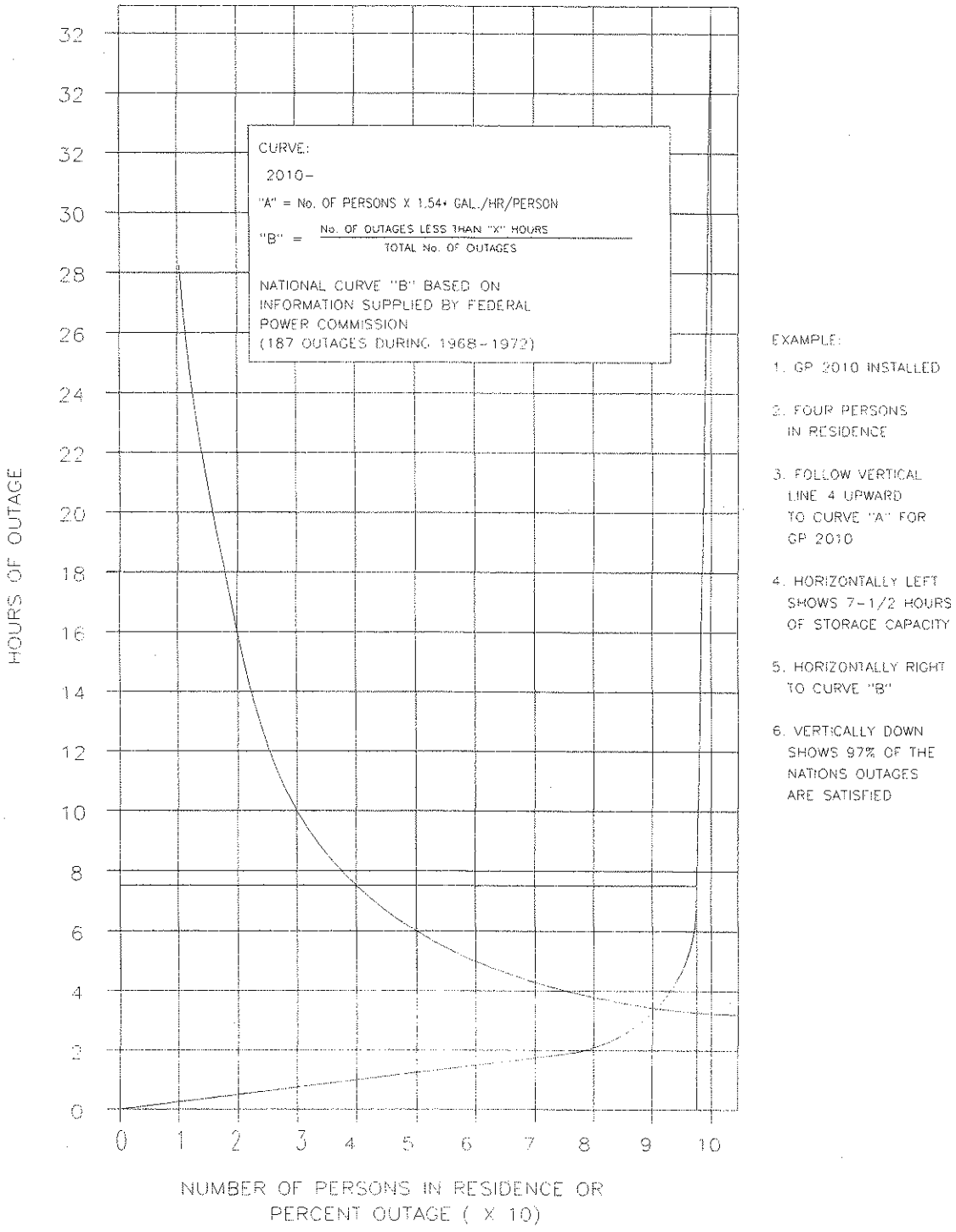
LPS System Design

Once the initial analysis of a project has confirmed the feasibility of using the low-pressure approach, the completion of a preliminary system design is straightforward. This is primarily a result of two characteristics of E/One's semi-positive displacement pump: near-constant flow over the entire range of operating pressures and the ability of the pump to handle transient overpressures.

The balance of this section outlines a systematic approach to LPS system design, leading from pump model and pipe selection to a detailed zone and system analysis.

Figure 2

Relationship of GP Storage Capacity to Power Outage Experience



Information Required

The information that should be assembled prior to initiation of the LPS system design includes:

- Topography map
- Soil conditions
- Climatic conditions (frost depth, low temperature and duration)
- Water table
- Applicable codes
- Discharge location
- Lot layout (with structures shown, if available)
- Total number of lots
- Dwelling type(s)
- Use and flow factors (seasonal occupancy or year-round, appliances, water supply sources)
- Area development sequence and timetable

Grinder Pump Station Size Selection

Use this table to select grinder pump models for the types of occupancy to be served.

Model	Recommended Flow (gpd)	Adequate for Managing ...
DH071	up to 700	Flow from one average single-family home, and up to two average, single-family homes where codes allow and with consent of the factory.
DH151	up to 1,500	Flow from up to two average single-family homes, and up to six average, single-family homes where codes allow and with consent of the factory.
DH152	up to 3,000	Flow from up to four average single-family homes, and up to 12 average, single-family homes with consent of the factory.
DH272	up to 5,000	Flow from up to six average single-family homes, and up to 20 average, single-family homes with consent of the factory.
DH502	up to 6,000	Flow from up to nine average single-family homes, and up to 24 average, single-family homes with consent of the factory.

Considerations include:

- Wetwell and discharge piping must be protected from freezing
- Model and basin size must be appropriate for incoming flows, including peak flows
- Appropriate alarm device must be used
- Suitable location

Daily flows above those recommended may exceed the tank's peak flow holding capacity and/or shorten the interval between pump overhauls. The company should be consulted if higher inflows

are expected.

The final selection will have to be determined by the engineer on the basis of actual measurements or best estimates of the expected sewage flow.

Grinder Pump Placement

The most economical location for installation of the grinder pump station is in the basement of the building it will serve. However, due consideration must be given when choosing an indoor location. If there is a risk of damage to items located in the basement level, other provisions should be made during basement installation or an outdoor unit should be considered.

Considerations such as ownership of the pumps by a municipality or private organization and/or the need for outdoor accessibility frequently dictate outdoor, in-ground installations. For outdoor installations, all GP models are available with high density polyethylene (HDPE) integral accessways ranging in height up to 10 feet. By keeping the unit as close as possible to the building, the lengths of gravity sewer and wiring will be minimized, keeping installation costs lower while reducing the chances of infiltration in the gravity flow section.

AC power from the building being served should be used for the grinder pump. Separate power sources add to installation and O&M costs, decrease overall reliability and frequently represent an aesthetic issue.

When two dwellings are to be served by a single unit, the station is usually placed in a position requiring the shortest gravity drains from each home. With multi-family buildings, more than one grinder pump may be required.

Pipe Selection

The final determination of the type of pipe to be used is the responsibility of the consulting engineer. In addition, the requirements of local codes, soil, terrain, water and weather conditions that prevail will guide this decision.

Although pipe fabricated from any approved material may be used, most LPS systems have been built with PVC and HDPE pipe. Continuous coils of small-diameter, HDPE pipe can be installed with automatic trenching machines and horizontal drilling machines to sewer areas at lower cost.

Table 1 compares the water capacity of two types of PVC pipe commonly used: SDR-21 and Sch 40, and one type of HDPE, SDR-11. All three have adequate pressure ratings for low pressure sewer service.

Although both types of PVC pipes are suitable, the three parameters compared in Table 2 illustrate why SDR-21 is suggested as a good compromise between capacity, strength, friction loss characteristics and cost.

System Layout

A preliminary sketch of the entire pressure sewer system should be prepared (Figure 3). Pump models should be selected and their location (elevation) should be noted. The location and direction

Table 1
PIPE WATER CAPACITY
Gallons/100 feet of Pipe Length

Nominal Pipe Size (in.)	Sch 40 PVC	SDR 21 PVC	SDR 11 HDPE
1 1/4	7.8	9.2	7.4
1 1/2	10.6	12.1	9.9
2	17.4	18.8	15.4
2 1/2	23.9	27.6	—
3	38.4	40.9	33.5
4	66.1	67.5	55.3
5	103.7	103.1	84.5
6	150.0	146.0	119.9
8	260.0	249.0	203.2

Table 2
PVC PIPE COMPARISONS
Nominal Pipe Size = 2 in.

Parameter	Sch 40	SDR 21
Wall Thickness, in.	0.154	0.113
Inside Diameter, in.	2.067	2.149
50 gpm Friction Loss, ft/100 ft	4.16	3.44

of flow of each lateral, zone and main, and the point of discharge should be shown.

The system should be designed to give the shortest runs and the fewest abrupt changes in direction. "Loops" in the system must be avoided as they lead to unpredictable and uneven distribution of flow.

Although not shown in Figure 3, the elevation of the shutoff valve of the lowest-lying pump in each zone should be recorded and used in the final determination of static head loss. Since Environment One grinder pumps are semi-positive displacement and relatively insensitive to changes in head, precisely surveyed profiles are unnecessary.

Air/vacuum valves, air release valves and combination air valves serve to prevent the concentration of air at high points within a system. This is accomplished by exhausting large quantities of air as the system is filled and also by releasing pockets of air as they accumulate while the system is in operation and under pressure. Air/vacuum valves and combination air valves also serve to prevent a potentially destructive vacuum from forming.

Air/vacuum valves should be installed at all system high points and significant changes in grade. Combination air valves should be installed at those high points where air pockets can form. Air release valves should be installed at intervals of 2,000 to 2,500 feet on all long horizontal runs that lack a clearly defined high point.

Air relief valves should be installed at the beginning of each downward leg in the system that exhibits a 30-foot or more drop. Trapped pockets of air in the system not only add static head, but also increase friction losses by reducing the cross sectional area available for flow. Air will accumulate in downhill runs preceded by an uphill run.

Long ascending or descending lines require air and vacuum or dual-function valves placed at approximately 2000-foot intervals. Long horizontal runs require dual function valves placed at approximately 2000-foot intervals.

Pressure air release valves allow air and/or gas to continuously and automatically released from a pressurized liquid system. If air or gas pockets collect at the high points in a pumped system, then

those pressurized air pockets can begin to displace usable pipe cross section. As the cross section of the pipe artificially decreases, the pump sees this situation as increased resistance to its ability to force the liquid through the pipe.

Air relief valves at high points may be necessary, depending on total system head, flow velocity and the particular profile. The engineer should consult Environment One in cases where trapped air is considered a potential problem.

Cleanout and flushing stations should be incorporated into the pipe layout. In general, cleanouts should be installed at the terminal end of each main, every 1,000 to 1,500 feet on straight runs of pipe, and whenever two or more mains come together and feed into another main.

Zone Designations

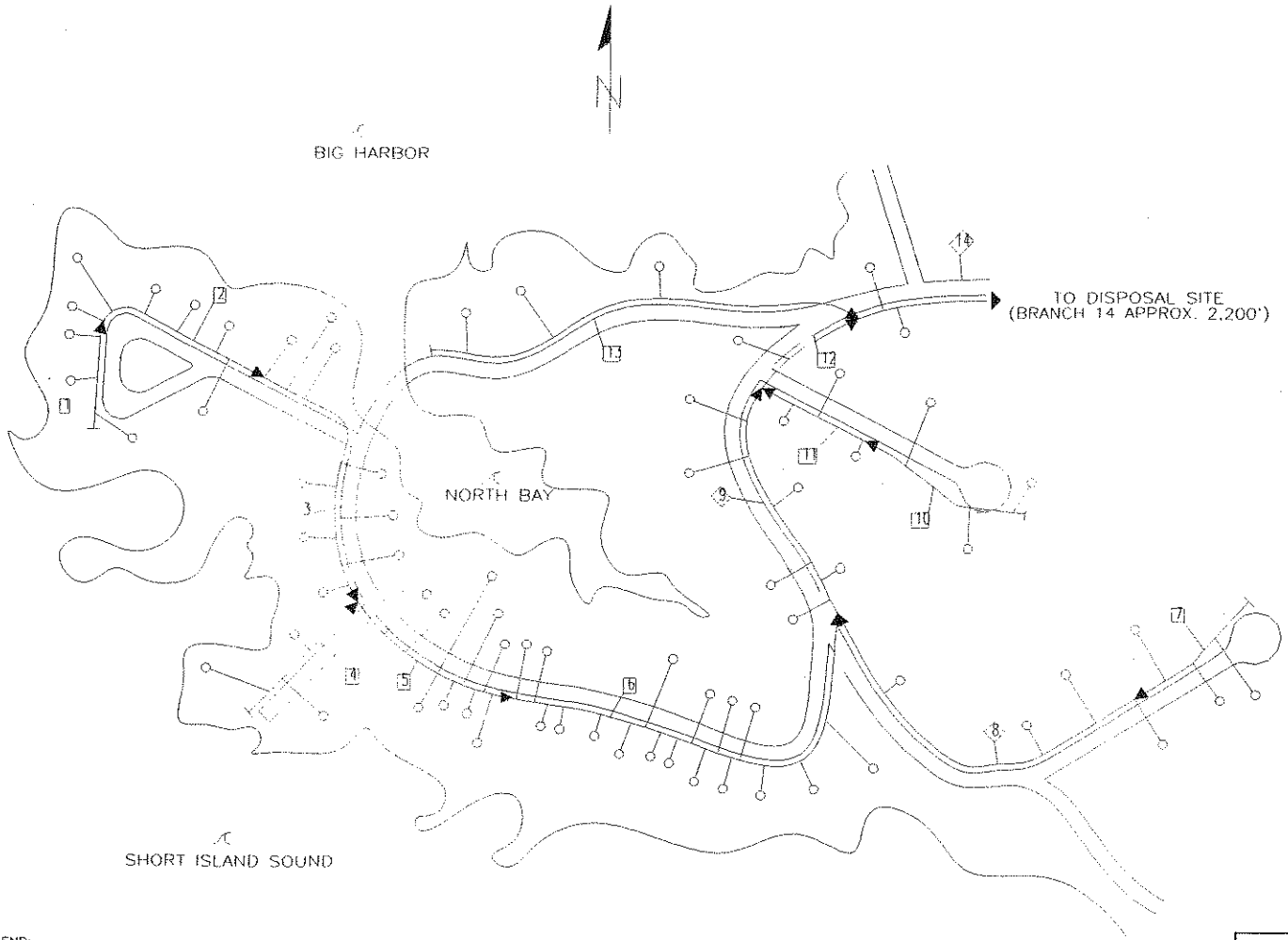
The LPS system illustrated in Figure 3 contains 72 pumps and is divided into 14 individually numbered zones. Division into zones facilitates final selection of pipe sizes, which are appropriate in relation to the requirements that flow velocity in the system is adequate and that both static and dynamic head losses are within design criteria. Assignment of individual zones follows from the relationship between the accumulating total number of pumps in a system to the predicted number that will periodically operate simultaneously (Table 3).

Table 4 was initially developed after careful analysis of more than 58,000 pump events in a 307-day period during the Albany project (4). It was extended for larger systems by application of probability theory. The validity of this table has since been confirmed by actual operating experience with thousands of large and small LPS systems during a 34-year period.

Using Figure 3, the actual exercise of assigning zones is largely mechanical. The single pump farthest from the discharge point in any main or lateral constitutes a zone. This and downstream pumps along the main are accumulated until their aggregate number is sufficient to increase the number of pumps in simultaneous operations by one, i.e., until the predicted maximum flow increases by 11 gpm.

Figure 3 shows that zones 1, 2 and 3 end when the number of pumps connected total 3, 6 and 9, and the number of pumps in daily simultaneous operation are 2, 3 and 4, respectively.

Any place where two or more sections of main join, or where the outfall is reached, also determines the end of a zone. This design rule takes precedence over the procedure stated above, as seen in zones 3, 4, 6, 8, 9, 11, 12, 13 and 14.



LEGEND:
- FLUSHING CONNECTION
- INLINE FLUSHING CONNECTION
- BRANCH DIVIDER & FLOW INDICATOR
- GRINDER PUMP STATION
- [3] – ZONE NUMBER
- DISCHARGE

SYSTEM FLOW DIAGRAM
ILLUSTRATED EXAMPLE

PRESSURE SEWER	
FIRST MADE FOR –	
AE-732	–
DRAWING NUMBER SH OF	REV

Completion of Pipe Schedule and Zone Analysis

The data recorded on the System Flow Diagram (Figure 3) is then transferred to Table 4.

Table 4 Column No.	Designation
1	Zone Number
2	Connects to Zone
3	Number of Pumps in Zone
4	Accumulated Pumps in Zone
11	Length of Main this Zone in Feet

Column 4 is completed by referring to Table 3, where the maximum number of pumps in simultaneous operation is given as a function of the number of pumps upstream from the end of the particular zone. The output of each zone will vary slightly with head requirements, but under typical conditions, the flow is approximately 11 gpm. Calculate the maximum anticipated flow for each zone by multiplying the number of simultaneous operations in Column 7 by 11 gpm and record the results in Column 8.

To complete columns 9, 10, 12 and 13, refer to Flow Velocity and Friction Head Loss table for the type of pipe selected — in this case, Table 5 for SDR-21. It will be seen that the engineer will frequently be presented with more than one option when selecting pipe size. Sometimes a compromise in pipe size will be required to meet present needs as well as planned future development. As a general rule, pipe sizes should be selected to minimize friction losses while keeping velocity near or above 2 feet per second.

For example, Zone 1 has a maximum of two pumps running (Column 7). Table 5 offers a choice of 1.25-inch, 1.5-inch or 2-inch pipe. 1.5-inch pipe is selected since flow velocity equals 3.04 ft/sec and friction loss equals 2.15 ft/100 ft. Since the zone is 205 feet in length (Column 11), the total friction loss (Column 13) is:

Table 3
MAXIMUM NUMBER OF GRINDER PUMP CORES OPERATING DAILY

Number of Grinder Pump Cores Connected	Maximum Daily Number of Grinder Pump Cores Operating Simultaneously
1	1
2–3	2
4–9	3
10–18	4
19–30	5
31–50	6
51–80	7
81–113	8
114–146	9
147–179	10
180–212	11
213–245	12
246–278	13
279–311	14
312–344	15
345–377	16
378–410	17
411–443	18
444–476	19
477–509	20
510–542	21
543–575	22
576–608	23
609–641	24
642–674	25
675–707	26
708–740	27
741–773	28
774–806	29
807–839	30
840–872	31
873–905	32
906–938	33
939–971	34
972–1,004	35

BY:	DATE:	PRELIMINARY LOW-PRESSURE SEWER SYSTEM PIPE SCHEDULE AND ZONE ANALYSIS OF:	Environment/One CORPORATION
PIPE: SDR 21 PVC			AE
PREPARED FOR:		Illustrated Example Table 4	SHEET NO. OF REV

1 ZONE NO.	2 CONN. TO ZONE	3 NO. PUMPS IN ZONE	4 ACCUM. PUMPS IN ZONE	5 GAL/DAY PER CORE	6 MAX. FLOW PER CORE	7 MAX. SIM OPS	8 MAX. FLOW (gpm)	9 PIPE SIZE (in)	10 MAX. VELOCITY (FPS)	11 LENGTH OF MAIN THIS ZONE	12 FRICTION LOSS FACTOR (ft/100 ft)	13 FRICTION LOSS THIS ZONE	14 ACCUM. FRICTION LOSS (ft)	15 MAX. MAIN ELEV.	16 MIN. PUMP ELEV.	17 STATIC HEAD (ft)	18 TOTAL DYNAMIC HEAD (ft)
1	2	3	3	200	11	2	22	1.5	3.04	205	2.15	4.41	73.41	40	10	30	103.41
2	3	6	9	200	11	3	33	2.0	2.92	380	1.54	5.86	69.00	40	10	30	99.00
3	5	9	18	200	11	4	44	2.0	3.89	630	2.63	16.56	63.14	40	5	35	98.14
4	5	3	3	200	11	2	22	1.5	3.04	310	2.15	8.46	53.25	40	5	35	88.25
5	6	9	30	200	11	5	55	3.0	2.24	800	0.60	4.83	46.58	40	5	35	81.58
6	9	17	47	200	11	6	66	3.0	2.69	1,000	0.85	8.46	41.75	40	5	35	76.75
7	8	3	3	200	11	2	22	1.5	3.04	175	2.15	3.77	49.56	40	5	35	84.56
8	9	4	7	200	11	3	33	2.0	2.92	810	1.54	12.50	45.80	40	30	10	55.80
9	12	6	60	200	11	7	77	3.0	3.14	520	1.12	5.85	33.30	40	10	30	63.30
10	11	3	3	200	11	2	22	1.5	3.04	230	2.15	4.95	37.03	40	10	30	67.03
11	12	3	6	200	11	3	33	2.0	2.92	300	1.54	4.63	32.08	40	10	30	62.08
12	14	1	67	200	11	7	77	3.0	3.14	240	1.12	2.70	27.45	40	10	30	57.45
13	14	3	3	200	11	2	22	1.5	3.04	985	2.15	21.19	45.94	40	5	35	80.94
14	14	2	72	200	11	7	77	3.0	3.14	2,200	1.12	24.75	24.75	40	30	10	34.75

$$HF = (2.15 \text{ ft}/100 \text{ ft})(205 \text{ ft}) = 4.41 \text{ ft}$$

For Zone 14, with 72 upstream pumps, it is seen that a maximum of seven pumps can be running simultaneously. Table 5 provides options of:

3-inch pipe: V = 3.14 ft/sec; HF = 1.12 ft/100 ft

or

4-inch pipe: V = 1.90 ft/sec; HF = 0.33 ft/100 ft

The smaller-diameter 3-inch pipe is selected because of the increased velocities, especially with the TDH below 185 feet. A choice of 3-inch pipe would lead to a friction loss in this zone of:

$$HF = (1.12 \text{ ft}/100 \text{ ft})\ (2200 \text{ ft}) = 24.75 \text{ ft}$$

Accumulated friction loss (Column 14) for each zone is next determined by adding the friction loss for each zone from the system outfall (Zone 14) to the zone in question. Thus, from Figure 3 it is seen that the accumulated friction loss for Zone 1 is:

Zone Number	Friction Loss (ft)
14	24.75
12	2.70
9	5.85
6	8.46
5	4.83
3	16.56
2	5.86
1	4.41

73.41 ft = Accumulated friction loss, Zone 1

The same summation is completed for each zone.

To complete the hydraulic analysis, refer to the drawing contours and record in Column 15 the maximum line elevation between the point of discharge and the zone under consideration. In Column 16, record the elevation of the lowest pump in the zone. Subtract the values in Column 16 from those in Column 15 and record only positive elevation differentials in Column 17. Add the values in Column 14 to those in Column 17 and record the total in Column 18 to show the maximum combination of friction and static head a pump will experience at any given point in the system.

Review

The accumulated data in Table 4 should finally be reviewed for conformity with the criteria of flow velocity greater than or equal to 2.0 ft/sec and total design head less than or equal to 185 feet. If the system pressure exceeds 92 feet, the number of cores operating will remain the same and the flow from each pump will be reduced from 11 gpm to 9 gpm.

Data should be reviewed to determine whether system improvements could result from construction modifications. As an example, deeper burial of pipe in one or two critical high-elevation zones might bring the entire system into compliance with design criteria. Environment One should be consulted in marginal cases and/or concerning:

- Odor control issues
- Frost protection issues
- Excessive static head conditions
- Excessive total dynamic head conditions
- Unusual applications

Table 5
SDR 21 PVC PIPE

Flow Velocity and Friction Head Loss *vs* Pumps in Simultaneous Operation (C = 150)

	1 1/4 in.		1 1/2 in.		2 in.		2 1/2 in.		3 in.		4 in.		5 in.		6 in.		8 in.		
N	V	H_F	V	H_F	V	H_F	V	H_F	V	H_F	V	H_F	V	H_F	V	H_F	V	H_F	N
1	1.99	**1.15**	1.52	**0.60**															1
2	3.99	**4.16**	3.04	**2.15**	1.95	**0.73**													2
3	5.98	**8.82**	4.56	**4.56**	2.92	**1.54**	1.99	**0.61**											3
4	7.97	**15.02**	6.08	**7.77**	3.89	**2.63**	2.66	**1.04**	1.79	**0.40**									4
5					4.87	**3.97**	3.32	**1.57**	2.24	**0.60**									5
6					5.84	**5.57**	3.99	**2.20**	2.69	**0.85**									6
7					6.81	**7.41**	4.65	**2.93**	3.14	**1.12**	1.90	**0.33**							7
8							5.32	**3.75**	3.59	**1.44**	2.17	**0.42**							8
9							5.98	**4.66**	4.04	**1.79**	2.44	**0.53**							9
10							6.64	**5.67**	4.49	**2.18**	2.71	**0.64**							10
11									4.93	**2.60**	2.98	**0.76**	1.95	**0.27**					11
12									5.38	**3.05**	3.25	**0.90**	2.13	**0.32**					12
13									5.83	**3.54**	3.52	**1.04**	2.31	**0.37**					13
14									6.28	**4.06**	3.80	**1.19**	2.48	**0.43**					14
15											4.07	**1.36**	2.66	**0.48**	1.88	**0.21**			15
16											4.34	**1.53**	2.84	**0.55**	2.00	**0.23**			16
17											4.61	**1.71**	3.02	**0.61**	2.13	**0.26**			17
18											4.88	**1.90**	3.19	**0.68**	2.25	**0.29**			18
19											5.15	**2.10**	3.37	**0.75**	2.38	**0.32**			19
20											5.42	**2.31**	3.55	**0.82**	2.50	**0.35**			20
21											5.69	**2.53**	3.73	**0.90**	2.63	**0.39**			21
22											5.96	**2.76**	3.90	**0.98**	2.75	**0.42**			22
23											6.24	**2.99**	4.08	**1.07**	2.88	**0.46**			23
24													4.26	**1.16**	3.00	**0.49**			24
25													4.44	**1.25**	3.13	**0.53**			25
26													4.61	**1.34**	3.25	**0.57**			26
27													4.79	**1.44**	3.38	**0.61**	1.99	**0.17**	27
28													4.97	**1.54**	3.50	**0.66**	2.07	**0.18**	28
29													5.15	**1.64**	3.63	**0.70**	2.14	**0.19**	29
30													5.32	**1.75**	3.75	**0.75**	2.21	**0.21**	30
31													5.50	**1.86**	3.88	**0.79**	2.29	**0.22**	31
32													5.68	**1.97**	4.01	**0.84**	2.36	**0.23**	32
33													5.86	**2.08**	4.13	**0.89**	2.44	**0.25**	33
34													6.03	**2.20**	4.26	**0.94**	2.51	**0.26**	34
35													6.21	**2.32**	4.38	**0.99**	2.58	**0.28**	35
36															4.51	**1.05**	2.66	**0.29**	36
37															4.63	**1.10**	2.73	**0.30**	37
38															4.76	**1.16**	2.81	**0.32**	38
39															4.88	**1.21**	2.88	**0.34**	39
40															5.01	**1.27**	2.95	**0.35**	40
41															5.13	**1.33**	3.03	**0.37**	41
42															5.26	**1.39**	3.10	**0.39**	42
43															5.38	**1.45**	3.17	**0.40**	43
44															5.51	**1.52**	3.25	**0.42**	44
45															5.63	**1.58**	3.32	**0.44**	45
46															5.76	**1.65**	3.40	**0.46**	46
47															5.88	**1.72**	3.47	**0.47**	47
48															6.01	**1.78**	3.54	**0.49**	48
49															6.13	**1.85**	3.62	**0.51**	49
50															6.26	**1.92**	3.69	**0.53**	50

Head Loss Calculations
From Modified Hazen - Williams Formula

$$H_F = .2083 \left[\left(\frac{100}{C} \right)^{1.852} \times \frac{q^{1.852}}{d^{4.8655}} \right]$$

$$V = .3208 \frac{q}{A}$$

$A = \frac{d^2\pi}{4}$ = cross-sectional flow, sq. in.

C = 150

q = flow in gallons per minute

d = I.D. of pipe in inches =
[average O.D. - (2 x min. wall thickness]

N = Number of pumps operating at 11 gpm
V = Flow velocity in ft/sec
H_F = Friction head loss in ft/100 ft of pipe

Table 6
SCHEDULE 40 PVC PIPE

Flow Velocity and Friction Head Loss *vs* Pumps in Simultaneous Operation (C = 150)

	1 1/4 in.		1 1/2 in.		2 in.		2 1/2 in.		3 in.		4 in.		5 in.		6 in.		8 in.		
N	V	H_F	V	H_F	V	H_F	V	H_F	V	H_F	V	H_F	V	H_F	V	H_F	V	H_F	N
1	2.36	**1.74**	1.73	**0.82**	1.05	**0.24**													1
2	4.72	**6.28**	3.47	**2.97**	2.10	**0.88**	1.47	**0.37**											2
3	7.08	**13.31**	5.20	**6.29**	3.15	**1.86**	2.21	**0.79**											3
4			6.93	**10.71**	4.21	**3.18**	2.95	**1.34**	1.91	**0.46**									4
5					5.26	**4.80**	3.68	**2.02**	2.39	**0.70**									5
6					6.31	**6.73**	4.42	**2.83**	2.87	**0.99**									6
7							5.16	**3.77**	3.34	**1.31**	1.94	**0.35**							7
8							5.89	**4.83**	3.82	**1.68**	2.22	**0.45**							8
9							6.63	**6.01**	4.30	**2.09**	2.49	**0.56**							9
10									4.78	**2.54**	2.77	**0.68**							10
11									5.25	**3.03**	3.05	**0.81**	1.94	**0.27**					11
12									5.73	**3.56**	3.33	**0.95**	2.12	**0.32**					12
13									6.21	**4.13**	3.60	**1.10**	2.29	**0.37**					13
14											3.88	**1.26**	2.47	**0.42**					14
15											4.16	**1.43**	2.65	**0.48**					15
16											4.44	**1.62**	2.82	**0.54**	1.95	**0.22**			16
17											4.71	**1.81**	3.00	**0.60**	2.08	**0.25**			17
18											4.99	**2.01**	3.17	**0.67**	2.20	**0.27**			18
19											5.27	**2.22**	3.35	**0.74**	2.32	**0.30**			19
20											5.54	**2.44**	3.53	**0.81**	2.44	**0.33**			20
21											5.82	**2.67**	3.70	**0.89**	2.56	**0.36**			21
22											6.10	**2.91**	3.88	**0.97**	2.69	**0.40**			22
23													4.06	**1.05**	2.81	**0.43**			23
24													4.23	**1.14**	2.93	**0.47**			24
25													4.41	**1.23**	3.05	**0.50**			25
26													4.59	**1.32**	3.17	**0.54**			26
27													4.76	**1.42**	3.30	**0.58**			27
28													4.94	**1.52**	3.42	**0.62**	1.98	**0.16**	28
29													5.11	**1.62**	3.54	**0.66**	2.05	**0.17**	29
30													5.29	**1.72**	3.66	**0.70**	2.12	**0.19**	30
31													5.47	**1.83**	3.79	**0.75**	2.19	**0.20**	31
32													5.64	**1.94**	3.91	**0.79**	2.26	**0.21**	32
33													5.82	**2.06**	4.03	**0.84**	2.33	**0.22**	33
34													6.00	**2.17**	4.15	**0.89**	2.40	**0.23**	34
35													6.17	**2.29**	4.27	**0.94**	2.47	**0.25**	35
36															4.40	**0.99**	2.54	**0.26**	36
37															4.52	**1.04**	2.61	**0.27**	37
38															4.64	**1.09**	2.68	**0.29**	38
39															4.76	**1.15**	2.75	**0.30**	39
40															4.88	**1.20**	2.82	**0.32**	40
41															5.01	**1.26**	2.89	**0.33**	41
42															5.13	**1.31**	2.96	**0.35**	42
43															5.25	**1.37**	3.03	**0.36**	43
44															5.37	**1.43**	3.11	**0.38**	44
45															5.49	**1.49**	3.18	**0.39**	45
46															5.62	**1.56**	3.25	**0.41**	46
47															5.74	**1.62**	3.32	**0.43**	47
48															5.86	**1.68**	3.39	**0.44**	48
49															5.98	**1.75**	3.46	**0.46**	49
50															6.11	**1.81**	3.53	**0.48**	50

Head Loss Calculations
From Modified Hazen - Williams Formula

$$H_F = .2083 \left[\left(\frac{100}{C} \right)^{1.852} \times \frac{q^{1.852}}{d^{4.8655}} \right]$$

$$V = .3208 \frac{q}{A}$$

$A = \frac{d^2\pi}{4}$ = cross-sectional flow, sq. in.

C = 150

q = flow in gallons per minute

d = I.D. of pipe in inches =
[average O.D. - (2 x min. wall thickness]

N = Number of pumps operating at 11 gpm
V = Flow velocity in ft/sec
H_F = Friction head loss in ft/100 ft of pipe

Table 7
SDR 11 HDPE PIPE

Flow Velocity and Friction Head Loss *vs* Pumps in Simultaneous Operation (C = 155)

	1 1/4 in.		1 1/2 in.		2 in.		3 in.		4 in.		5 in.		6 in.		8 in.		
N	V	H_F	V	H_F	V	H_F	V	H_F	V	H_F	V	H_F	V	H_F	V	H_F	N
1	2.47	**1.84**	1.86	**0.92**													1
2	4.95	**6.63**	3.72	**3.32**	2.38	**1.12**											2
3	7.42	**14.04**	5.58	**7.03**	3.57	**2.37**	1.64	**0.36**									3
4			7.44	**11.98**	4.76	**4.04**	2.19	**0.61**									4
5					5.95	**6.11**	2.74	**0.92**									5
6					7.14	**8.56**	3.29	**1.30**	1.99	**0.38**							6
7							3.83	**1.72**	2.32	**0.51**							7
8							4.38	**2.21**	2.65	**0.65**							8
9							4.93	**2.75**	2.98	**0.81**	1.95	**0.29**					9
10							5.48	**3.34**	3.31	**0.98**	2.17	**0.35**					10
11							6.03	**3.98**	3.65	**1.17**	2.39	**0.42**					11
12									3.98	**1.38**	2.60	**0.49**					12
13									4.31	**1.60**	2.82	**0.57**	1.99	**0.24**			13
14									4.64	**1.83**	3.04	**0.65**	2.14	**0.28**			14
15									4.97	**2.08**	3.25	**0.74**	2.29	**0.32**			15
16									5.30	**2.35**	3.47	**0.84**	2.45	**0.36**			16
17									5.63	**2.63**	3.69	**0.94**	2.60	**0.40**			17
18									5.97	**2.92**	3.90	**1.04**	2.75	**0.44**			18
19									6.30	**3.23**	4.12	**1.15**	2.90	**0.49**			19
20											4.34	**1.27**	3.06	**0.54**			20
21											4.56	**1.39**	3.21	**0.59**			21
22											4.77	**1.51**	3.36	**0.64**	1.98	**0.18**	22
23											4.99	**1.64**	3.52	**0.70**	2.08	**0.19**	23
24											5.21	**1.77**	3.67	**0.76**	2.17	**0.21**	24
25											5.42	**1.91**	3.82	**0.82**	2.26	**0.23**	25
26											5.64	**2.06**	3.98	**0.88**	2.35	**0.24**	26
27											5.86	**2.21**	4.13	**0.94**	2.44	**0.26**	27
28											6.07	**2.36**	4.28	**1.01**	2.53	**0.28**	28
29													4.43	**1.08**	2.62	**0.30**	29
30													4.59	**1.15**	2.71	**0.32**	30
31													4.74	**1.22**	2.80	**0.34**	31
32													4.89	**1.29**	2.89	**0.36**	32
33													5.05	**1.37**	2.98	**0.38**	33
34													5.20	**1.44**	3.07	**0.40**	34
35													5.35	**1.52**	3.16	**0.42**	35
36													5.50	**1.60**	3.25	**0.44**	36
37													5.66	**1.69**	3.34	**0.47**	37
38													5.81	**1.77**	3.43	**0.49**	38
39													5.96	**1.86**	3.52	**0.52**	39
40													6.12	**1.95**	3.61	**0.54**	40
41															3.70	**0.57**	41
42															3.79	**0.59**	42
43															3.88	**0.62**	43
44															3.97	**0.65**	44
45															4.06	**0.67**	45
46															4.15	**0.70**	46
47															4.24	**0.73**	47
48															4.33	**0.76**	48
49															4.42	**0.79**	49
50															4.51	**0.82**	50

Head Loss Calculations
From Modified Hazen - Williams Formula

$$H_F = .2083 \left[\left(\frac{100}{C} \right)^{1.852} \times \frac{q^{1.852}}{d^{4.8655}} \right]$$

$$V = .3208 \frac{q}{A}$$

$A = \frac{d^2\pi}{4}$ = cross-sectional flow, sq. in.

C = 150

q = flow in gallons per minute

d = I.D. of pipe in inches = [average O.D. - (2 x min. wall thickness]

N = Number of pumps operating at 11 gpm

V = Flow velocity in ft/sec

H_F = Friction head loss in ft/100 ft of pipe

References

1. Carcich, I., Hetling, L.J., and Farrell, R.P. "A Pressure Sewer System Demonstration," EPA-R2-72-091, Office of Research and Monitoring, U.S. Environmental Protection Agency, Washington, D.C., November 1972.

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3. "Handbook of PVC Pipe: Design and Construction," Uni-Bell PVC Pipe Association, Dallas, Texas, Second Edition, 1982.

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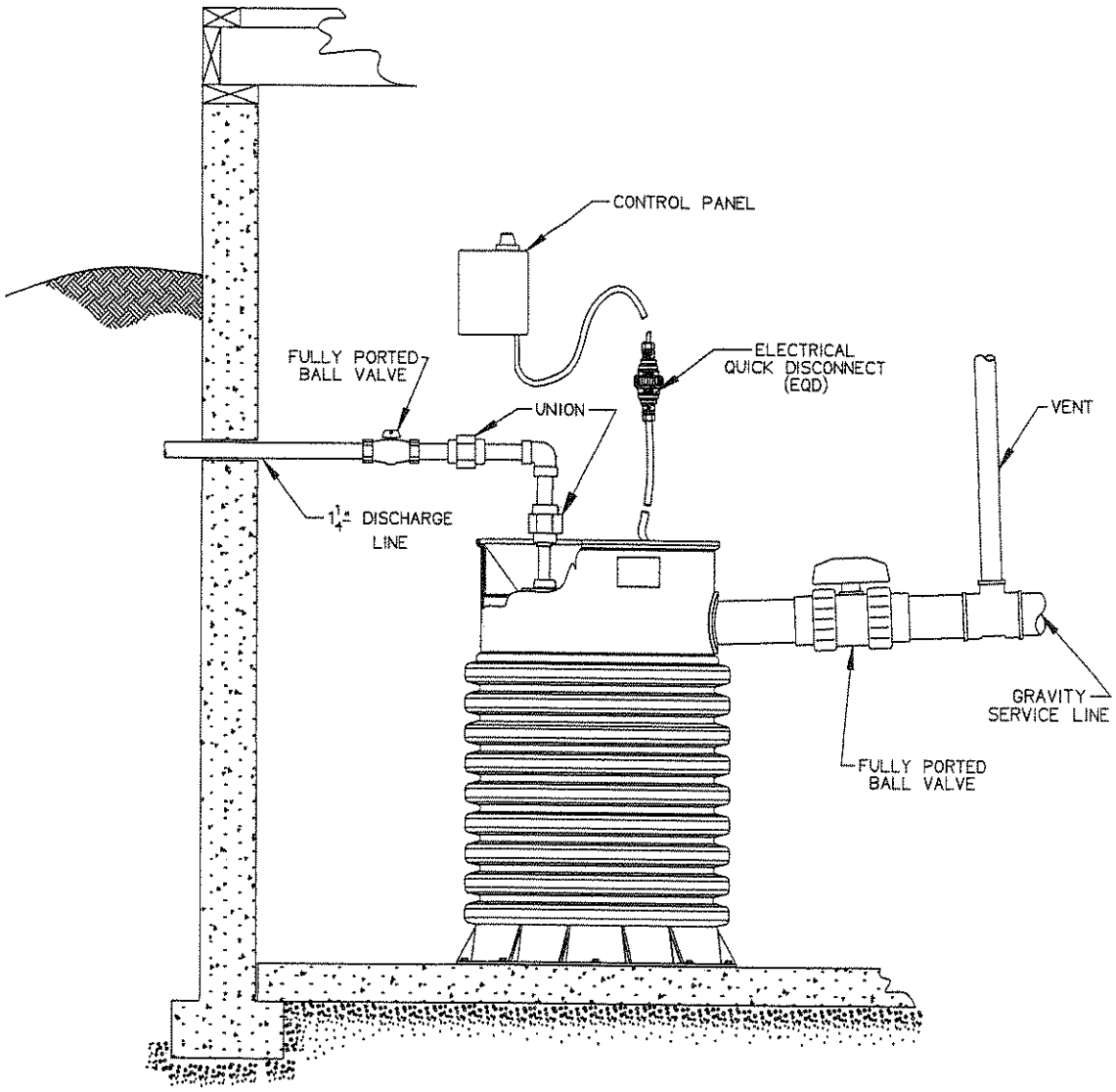
5. Stepanoff, A.J. "Centrifugal and Axial Flow Pumps," John Wiley and Sons, New York, 1948.

6. Tucker, L.S. "Hydraulics of a Pressurized Sewerage System and Use of Centrifugal Pumps," TM-6, American Society of Civil Engineers, 1967.

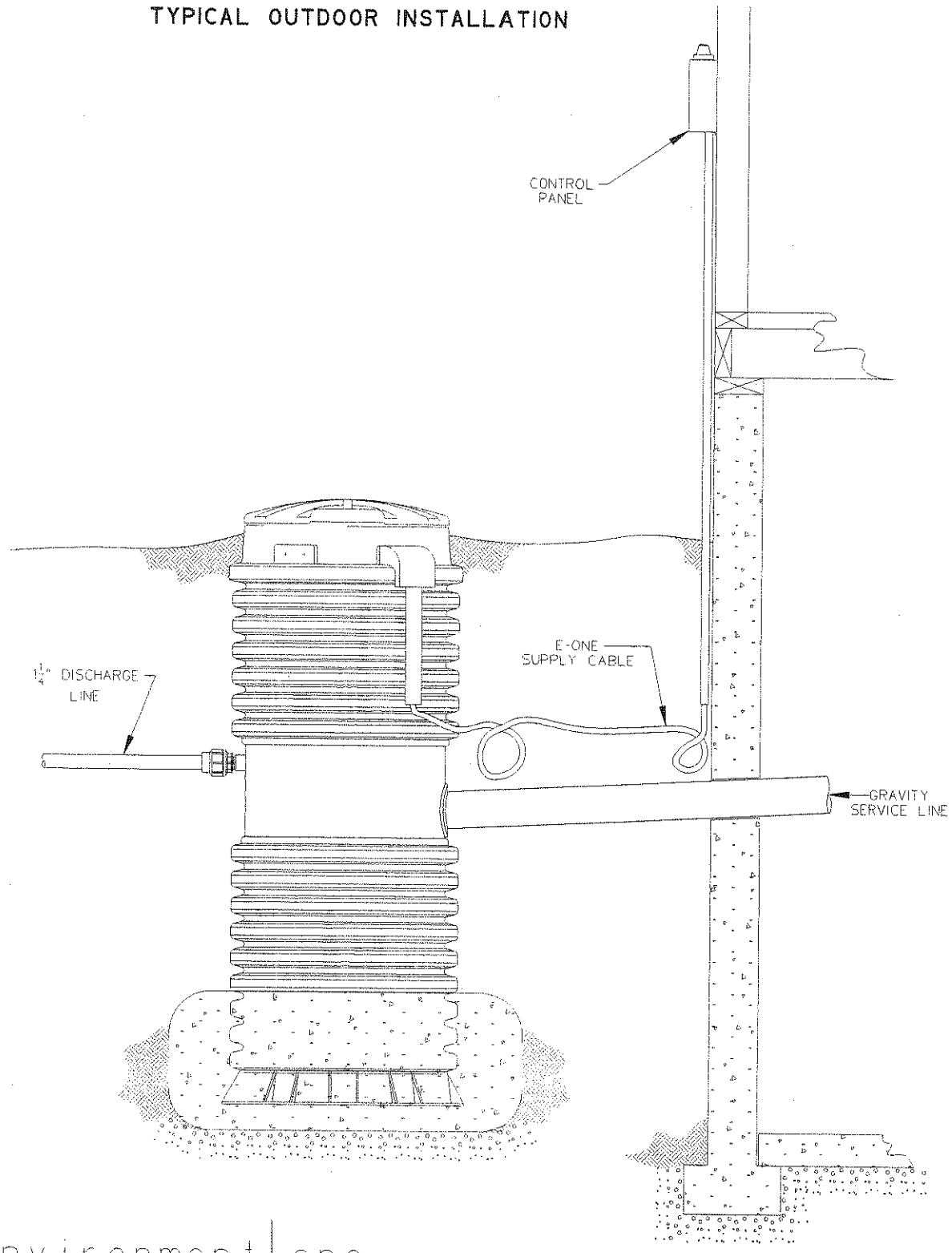
7. Tucker, L.S. "Sewage Flow Variations in Individual Homes," TM-2, American Society of Civil Engineers, February 1967.

8. Waller, D.H. "Peak Flow of Sewage from Individual Homes," TM-9, American Society of Civil Engineers, January 1968.

TYPICAL INDOOR INSTALLATION



TYPICAL OUTDOOR INSTALLATION



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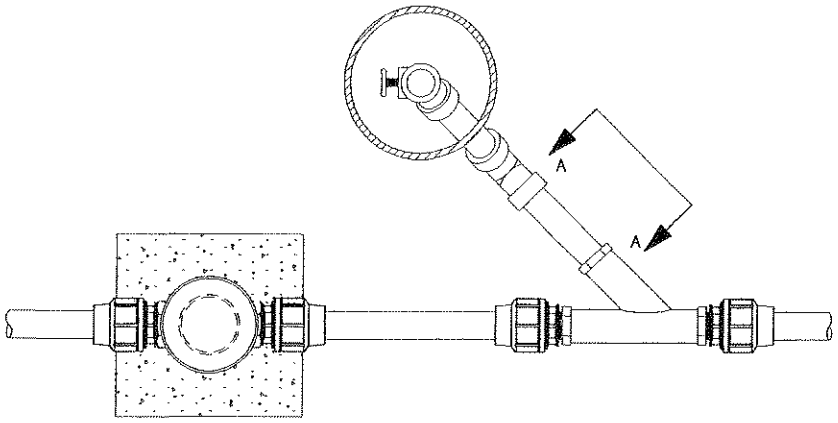
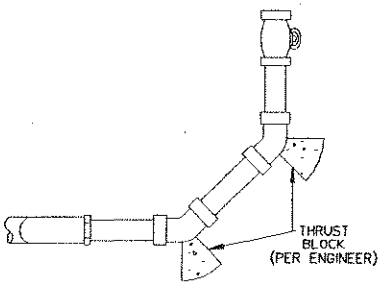
CORPORATION

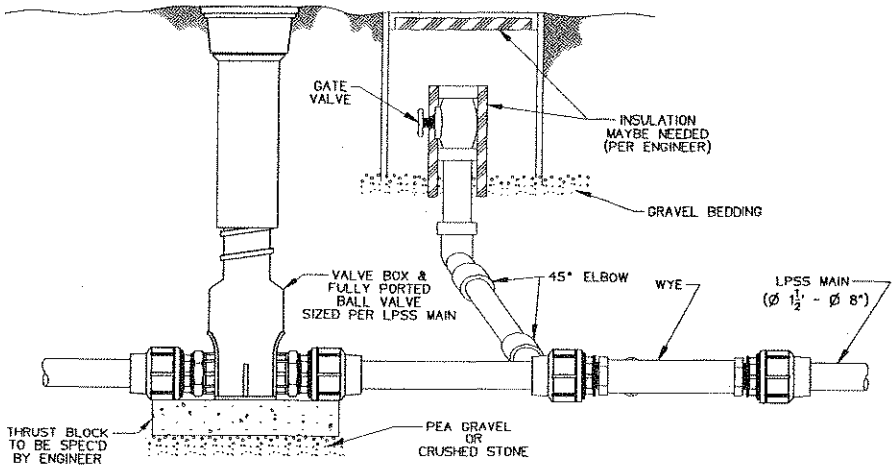
LM000112 REV. A



PLAN VIEW



VIEW "A"
3/4 = 1

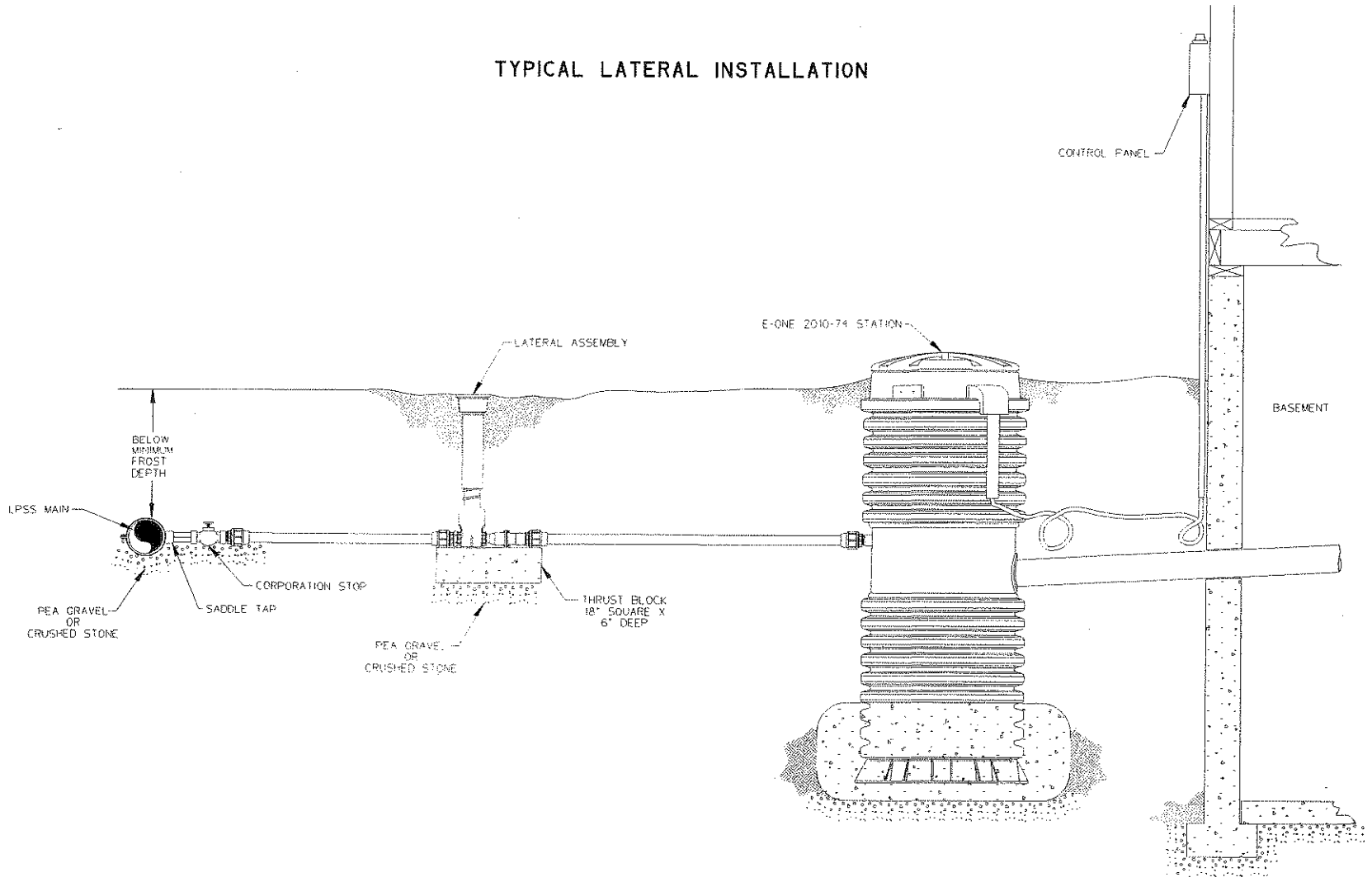


TYPICAL FLUSHING CONNECTION ON LPSS MAIN

environment one
CORPORATION

LM000113 REV. A

TYPICAL LATERAL INSTALLATION



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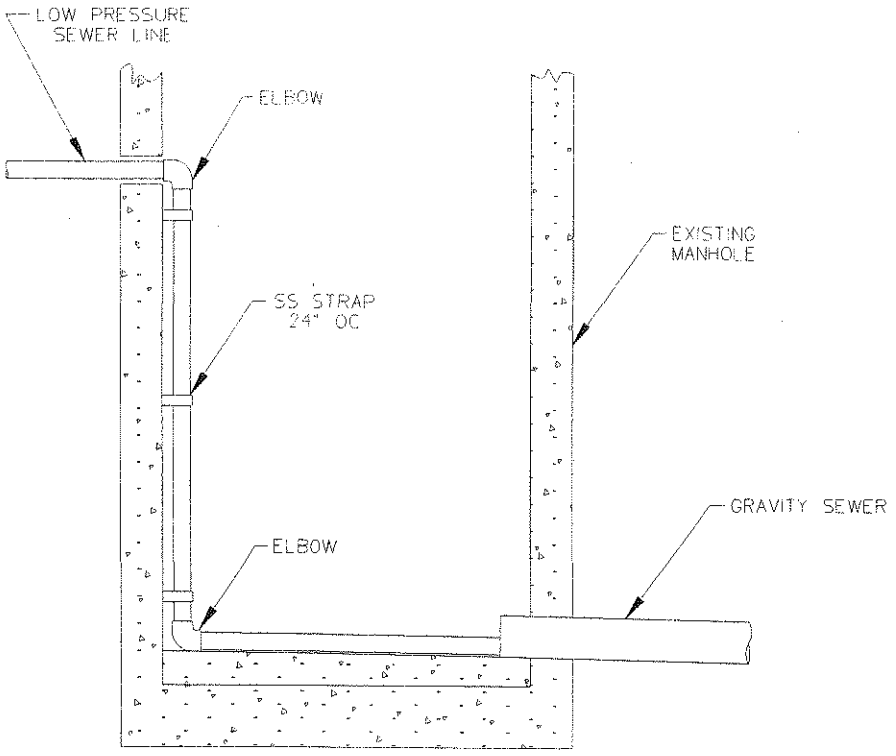
LM000114 REV. -

TYPICAL DROP CONNECTION
LPSS IN EXISTING MANHOLE



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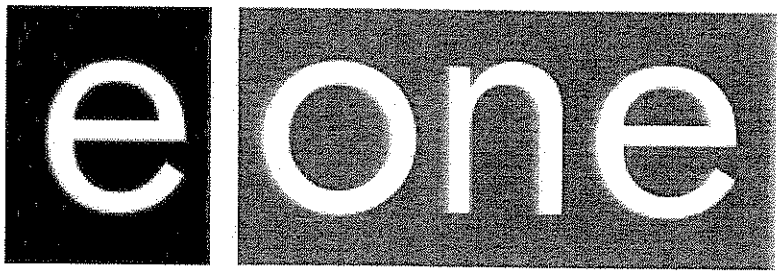
LM000115 REV. -

Manufacturer Evaluation List

	General Requirements for Low Pressure Sewer Systems
Service and Maintenance Check List	• Local fast-response service and maintenance organization has been designated • Manufacturers of all equipment specified for the system have supplied all installation details • Warranties for all equipment specified for the system have been evaluated • Fast replacement parts availability for all equipment in the system has been ensured by each equipment manufacturer • User instructions have been supplied to homeowners
Grinder Pump	• Designated for the specific purpose of grinding and pumping domestic wastewater • Suitable for parallel operation in a system containing thousands of pumps connected to a common discharge line • Has a history of reliable operation • Compatible with existing power sources and provides economical operation • Simple to service and troubleshoot, easily accessible for removal of grinder pump core; designed with simple wiring and controls; easily disassembled and reassembled • Warranty covering parts and labor for a reasonable length of time • Supported by a thoroughly detailed installation manual, service manual and facilities for service training
Certifications	• Canadian Standards Association • Underwriters Laboratories, Inc. • National Sanitation Foundation
Required Features	• Non-clogging pump • Non-jamming grinder • Anti-siphon valve integral with grinder pump • All valves of non-clogging design: integral check valve, anti-siphon valve and redundant check valve • High-level warning alarm
Motor	• Low rpm (1,725) • Overload protection, built-in, automatic reset • High torque, low starting current
Tank	• Self scouring • Completely sealed • Non-corroding material
Level Sensing Control	• Non-fouling type • No moving parts in contact with sewage
Motor Controls	• Completely protected • Simple to service or replace • UL-listed alarm panel



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Niskayuna, New York USA 12309–1090

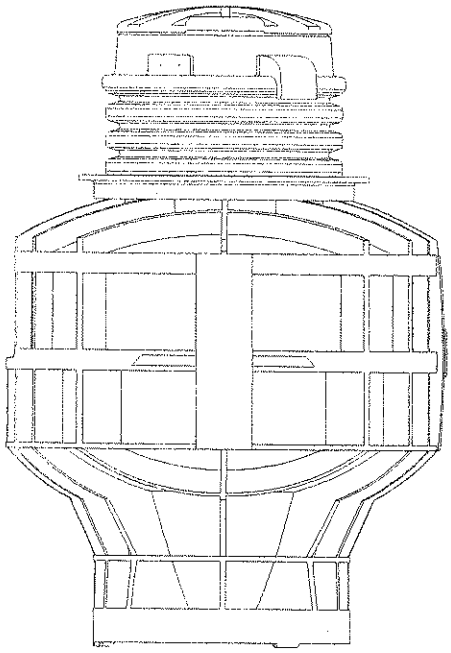
Voice: (01) 518.346.6161
Fax: 518.346.6188

www.eone.com

LM000353 Rev. –
050106

E/ONE EXTREME SERIES

WH231/WR231



Features

The WH231 or WR231 is a complete unit that includes: the grinder pump, check valve, polyethylene tank and controls.

The WH231 is the "hardwired," or "wired," model where a cable connects the motor controls to the level controls through watertight penetrations.

The WR231 is the "radio frequency identification" (RFID), or "wireless," model that uses wireless technology to communicate between the level controls and the motor controls.

All solids are ground into fine particles, allowing them to pass easily through the pump, check valve, and small diameter pipe lines. Even objects that are not normally found in sewage, such as plastic, rubber, fiber, wood, etc. are ground into fine particles.

The 1-1/4" inch discharge connection is adaptable to any piping materials, thereby allowing us to meet your local code requirements.

The tank is made of tough corrosion-resistant polyethylene. Designed specifically for low pressure sewer applications, the WH231 or WR231 has an optimum tank capacity of 237 gallons, providing ample user storage. The lower portion of the tank has a smaller diameter tapered down to a dish shaped bottom. These design features reduce the retained volume and promote scouring which will minimize odor and corrosiveness. This model can handle flows of 850 GPD.

The internal check valve assembly, located in the grinder pump, is custom designed for non-clog, trouble-free operation.

The grinder pump is automatically activated. It runs infrequently for very short periods. The annual energy consumption is typically that of a 40 watt light bulb.

Operational Information

Motor

1 HP, 1,725 RPM, high torque, capacitor start, thermally protected, 120/240 V / 60 Hz, one phase

Inlet Connections

4-inch inlet grommet standard for DWV pipe. Other inlet configurations available from the factory.

Discharge Connections

Pump discharge terminates in 1-1/4" female NPT. Can easily be adapted to 1-1/4" PVC pipe or any other material required by local codes.

*Discharge**

15 gpm at 0 psig

11 gpm at 40 psig

7.8 gpm at 80 psig

Overload Capacity

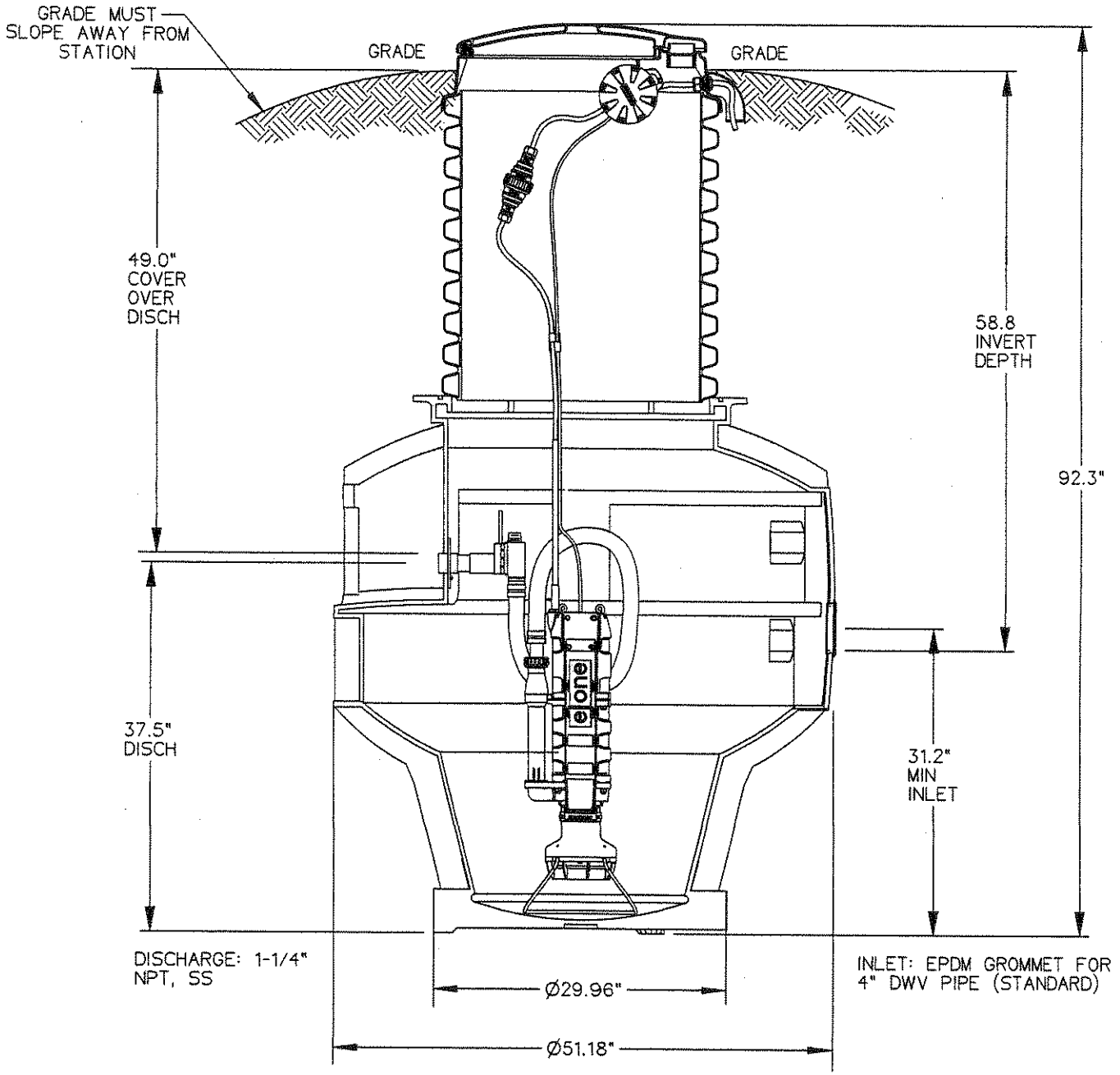
The maximum pressure that the pump can generate is limited by the motor characteristics. The motor generates a pressure well below the rating of the piping and appurtenances. The automatic reset feature does not require manual operation following overload.

Patent Numbers: 5,752,315 5,562,254 5,439,180

* Discharge data includes loss through check valve, which is minimal.

NA0059P01

OPTIONS : ☐ WH231-92 (HARD WIRED LEVEL CONTROLS)
☐ WR231-92 (WIRELESS LEVEL CONTROLS)



CONCRETE BALLAST MAY BE REQUIRED
SEE INSTALLATION INSTRUCTIONS
FOR DETAILS

AD	CH	07/16/07	B	
DR BY	CHK'D	DATE	ISSUE	SCALE

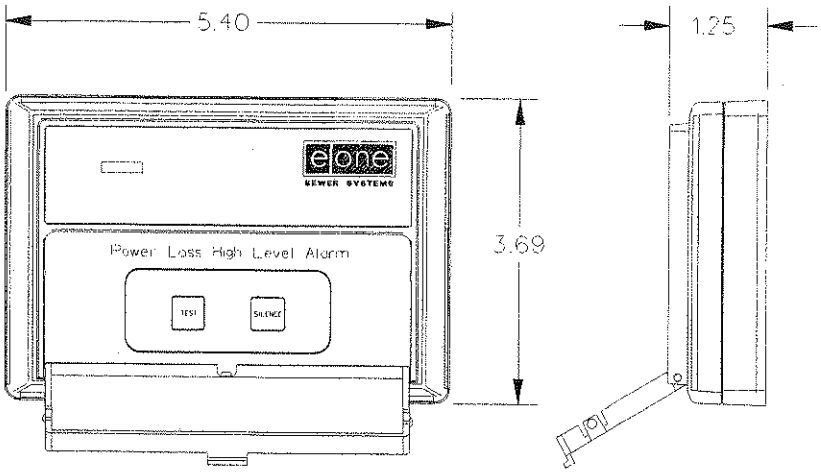
SEWER SYSTEMS

MODEL WH231-92 / WR231-92

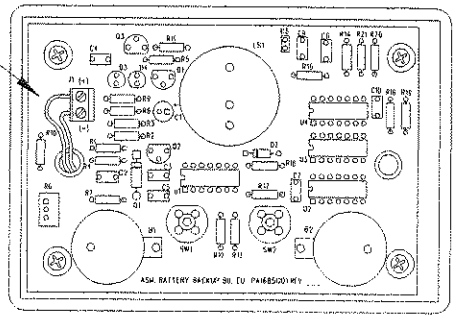
NA0059P05

REMOTE SENTRY

LOW PROFILE CASE
LITHIUM BATTERY OPERATED
AUDIBLE ALARM
PUSH TO SILENCE ALARM
PUSH TO TEST ALARM



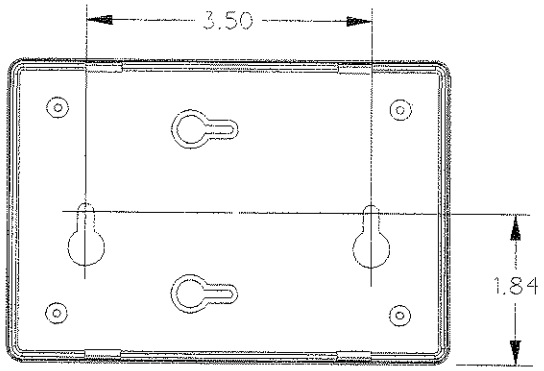
CONNECTION FROM ALARM PANEL



REMOTE SENTRY SHOWN WITHOUT COVER

SPECIFICATIONS

12 VDC POWER SUPPLY - (4) LITHIUM CELLS
THERMOPLASTIC ENCLOSURE - LOW PROFILE WALL MOUNT
(5.4" W x 3.69" H x 1.25" D)



MOUNTING DIMENSIONS

DRL	CAH	12/12/01	-	1/2
DR BY	CHK'D	DATE	ISSUE	SCALE

SEWER SYSTEMS

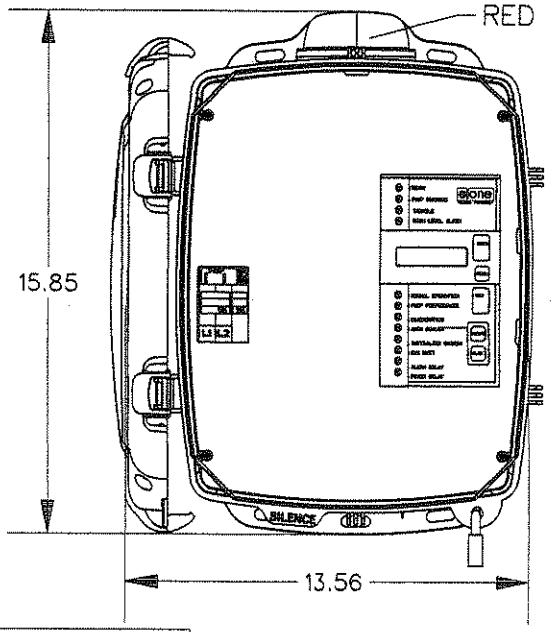
REMOTE SENTRY

LM000196

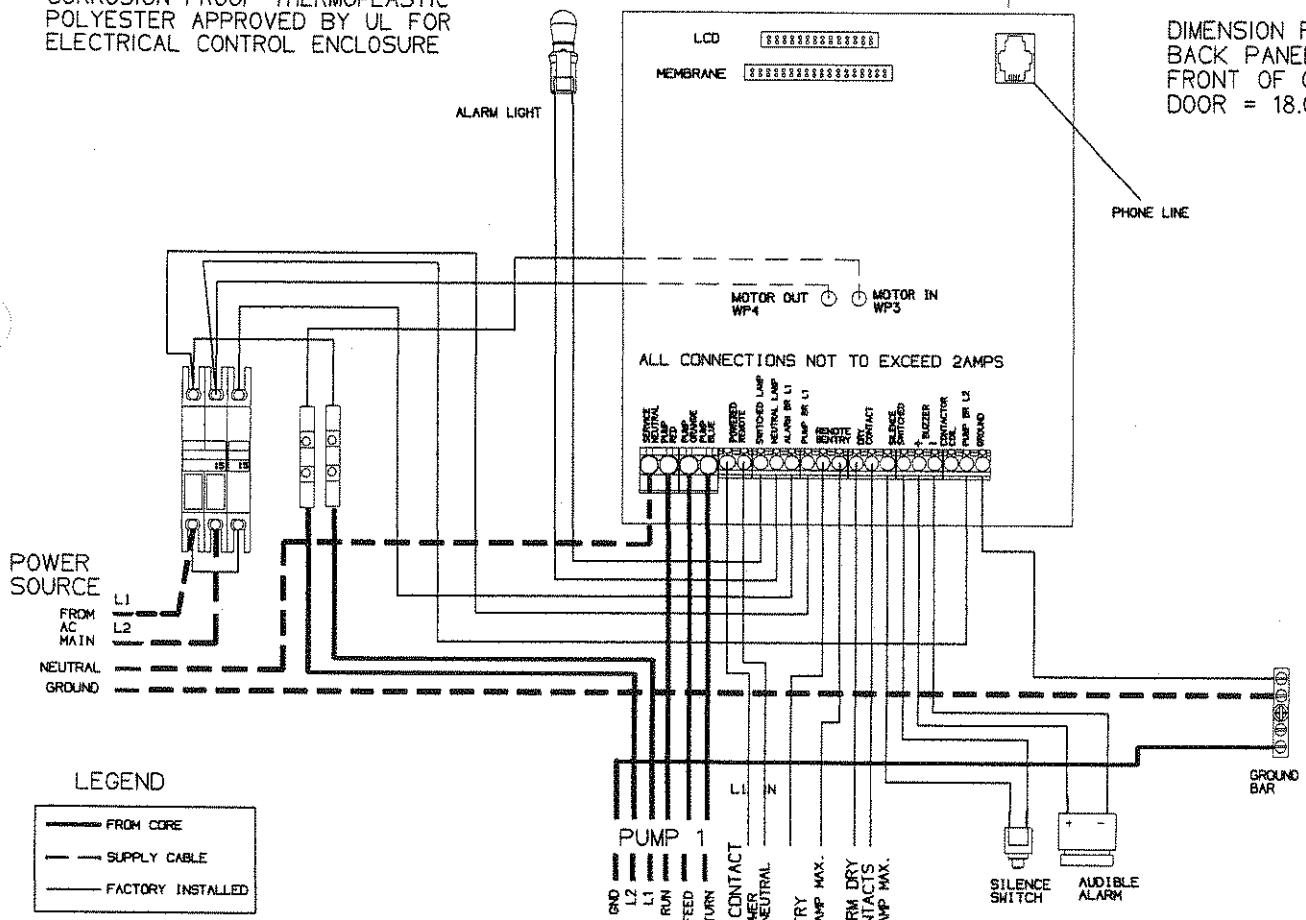
SENTRY SIMPLEX PRESTAT

REDUNDANT RUN (HIGH LEVEL)
EXTERNAL VISUAL & AUDIBLE ALARM
EXTERNAL LATCHING MANUAL SILENCE
MANUAL RUN
PUMP RUN INDICATOR
CONFORMAL COATED CIRCUIT BOARD
PADLOCK
DEAD FRONT
PREDICTIVE ALARMS
REAL TIME PUMP PERFORMANCE
ADJUSTABLE ALARM DELAY
ADJUSTABLE RUN TIME DELAY
HOUR/CYCLE COUNTER
PROGRAMMABLE AUTO DIALER
NEMA 4X ENCLOSURE ASSEMBLY

CORROSION PROOF THERMOPLASTIC POLYESTER APPROVED BY UL FOR ELECTRICAL CONTROL ENCLOSURE



DIMENSION FROM BACK PANEL TO FRONT OF OPEN DOOR = 18.02"



LEGEND

- FROM CORE
- SUPPLY CABLE
- FACTORY INSTALLED

PIN	FUNCTION	2000S	EXTREME
1	MANUAL RUN	RED	BROWN
2	L1	BLACK	RED
3	L2	WHITE	BLACK
4	GND	GREEN	GRN/YEL
5	ALARM FEED	ORANGE	YELLOW
6	ALARM RETURN	BLUE	BLUE

CONTROL CABLE:
TYPE TC: DIRECT BURIAL, 12AWG, SIX CONDUCTOR

CE UPC® ASME A112.3.4

CSA LR26266 UL LISTED 506D NSF

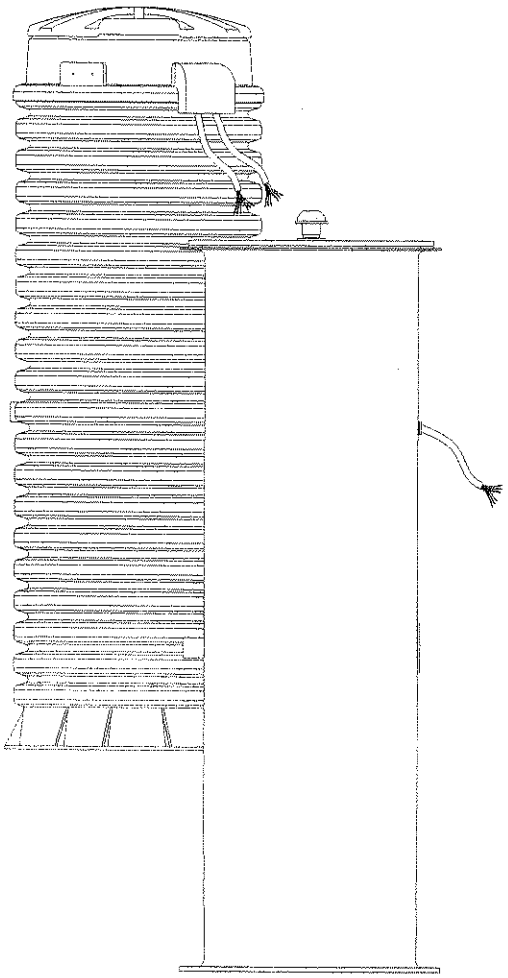
AD	SM	05-03-07	C	N/A
DR BY	CHK'D	DATE	ISSUE	SCALE

eone SEWER SYSTEMS

SENTRY SIMPLEX PRESTAT PANEL, 240V, 60Hz DOUBLE POLE POWER

LM000334

E/ONE EXTREME SERIES



Series-W Wetwell Grinder Pump Station with Wired Level Sensor

Typical Specifications

Semi-Positive Displacement Type Grinder Pump Stations

SECTION: GRINDER PUMP STATIONS

1.0 General

1.01 GENERAL DESCRIPTION: The **MANUFACTURER** shall furnish complete factory-built and tested grinder pump unit(s), each consisting of a grinder pump core suitably mounted on an integral stand of stainless steel, electrical quick disconnect (NEMA 6P), pump removal harness, discharge assembly and shut-off valve, anti-siphon valve and check valve assembly, electrical alarm assembly, and all necessary internal wiring and controls. For ease of serviceability, all pump motor/grinder units shall be of like type and horsepower throughout the system.

1.02 SUBMITTALS: After receipt of notice to proceed, the **MANUFACTURER** shall furnish a minimum of six (6) sets of shop drawings detailing the equipment to be furnished including dimensional data and materials of construction. The **ENGINEER** shall promptly review this data, and return two (2) copies as accepted, or with requested modifications. Upon receipt of accepted shop drawings, the **MANUFACTURER** shall proceed immediately with fabrication of the equipment.

1.03 MANUFACTURER: Grinder pump stations, complete with all appurtenances, form an integral system, and as such, shall be supplied by one grinder pump station manufacturer. The **CONTRACTOR** shall be responsible for the satisfactory operation of the entire system. The equipment specified shall be a product of a company experienced in the design and manufacture of grinder pumps for specific use in low pressure sewage systems. The company shall submit detailed installation and user instructions for its product, submit evidence of an established service program including complete parts and service manuals, and be responsible for maintaining a continuing inventory of grinder pump replacement parts. The **MANUFACTURER** shall provide a reference and contact list from ten of its largest contiguous grinder pump installations of the type of grinder pumps described within this specification.

The **MANUFACTURER** of the grinder pump station shall be Environment One Corporation (or Proposed Alternate).

Attention is directed to the fact that the drawings and overall system design are based on a particular piece of equipment from a particular manufacturer. These specifications are intended to provide guidelines for standard equipment of a recognized manufacturer who already meets all the requirements of this specification.

1.03a ALTERNATE EQUIPMENT: In the event that the **CONTRACTOR** or another supplier proposes an Alternate to the specified **MANUFACTURER**, the **ENGINEER** recognizes that it will be difficult to conform to certain details of this Specification due to different manufacturing techniques or grinder pump station designs. If proposing an Alternate, the **CONTRACTOR** (supplier) must submit, no less than 15 business days in advance of the bid date, a complete description of any changes that will be necessary to the system design, a complete submittal package as outlined in Section 1.02 SUBMITTALS, a system hydraulic analysis (including pipe sizes, flows, velocities, retention times and number and location of recommended valves and cleanouts, if any) based on the proposed pump, a list of exceptions to this Specification, and demonstration of compliance to Section 1.04 EXPERIENCE CLAUSE of this Specification. This information must be submitted to the **ENGINEER** for pre-approval of the alternate equipment being proposed and determination of compliance with these Contract Documents. If the equipment differs materially or differs from the dimensions given on the Drawings, the **CONTRACTOR** (supplier) shall submit complete drawings showing elevations, dimensions, or any necessary changes to the Contract Documents for the proposed equipment and its installation. Pre-approval, if

granted, will be provided in writing by the **ENGINEER** to the **CONTRACTOR** (supplier) at least five business days in advance of the bid date. If the **ENGINEER'S** approval is obtained for Alternate Equipment, the **CONTRACTOR** (supplier) must make any needed changes in the structures, system design, piping or electrical systems necessary to accommodate the proposed equipment at the expense of the **CONTRACTOR** (supplier).

1.04 EXPERIENCE CLAUSE: The equipment furnished hereunder shall be the product of a company experienced in the design and manufacture of grinder pumps specifically designed for use in low pressure systems. All manufacturers proposing equipment for this project shall have at least ten (10) years of experience in the design and manufacture of units of identical size(s) and performance to the specified units. All manufacturers proposing equipment for this project must also have not less than five hundred (500) successful installations of low pressure sewer systems utilizing grinder pumps of like type to the grinder pumps specified herein. An installation is defined as a minimum of twenty-five (25) pumps discharging into a common force main which forms a low pressure sewer system. The **CONTRACTOR** (supplier) proposing alternate equipment shall also submit, as part of the bid schedule, an installation list with contact person(s), phone number(s) and date(s) of at least ten (10) installations of the type of pump specified herein that have been in operation for at least 10 years.

In lieu of this experience clause, the **CONTRACTOR** (supplier) of alternate equipment will be required to submit a five (5) year performance bond for one hundred (100) percent of the stipulated cost of the equipment as bid and as shown in the Bid Schedule. This performance bond will be used to guarantee the replacement of the equipment in the event that it fails within the bond period.

1.05 OPERATING CONDITIONS: The pumps shall be capable of delivering 15 GPM against a rated total dynamic head of 0 feet (0 PSIG), 11 GPM against a rated total dynamic head of 92 feet (40 PSIG), and 7.8 GPM against a rated total dynamic head of 185 feet (80 PSIG). The pump(s) must also be capable of operating at negative total dynamic head without overloading the motor(s). Under no conditions shall in-line piping or valving be allowed to create a false apparent head.

1.06 WARRANTY: The grinder pump **MANUFACTURER** shall provide a part(s) and labor warranty on the complete station and accessories, including, but not limited to, the panel for a period of twenty-four (24) months after notice of **OWNER'S** acceptance, but no greater than twenty-seven (27) months after receipt of shipment. Any manufacturing defects found during the warranty period will be reported to the **MANUFACTURER** by the **OWNER** and will be corrected by the **MANUFACTURER** at no cost to the **OWNER**.

1.07 WARRANTY PERFORMANCE CERTIFICATION: As a bid certification requirement, each bidder shall provide with their bid schedule a Warranty Performance Certification statement executed by the most senior executive officer of the grinder pump **MANUFACTURER**, which certifies a minimum of a twenty four (24) month warranty. They must further detail any exclusions from the warranty or additional cost items required to maintain the equipment in warrantable condition, including all associated labor and shipping fees, and certify that the **MANUFACTURER** will bear **all** costs to correct any original equipment deficiency for the effective period of the warranty. All preventive maintenance type requirements shall be included in this form as exclusions. These requirements include, but are not limited to, unjamming of grinder mechanism, periodic motor maintenance, and periodic cleaning of liquid level controls. Should the **CONTRACTOR** (supplier) elect to submit a performance bond in lieu of the experience clause outlined above, this Warranty Performance Certification shall also be used as a criterion to evaluate the **CONTRACTOR'S** (supplier's) performance over the warranty period. A Warranty Performance Certification form is included with the bid schedule and must be completed

and submitted as part of the bid package. Bids with incomplete forms or missing forms will be considered nonresponsive.

2.0 PRODUCT

2.01 PUMP: The pump shall be a custom designed, integral, vertical rotor, motor driven, solids handling pump of the **progressing cavity type** with a single mechanical seal. Double radial O-ring seals are required at all casting joints to minimize corrosion and create a protective barrier. All pump castings shall be cast iron, fully epoxy coated to 8-10 mil Nominal dry thickness, wet applied. The rotor shall be through-hardened, highly polished, precipitation hardened stainless steel. The stator shall be of a specifically compounded ethylene propylene synthetic elastomer. The material shall be suitable for domestic wastewater service. Its physical properties shall include high tear and abrasion resistance, grease resistance, water and detergent resistance, temperature stability, excellent aging properties, and outstanding wear resistance. Buna-N is not acceptable as a stator material because it does not exhibit the properties as outlined above and required for wastewater service.

2.02 GRINDER: The grinder shall be placed immediately below the pumping elements and shall be direct-driven by a single, one-piece motor shaft. The grinder impeller assembly shall be securely fastened to the pump motor shaft by means of a threaded connection attaching the grinder impeller to the motor shaft. Attachment by means of pins or keys will not be acceptable. The grinder will be a one-piece, forged 4140 cutter wheel of the rotating type with inductively hardened cutter teeth (Rockwell 55-58c) for abrasion resistance. A stationary quench hardened and ground shredding ring shall be provided. The shredding ring will have a staggered tooth pattern with only one edge engaged at a time, maximizing the cutting torque.

This assembly shall be dynamically balanced and operate without objectionable noise or vibration over the entire range of recommended operating pressures. The grinder shall be constructed so as to eliminate clogging and jamming under all normal operating conditions including starting. Sufficient vortex action shall be created to scour the tank free of deposits or sludge banks which would impair the operation of the pump. These requirements shall be accomplished by the following, in conjunction with the pump:

1. The grinder shall be positioned in such a way that solids are fed in an upward flow direction.

2. The maximum flow rate through the cutting mechanism must not exceed 4 feet per second. This is a critical design element to prevent jamming and as such must be adhered to.

3. The inlet shroud shall have a diameter of no less than 5 inches. Inlet shrouds that are less than 5 inches in diameter will not be accepted due to their inability to maintain the specified 4 feet per second maximum inlet velocity which by design prevents unnecessary jamming of the cutter mechanism and eliminates blinding of the pump by large objects blocking the inlet shroud.

4. The impeller mechanism must rotate at a nominal speed of no greater than 1800 rpm.

The grinder shall be capable of reducing all components in normal domestic sewage, including a reasonable amount of "foreign objects," such as paper, wood, plastic, glass, rubber and the like, to finely-divided particles which will pass freely through the passages of the pump and the 1-1/4" diameter stainless steel discharge piping.

2.03 ELECTRIC MOTOR: As a maximum, the motor shall be a 1 HP, 1725 RPM, 240 Volt 60 Hertz, 1 Phase, capacitor start, ball bearing, air-cooled induction type with Class F installation, low starting current not to exceed 30 amperes and high starting torque of 8.4 foot pounds. The motor shall be press-fit into the casting for better heat transfer and longer winding life. Inherent protection against running overloads or locked rotor conditions for the pump motor shall be provided by the use of an automatic-reset, integral thermal overload protector incorporated into the motor. This motor protector combination shall have been specifically investigated and listed by Underwriters Laboratories, Inc., for the application. Non-capacitor start motors or permanent split capacitor motors will not be accepted because of their reduced starting torque and consequent diminished grinding capability. The wet portion of the motor armature must be 300 Series stainless. To reduce the potential of environmental concerns, the expense of handling and disposing of oil, and the associated maintenance costs, oil-filled motors will not be accepted.

2.04 MECHANICAL SEAL: The pump/core shall be provided with a mechanical shaft seal to prevent leakage between the motor and pump. The seal shall have a stationary ceramic seat and carbon rotating surface with faces precision lapped and held in position by a stainless steel spring.

2.05 TANK: **High Density Polyethylene Construction.** The tank shall be a wetwell design made of high density polyethylene of a grade selected for environmental stress cracking resistance. Corrugated sections are to be made of a double wall construction with the internal wall being generally smooth to promote scouring. Corrugations of outside wall are to be of a minimum amplitude of 1 1/2" to provide necessary transverse stiffness. Any incidental sections of a single wall construction are to be a minimum .250 inch thick. All seams created during tank construction are to be thermally welded and factory tested for leak tightness. Tank wall and bottom must withstand the pressure exerted by saturated soil loading at maximum burial depth. All station components must function normally when exposed to maximum external soil and hydrostatic pressure.

The tank shall be furnished with PVC inlet flange to accept a 4.50" OD DWV pipe. Tank capacities shall be as shown on the contract drawings.

The tank shall include a lockable cover assembly providing low profile mounting and watertight capability. The cover assembly shall also include an integral 2-inch vent to prevent sewage gases from accumulating in the tank. Accessway design and construction shall facilitate field adjustment of station height in increments of 4" or less without the use of any adhesives or sealants requiring cure time before installation can be completed. An electrical junction box shall not be permitted in the tank.

The station shall have all necessary penetrations factory sealed and tested. No field penetrations shall be acceptable.

Fiberglass Construction. The tank shall be a wetwell design consisting of a single wall, laminated fiberglass construction. The resin used shall be of a commercial grade suitable for the environment. The reinforcing material shall be a commercial grade of glass fiber capable of bonding with the selected resin. The inner surface shall have a smooth finish and be free of cracks and crazing. The exterior tank surface shall be relatively smooth with no exposed fiber or sharp projections present.

The tank wall and bottom shall be of sufficient thickness and construction to withstand the imposed loading due to saturated soil at the specified burial depth for each available tank height. All station components must function normally when exposed to the external soil and hydrostatic pressures developed at the specified burial depth. The tank bottom shall be reinforced with a fiberglass plate extending beyond the tank walls to support concrete anchoring, as required, to prevent flotation.

The tank shall have a stainless steel discharge bulkhead which terminates outside the tank wall with a 1-1/4" female pipe thread. The discharge bulkhead shall be factory installed and warranted by the manufacturer to be watertight. The tank shall be furnished with an EPDM grommet to accept a 4.50" OD (4" DWV or SCH 40) inlet pipe. The power and control cable shall connect to the pump by means of the provided NEMA 6P electrical quick disconnect (EQD) and shall enter the tank through a watertight strain relief connector supplied by the manufacturer. An electrical junction box shall not be permitted in the tank. Installation of the inlet grommet and cable strain relief shall require field penetration of the tank wall by the installing party. The tank shall also be vented to prevent sewage gases from accumulating inside the tank by means of a factory-provided, field-installed mushroom vent.

Consult the contract drawings for station tank sizes (diameter and height).

Fiberglass Simplex Station Cover (up to 30-inch diameter): The tank shall include a solid fiberglass cover, secured with threaded stainless steel fasteners, providing low profile mounting. The cover shall also be vented to prevent sewage gases from accumulating in the tank.

Fiberglass Duplex Station Cover: Tanks shall include an aluminum checker plate cover, secured with threaded stainless steel fasteners, providing low profile mounting. This cover shall be a 1/3 – 2/3 split hinged cover for ease of access and core removal. The cover shall also be vented to prevent sewage gases from accumulating in the tank.

2.06 DISCHARGE HOSE AND DISCONNECT/VALVE: All discharge fittings and piping shall be constructed of 304 Series stainless steel, polypropylene, EPDM or PVC. The discharge hose assembly shall include a shut-off valve rated for 200 psi WOG and a quick disconnect feature to simplify installation and pump removal. The bulkhead penetration shall be factory installed and warranted by the manufacturer to be watertight.

2.07 ELECTRICAL QUICK DISCONNECT: The grinder pump core shall include a factory-installed NEMA 6P electrical quick disconnect (EQD) for all power and control functions. The EQD will be supplied with a minimum of 32', 25' of useable electrical supply cable (ESC) to connect to the alarm panel. The EQD requires no tools for assembly, seals against water before the electrical connection is made, and includes radial seals to assure watertight seal regardless of tightening torque. Plug-type connections of the power cable onto the pump housing will not be acceptable due to the potential for leaks and electrical shorts. Junction boxes are not acceptable. The EQD shall be so designed to be conducive to field wiring as needed.

2.08 CHECK VALVE: The pump discharge shall be equipped with a factory installed, gravity operated, flapper-type integral check valve built into the stainless steel discharge piping. The check valve will provide a full-ported passageway when open, and shall introduce a friction loss of less than 6 inches of water at maximum rated flow. Moving parts will be made of a 300 series stainless steel and fabric reinforced synthetic elastomer to ensure corrosion resistance, dimensional stability, and fatigue strength. A nonmetallic hinge shall be an integral part of the flapper assembly providing a maximum degree of freedom to assure seating even at a very low back-pressure. The valve body shall be an injection molded part made of an engineered thermoplastic resin. The working pressure of the valve shall be at least 235 psi. Ball type check valves are unacceptable due to their limited sealing capacity in slurry applications.

2.09 ANTI-SIPHON VALVE: The pump discharge shall be equipped with a factory-installed, gravity-operated, flapper-type integral anti-siphon valve built into the stainless steel discharge piping. Moving parts will be made of 300 series stainless steel and fabric-

reinforced synthetic elastomer to ensure corrosion resistance, dimensional stability, and fatigue strength. A nonmetallic hinge shall be an integral part of the flapper assembly, providing a maximum degree of freedom to ensure proper operation even at a very low pressure. The valve body shall be injection-molded from an engineered thermoplastic resin. Holes or ports in the discharge piping are not acceptable anti-siphon devices, due to their tendency to clog from the solids in the slurry being pumped. Anti-siphon port diameter shall be no less than 60% of the inside diameter of the pump discharge piping.

2.10 CORE UNIT: The grinder pump station shall have an easily removable core assembly containing pump, motor, grinder, all motor controls, check valve, anti-siphon valve, electrical quick disconnect and wiring. The watertight integrity of the core unit shall be established by a 100% factory test at a minimum of 5 PSIG.

2.11 CONTROLS: All necessary motor starting controls shall be located in the cast iron enclosure of the core unit secured by stainless steel fasteners. Locating motor starting controls in a plastic enclosure is not acceptable. Wastewater level sensing controls shall be housed in a separate enclosure from motor starting controls. Level sensor housing must be sealed via a radial type seal; solvents or glues are not acceptable. Level sensing control housing must be integrally attached to pump assembly so that it may be removed from the station with the pump and in such a way as to minimize the potential for the accumulation of grease and debris accumulation, etc. Level sensing housing must be a high-impact thermoplastic copolymer over-molded with a thermo plastic elastomer. The use of PVC for the level sensing housing is not acceptable.

Non-fouling wastewater level controls for controlling pump operation shall be accomplished by monitoring the pressure changes in an integral air column connected to a pressure switch. The air column shall be integrally molded from a thermoplastic elastomer suitable for use in wastewater and with excellent impact resistance. The air column shall have only a single connection between the water level being monitored and the pressure switch. Any connections are to be sealed radially with redundant O-rings. The level detection device shall have no moving parts in direct contact with the wastewater and shall be an integral to the pump core assembly in a single, readily-exchanged unit. Depressing the push to run button must operate the pump even with the level sensor housing removed from the pump.

All fasteners throughout the assembly shall be 300 Series stainless steel. High-level sensing will be accomplished in the manner detailed above by a separate air column sensor and pressure switch of the same type. Closure of the high-level sensing device will energize an alarm circuit as well as a redundant pump-on circuit. For increased reliability, pump ON/OFF and high-level alarm functions shall not be controlled by the same switch. Float switches of any kind, including float trees, will not be accepted due to the periodic need to maintain (rinsing, cleaning) such devices and their tendency to malfunction because of incorrect wiring, tangling, grease buildup, and mechanical cord fatigue. To assure reliable operation of the pressure switches, each core shall be equipped with a factory installed equalizer diaphragm that compensates for any atmospheric pressure or temperature changes. Tube or piping runs outside of the station tank or into the tank mounted junction boxes providing pressure switch equalization will not be permitted due to their susceptibility to condensation, kinking, pinching, and insect infestation. The grinder pump will be furnished with a 6 conductor 14 gauge, type SJOW cable, pre-wired and watertight to meet UL requirements with a **FACTORY INSTALLED** NEMA 6P EQD half attached to it.

2.12 ALARM PANEL: Each grinder pump station shall include a NEMA 4X, UL-listed alarm panel suitable for wall or pole mounting. The NEMA 4X enclosure shall be manufactured of thermoplastic polyester to ensure corrosion resistance. The enclosure shall include a hinged, lockable cover with padlock, preventing access to electrical components, and

creating a secured safety front to allow access only to authorized personnel. The enclosure shall not exceed 10.5" W x 14" H x 7" D, or 12.5" W x 16" H x 7.5" D if certain options are included.

The alarm panel shall contain one (1) 15-amp, double-pole circuit breaker for the pump core's power circuit and one (1) 15-amp single-pole circuit breaker for the alarm circuit. The panel shall contain a push-to-run feature, an internal run indicator, and a complete alarm circuit. All circuit boards in the alarm panel are to be protected with a conformal coating on both sides and the AC power circuit shall include an auto resetting fuse.

The alarm panel shall include the following features: external audible and visual alarm; push-to-run switch; push-to-silence switch; redundant pump start; and high level alarm capability. The alarm sequence is to be as follows when the pump and alarm breakers are on:

1. When liquid level in the sewage wet-well rises above the alarm level, audible and visual alarms are activated, the contacts on the alarm pressure switch activate, and the redundant pump starting system is energized.

2. The audible alarm may be silenced by means of the externally mounted, push-to-silence button.

3. Visual alarm remains illuminated until the sewage level in the wet-well drops below the "off" setting of the alarm pressure switch.

The visual alarm lamp shall be inside a red, oblong lens at least 3.75" L x 2.38" W x 1.5" H. Visual alarm shall be mounted to the top of the enclosure in such a manner as to maintain NEMA 4X rating. The audible alarm shall be externally mounted on the bottom of the enclosure, capable of 93 dB @ 2 feet. The audible alarm shall be capable of being deactivated by depressing a push-type switch that is encapsulated in a weatherproof silicone boot and mounted on the bottom of the enclosure (push-to-silence button).

For duplex stations, in addition to the above, two high level indicator lights shall be mounted within the enclosure on the duplex panel's alarm circuit board. During high level alarm indication on duplex stations, the appropriate indicator light will illuminate to indicate which core requires service.

The entire alarm panel, as manufactured and including any of the following options, shall be listed by Underwriters Laboratories, Inc.

(OPTIONAL) Alarm Contacts Package – Note: The Alarm Contacts Package is Included with Optional PreSTAT Feature

- **Alarm Activated Dry Contacts** – Normally open relay contact closes upon alarm activation.
- **Alarm Activated Contacts for Remote Indoor Alarm Module** – Will work with or without power to the alarm panel and is designed to work with E/One's Remote Sentry.
- **Alarm Activated Remote Powered Terminal** – Normally open relay contact closes upon alarm activation supplying an output voltage which will be equal to the alarm circuit input supply voltage.

(OPTIONAL) Generator Receptacle and Auto Transfer – The alarm panel shall include a 20 amp, 250 VAC generator receptacle with a spring-loaded, gasketed cover suitably mounted to provide access for connection of an external generator while maintaining a 4X rating. An automatic transfer switch shall be provided, which automatically switches from

AC power to generator power during a power outage. The alarm board power shall be provided through the generator receptacle during a power outage, allowing the audible and visual alarms to function normally in generator mode. When AC power is restored, the panel is automatically switched back to the AC power mode.

(OPTIONAL) Service Equipment/Main Service Disconnect Breaker – A separate, internal breaker rated and approved for use as "service equipment" and acts as a main service disconnect of the grinder pump station shall be provided.

(OPTIONAL) Remote Sentry Indoor Alarm Module – A separate, remote indoor alarm module shall be provided to indicate a high level alarm with or without AC power to the grinder pump station. The Remote Sentry indoor alarm module shall have an internal power source enabling its continued operation without AC power. The Remote Sentry shall have an audible alarm and a visual alarm, both of which shall automatically reset if the high level alarm condition is eliminated. The Remote Sentry indoor alarm module shall include a Silence button for the audible alarm and a Test button.

(OPTIONAL) Run-time/Hour Meter – A run-time or hour meter to display the total run-time or operation time for the pump core shall be provided.

(OPTIONAL) Event/Cycle Counter – An event or cycle counter to display the number of operations of the pump core shall be provided.

(OPTIONAL) Protection Package, consisting of:

- Brownout Protection w/ Trouble Indication
- Run Dry Protection w/ Trouble Indication
- High System Pressure Protection w/ Trouble Indication

(OPTIONAL; SIMPLEX PANEL ONLY) PreSTAT Diagnostic Package, consisting of:

- High/Low Voltage Monitoring with Trouble Indication
- High/Low Current Monitoring with Trouble Indication
- Extended Run Time with Trouble Indication
- Cycle/Event Counter
- Run-Time Counter (Hour Meter)
- Run Time Limit (time adjustable)
- Power-up Delay (time adjustable)
- Alarm Delay (time adjustable)

(OPTIONAL; SIMPLEX PANEL ONLY) PreSTAT Communications Package, providing one or more of the following:

- GSM Modem communication, and/or
- RS232 output, and/or
- RS485 output, or
- Telephone Modem (land line)

Specific indicators and programming features shall include:

- Ready LED to indicate AC power to the station is satisfactory
- Pump Run LED to indicate pump is operating
- Trouble LED indicator
- High Level Alarm LED indicator
- Manual Run switch to manually activate pump
- Menu-driven programmable controller with navigation overlay-type buttons
- Normal Operation LED for Mode status
- Diagnostic LED's to indicate the Mode switch has been activated

2.13 SERVICEABILITY: The grinder pump core, including level sensor assembly, shall have two lifting hooks complete with lift-out harness connected to its top housing to facilitate easy core removal when necessary. The level sensor assembly must be easily removed from the pump assembly for service or replacement. All mechanical and electrical connections must provide easy disconnect capability for core unit removal and installation. Each EQD half must include a water-tight cover to protect the internal electrical pins while the EQD in unplugged. A pump push-to-run feature will be provided for field trouble shooting. The push to run feature must operate the pump even if the level sensor assembly has been removed from the pump assembly. All motor control components shall be mounted on a readily replaceable bracket for ease of field service.

2.14 OSHA CONFINED SPACE: All maintenance tasks for the grinder pump station must be possible without entry into the grinder pump station (as per OSHA 1910.146 Permit-required confined spaces). *"Entry means the action by which a person passes through an opening into a permit-required confined space. Entry includes ensuing work activities in that space and is considered to have occurred as soon as any part of the entrant's body breaks the plane of an opening into the space."*

2.15 SAFETY: The grinder pump shall be free from electrical and fire hazards as required in a residential environment. As evidence of compliance with this requirement, the completely assembled and wired grinder pump station shall be listed by Underwriters Laboratories, Inc., to be safe and appropriate for the intended use. UL listing of components of the station, or third-party testing to UL standard are not acceptable.

The grinder pump shall meet accepted standards for plumbing equipment for use in or near residences, shall be free from noise, odor, or health hazards, and shall have been tested by an independent laboratory to certify its capability to perform as specified in either individual or low pressure sewer system applications. As evidence of compliance with this requirement, the grinder pump shall bear the seal of NSF International. Third-party testing to NSF standard is not acceptable.

3.0 EXECUTION

3.01 FACTORY TEST: Each grinder pump shall be submerged and operated for 5 minutes (minimum). Included in this procedure will be the testing of all ancillary components such as, the anti-siphon valve, check valve, discharge assembly and each unit's dedicated level controls and motor controls. All factory tests shall incorporate each of the above listed items. Actual appurtenances and controls which will be installed in the field, shall be particular to the tested pump only. A common set of appurtenances and controls for all pumps is not acceptable. Certified test results shall be available upon request showing the operation of each grinder pump at two (2) different points on its curve, with a maximum pressure of no less than 80 psi and a factory bearing vibration test. The **ENGINEER** reserves the right to inspect such testing procedures with representatives of the **OWNER,** at the **GRINDER PUMP MANUFACTURER'S** facility.

All completed stations shall be factory leak tested to assure the integrity of all joints, seams and penetrations. All necessary penetrations such as inlets, discharge fittings and cable connectors shall be included in this test along with their respective sealing means (grommets, gaskets etc.).

3.02 DELIVERY: All grinder pump units will be delivered to the job site 100 percent completely assembled, including testing, ready for installation. Field installation of the pump in tanks under 96" is not allowed. Field installation of the level sensor into the tank is not allowed. Grinder pump stations will be individually mounted on wooden pallets.

3.03 INSTALLATION: Earth excavation and backfill are specified under **SITE WORK**, but are also to be done as a part of the work under this section, including any necessary sheeting and bracing.

The **CONTRACTOR** shall be responsible for handling ground water to provide a firm, dry subgrade for the structure, and shall guard against flotation or other damage resulting from general water or flooding.

The grinder pump stations shall not be set into the excavation until the installation procedures and excavation have been approved by the **ENGINEER**.

Remove packing material. Users instructions MUST be given to the **OWNER**. Hardware supplied with the unit, if required, will be used at installation. The basin will be supplied with a standard 4" inlet grommet (4.50" OD) for connecting the incoming sewer line. Appropriate inlet piping must be used. The basin may not be dropped, rolled or laid on its side for any reason.

Installation shall be accomplished so that 1" to 4" of accessway, below the bottom of the lid, extends above the finished grade line. The finished grade shall slope away from the unit. The diameter of the excavated hole must be large enough to allow for the concrete anchor.

A 6" inch (minimum) layer of naturally rounded aggregate, clean and free flowing, with particle size of not less than 1/8" or more than 3/4" shall be used as bedding material under each unit.

A concrete anti-flotation collar, as detailed on the drawings, and sized according to the manufacturer's instructions, shall be required and shall be pre-cast to the grinder pump or poured in place. Each grinder pump station with its pre-cast anti-flotation collar shall have a minimum of three (3) lifting eyes for loading and unloading purposes.

If the concrete is poured in place, the unit shall be leveled, and filled with water, to the bottom of the inlet, to help prevent the unit from shifting while the concrete is being poured. The concrete must be manually vibrated to ensure there are no voids. If it is necessary to pour the concrete to a level higher than the inlet piping, an 8" sleeve is required over the inlet prior to the concrete being poured.

The **CONTRACTOR** will provide and install a four (4) foot piece of four inch SCH 40 PVC pipe with water tight cap, to stub-out the inlet for the property owners' installation contractor, as depicted on the contract drawings.

The electrical enclosure shall be furnished, installed and wired to the grinder pump station by the **CONTRACTOR**. An alarm device is required on every installation, there shall be **NO EXCEPTIONS**. It will be the responsibility of the **CONTRACTOR** and the **ENGINEER** to coordinate with the individual property owner(s) to determine the optimum location for the Alarm Panel.

The **CONTRACTOR** shall mount the alarm device in a conspicuous location, as per national and local codes. The alarm panel will be connected to the grinder pump station by a length of six (6) conductor 12 gauge type TC cable as shown on the contract drawings. The power and alarm circuits must be on separate power circuits. The grinder pump stations will be provided with a minimum of 32', 25' of useable electrical supply cable outside the station, to connect to the alarm panel. This cable shall be supplied with a **FACTORY INSTALLED** EQD half to connect to the mating EQD half on the core.

3.04 BACKFILL REQUIREMENTS: Proper backfill is essential to the long-term reliability of any underground structure. Several methods of backfill are available to produce favorable

results with different native soil conditions. The most highly recommended method of backfilling is to surround the unit to grade using Class I or Class II backfill material as defined in ASTM 2321. Class 1A and Class 1B are recommended where frost heave is a concern; Class 1B is a better choice when the native soil is sand or if a high, fluctuating water table is expected. Class 1, angular crushed stone, offers an added benefit in that it doesn't need to be compacted.

Class II, naturally rounded stone, may require more compactive effort, or tamping, to achieve the proper density. If the native soil condition consists of clean compactible soil, with less than 12% fines, free of ice, rocks, roots and organic material, it may be an acceptable backfill. Soil must be compacted in lifts not to exceed one foot to reach a final Proctor Density of between 85% and 90%. Heavy, non-compactible clays and silts are not suitable backfill for this or any underground structure such as inlet or discharge lines.

If you are unsure of the consistency of the native soil, it is recommended that a geotechnical evaluation of the material is obtained before specifying backfill.

Another option is the use of a flowable fill (i.e., low slump concrete). This is particularly attractive when installing grinder pump stations in augured holes where tight clearances make it difficult to assure proper backfilling and compaction with dry materials. Flowable fills should not be dropped more than four feet from the discharge to the bottom of the hole to avoid separation of the constituent materials.

Backfill of clean, native earth, free of rocks, roots, and foreign objects, shall be thoroughly compacted in lifts not exceeding 12" to a final Proctor Density of not less than 85%. Improper backfilling may result in damaged accessways. The grinder pump station shall be installed at a minimum depth from grade to the top of the 1 1/4" discharge line, to assure maximum frost protection. The finish grade line shall be 1" to 4" below the bottom of the lid, and final grade shall slope away from the grinder pump station.

All restoration will be the responsibility of the **CONTRACTOR**. Per unit costs for this item shall be included in the **CONTRACTOR'S** bid price for the individual grinder pump station. The properties shall be restored to their original condition in all respects, including, but not limited to, curb and sidewalk replacement, landscaping, loaming and seeding, and restoration of the traveled ways, as directed by the **ENGINEER**.

3.05 START-UP AND FIELD TESTING: The **MANUFACTURER** shall provide the services of qualified factory trained technician(s) who shall inspect the placement and wiring of each station, perform field tests as specified herein, and instruct the **OWNER'S** personnel in the operation and maintenance of the equipment before the stations are accepted by the **OWNER**.

All equipment and materials necessary to perform testing shall be the responsibility of the **INSTALLING CONTRACTOR.** This includes, as a minimum, a portable generator and power cable (if temporary power is required), water in each basin (filled to a depth sufficient to verify the high level alarm is operating), and opening of all valves in the system. These steps shall be completed prior to the qualified factory trained technician(s) arrival on site.

The services of a trained factory-authorized technician shall be provided at a rate of 40 hours for every 100 grinder pump stations supplied.

Upon completion of the installation, the authorized factory technician(s) will perform the following test on each station:

1. Make certain the discharge shut-off valve in the station is fully open.

2. Turn ON the alarm power circuit and verify the alarm is functioning properly.

3. Turn ON pump power circuit. Initiate pump operation to verify automatic "on/off" controls are operative. Pump should immediately turn ON.

4. Consult the Manufacturer's Service Manual for detailed start-up procedures.

Upon completion of the start-up and testing, the **MANUFACTURER** shall submit to the **ENGINEER** the start-up authorization form describing the results of the tests performed for each grinder pump station. Final acceptance of the system will not occur until authorization forms have been received for each pump station installed and any installation deficiencies corrected.

4.0 OPERATION AND MAINTENANCE

4.01 SPARE CORE: The **MANUFACTURER** will supply one (1) spare grinder pump core for every 50 grinder pump stations installed, complete with all operational controls, level sensors, check valve, anti-siphon valve, pump/motor unit, and grinder.

4.02 MANUALS: The **MANUFACTURER** shall supply four (4) copies of Operation and Maintenance Manuals to the **OWNER**, and one (1) copy of the same to the **ENGINEER**.

END OF SECTION

WARRANTY CERTIFICATION

As a pre-bid certification requirement, each bidder shall provide a Warranty Performance Certification executed by the most senior executive officer, which certifies a minimum of a two (2) year warranty. They must further detail any exclusions from the warranty or additional cost items required to maintain the equipment in warrantable condition, including all associated labor and shipping fees, and certify that the manufacturer will bear **all** costs to correct original equipment deficiency for the effective period of the warranty.

I, _____, by and through my duly authorized signature below as its most senior operating executive, certify that_____ will provide a two (2) year warranty on grinder pump equipment manufactured and supplied by _____ _____for the _____ project. I further certify that, other than failure to install equipment in accordance with manufacturer's instructions, no exclusions and/or cost items to maintain said equipment in warrantable condition, including labor, travel and shipping fees, exist except as detailed immediately below:

EXCLUSIONS: 1. _____
2. _____
3. _____

COST ITEMS TO MAINTAIN EQUIPMENT IN WARRANTABLE CONDITION:	Required Frequency (mos)	Avg. monthly cost ($) times warranty period
1. _____	_____	$ _____
2. _____	_____	$ _____
3. _____	_____	$ _____
4. _____	_____	$ _____
5. _____	_____	$ _____

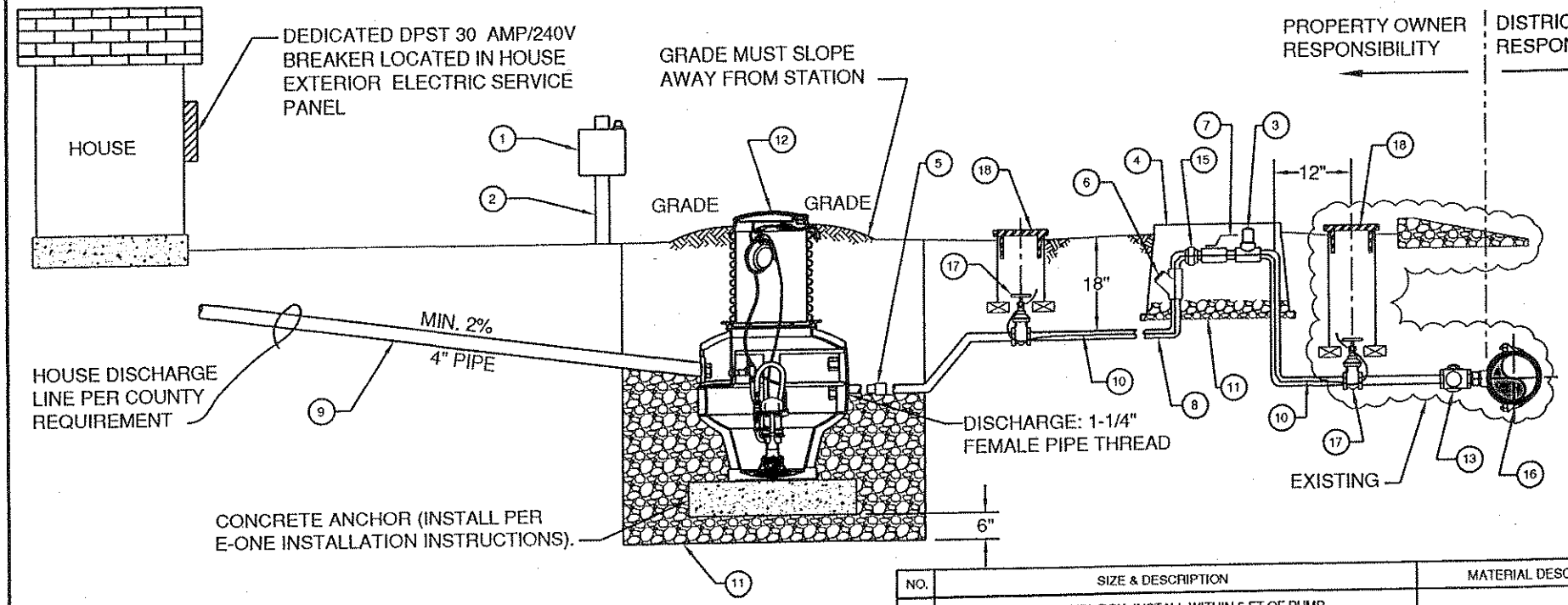
Total labor/material cost to maintain equipment in warrantable condition for warranty period ($):_____
$ _____

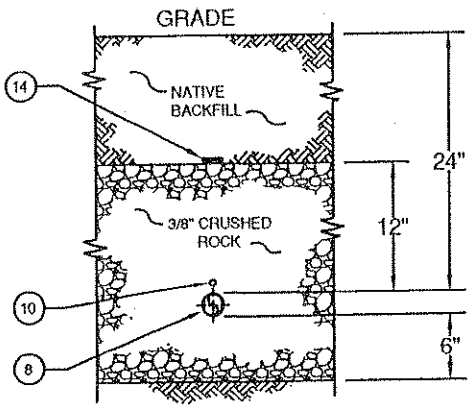
For any items not identified as exclusions or additional cost items above, OR for additional labor & material costs required to maintain equipment in warrantable condition that exceed the Avg. monthly cost ($) detailed above, _____ will bear all costs to correct such original equipment deficiency for the effective period of the warranty including all applicable labor, travel and shipping fees.

_____ _____
Signature Date

_____
Title

Environment One
2773 Balltown Road
Niskayuna, New York 12309





LATERAL TRENCH DETAIL
NOT TO SCALE

NO.	SIZE & DESCRIPTION	MATERIAL DESCRIPTION
1	E-ONE CONTROL PANEL BOX, INSTALL WITHIN 5 FT OF PUMP	
2	4 X 4 POST TREATED	
3	3/4" VACUUM RELIEF VALVE	WATTS N36-M1
4	METER BOX	CARSON 1220
5	1-1/2" X 1-1/4" REDUCER	ASTM D2729
6	1-1/2" VERTICAL BALL CHECK VALVE	FLOWMATIC, PART No. 208T
7	1-1/2" BALL VALVE	WATTS B6080
8	1-1/2" PVC PIPE	ASTM D2241, SCH. 40
9	4" PIPE PER COUNTY REQUIREMENTS	
10	SOLID TONER WIRE ATTACHED TO PIPE	14 GAUGE COPPER
11	3/4" ROCK	
12	GRINDER PUMP (MIN.10' FROM HOUSE)	E-ONE: WH231-92 (MIN.)
13	CORP. STOP	JONES - J1931
14	SEWER TAPE (DETECTABLE) 12" ABOVE PIPE	
15	1-1/2" UNION	ASTM D2729, SCH. 40
16	SADDLE (MAIN SIZE x 1 1/2")	ROMAC 202NS
17	1 1/2" GATE VALVE	BRONZE NIBCO T133
18	VALVE CAN W/SEWER ON LID	

VALLEY CENTER MUNICIPAL WATER DISTRICT
REVISED: 08/08/07

STD. DWG.

GRINDER PUMP INSTALLATION

LPS-1

For Water Heater/Tank Applications

Job Name _____ Contractor _____

Job Location _____ Approval _____

Engineer _____ Contractor's P.O. No. _____

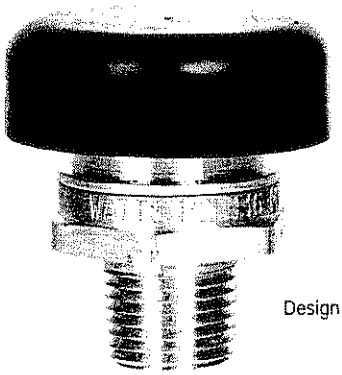
Approval _____ Representative _____

Model N36-M1

Vacuum Relief Valve

Sizes: ½" and ¾" (15 and 20mm) Male NPT

Tested and rated under "ANSI Z21.22 Relief Valves for Hot Water Supply Systems".



Watts N36-M1

Design certified by C SP US

FEATURES

- Low profile
- All brass body
- Protective cap
- Suitable for low pressure steam and water service
- Tested and rated to ANSI Z21.22
- CSA certified

For automatic venting of a closed system to atmosphere when a vacuum is created. The Watts N36-M1 Vacuum Relief Valve permits air to enter and prevent vacuum conditions that could siphon the water from the system, resulting in collapse of a tank or water heater or equipment burn out.

APPLICATIONS

- Domestic water heaters and supply tanks
- Table top heaters
- Jacketed steam kettles
- Unit heaters
- Low pressure steam systems
- Steam coil heaters

Note: Vacuum relief valves are not designed or approved as back-siphonage backflow preventers. For protection against back-siphonage install Watts Series 288A vacuum breakers.

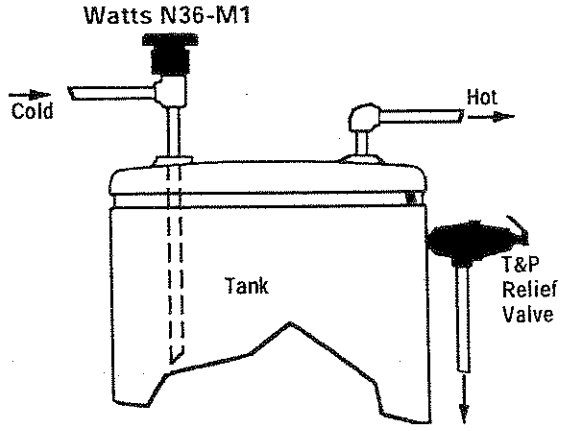


Figure 1
Domestic Hot Water Supply Tanks and Heaters with Top Supply

STANDARDS

Tested and rated to ANSI Z21.22
CSA certified

SPECIFICATIONS

A Watts Model N36-M1 Vacuum Relief Valve shall be installed on domestic hot water supply tanks/ heaters/ unit heaters/ steam kettles as indicated on plans. The vacuum relief valve shall be ANSI Z21.22 rated and CSA certified. The vacuum relief valve shall have an all brass body and include a protective cap.

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Water Products Division • Safety & Control Valves

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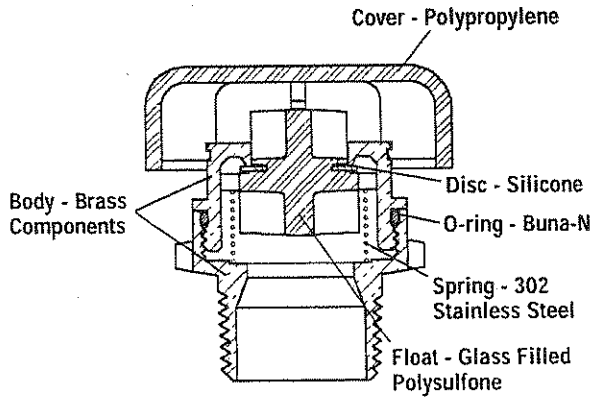
Canada: 5435 North Service Rd., Burlington, ONT. L7L 5H7; www.wattscda.com

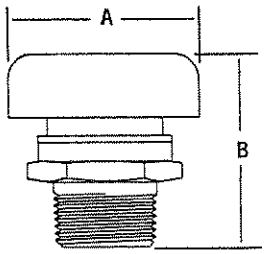
MATERIALS



PRESSURE/TEMPERATURE

Maximum steam working pressure: 15 psi (1.03 bars)
Maximum temperature: 250°F (121°C)

DIMENSIONS / WEIGHT



Size (DN)		Dimensions A		B		Weight	
in.	mm	in.	mm	in.	mm	oz.	gr.
½	15	2	50	2	50	4	113
¾	20	2	50	2	50	4	113

CAPACITY

Size (DN)			Venting Capacity	
in.	mm	Model	CFM	LPM
½	15	N36-M1	15	425
¾	20	N36-M1	15	425

TYPICAL INSTALLATIONS

Water Service

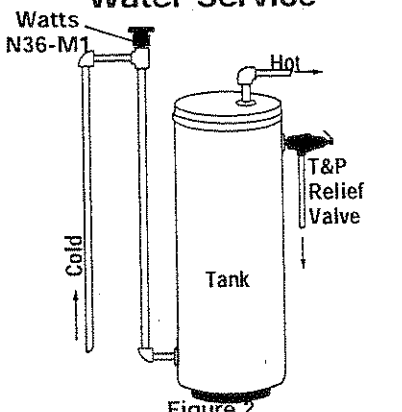


Figure 2
Domestic Hot Water Supply Tanks and Heaters with Bottom Feed

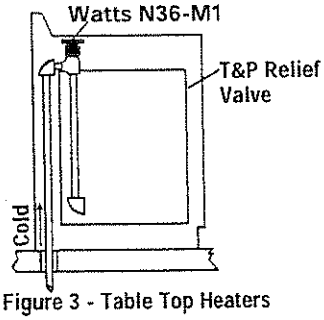


Figure 3 - Table Top Heaters

Steam Service

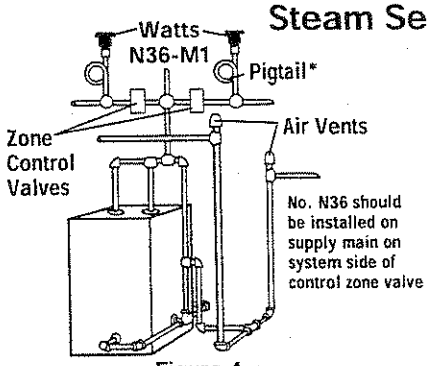


Figure 4
Low Pressure Steam Heating Systems

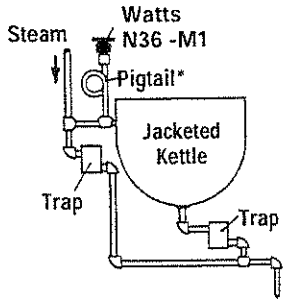


Figure 5
Jacketed Kettles

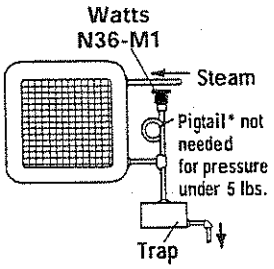


Figure 6
Unit Heaters

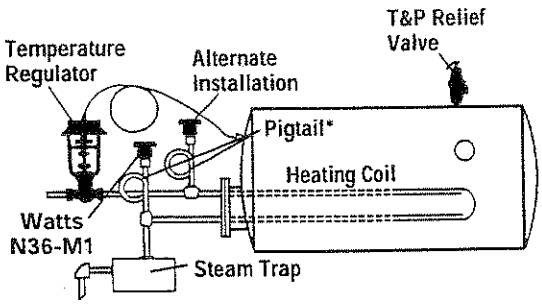


Figure 7
Steam Coil Heaters

*Note: When used for steam service, be sure to use pigtail to prevent live steam from damaging N36 valve.

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Canada: 5435 North Service Rd., Burlington, ONT. L7L 5H7; www.wattscda.com
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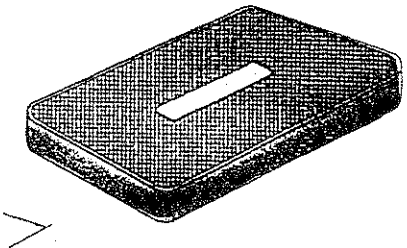
Printed in U.S.A.

Small Box Series
General Detail

Model 1220-12

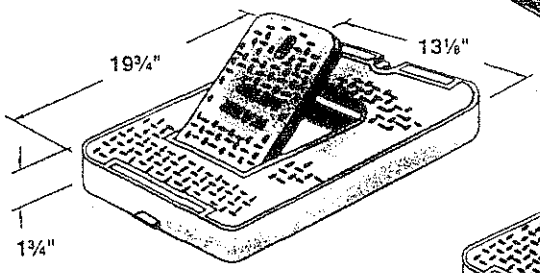
1220 Polymer Concrete Cover

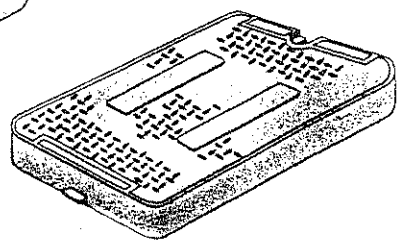
Weight: Polymer Concrete 27 lbs.
Part No: 1220-PR



1220 Non Hinged Cover

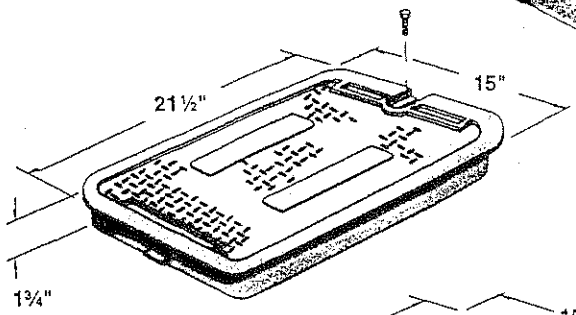
Weight: HDPE 4 lbs.
Part No: 1220-3 Non Bolt
1220-3B Bolt Down
Solid Cast Iron Also Available





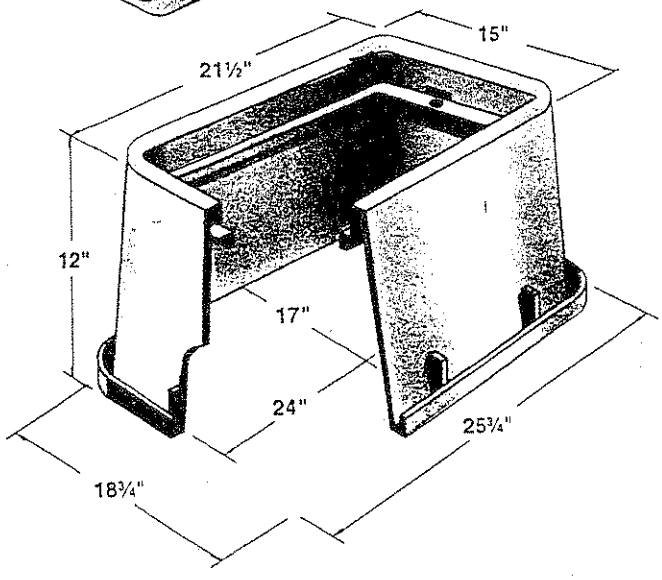
1220 Meter Reading Cover

Weight: HDPE 4 lbs.
Part No: 1220-5 Non Bolt
1220-5B Bolt Down
Weight: Cast Iron Reader 2 lbs.
Part No: 1220-6 Non Bolt
1220-6B Bolt Down



1220 T-Cover

Weight: HDPE 4 lbs.
Part No: 1220-4 Non Bolt
1220-4B Bolt Down
Solid Cast Iron Also Available



1220 Box

Weight: HDPE 9.4 lbs.
Part No: 1220-12

Colors Available:
Green or Grey
Black or Tan on Special Order

* NOTE: For use in non-vehicular traffic installations only. We do NOT recommend installation in concrete or asphalt. Weights and dimensions may vary slightly.

Revision Date 1/1/98

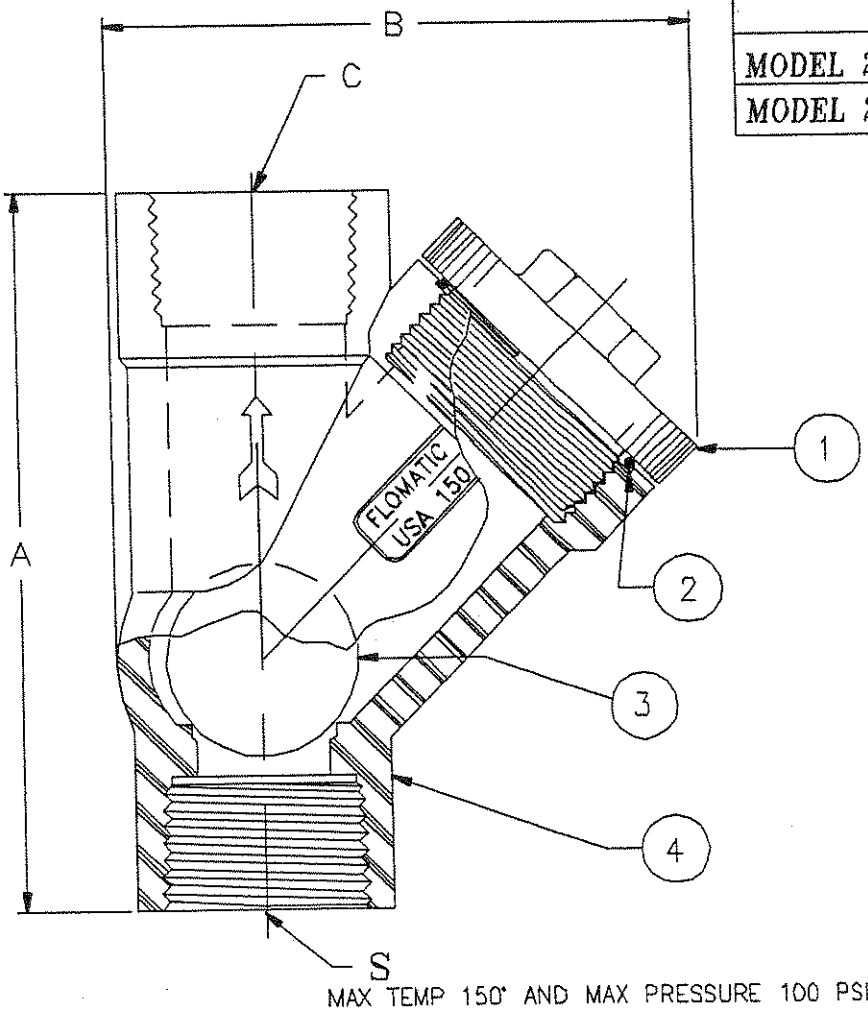
CARSON INDUSTRIES, INC.
Glendora, California
Toll-Free: (800) 735-5566
Phone: (909) 592-6272
Fax: (909) 592-7971

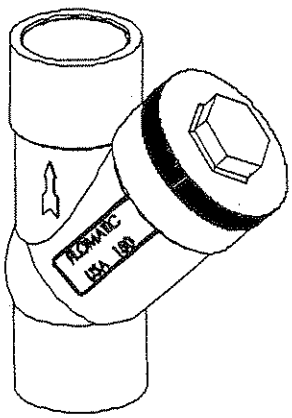
CARSON INDUSTRIES, LTD.
Roscommon, Ireland
Phone: 35 39 03-25922
Fax: 35 39 03-25921

BALL CHECK VALVE
1" thru 2"

MODEL 208T - THREADED

MODEL 208S - SOCKET





MAX TEMP 150° AND MAX PRESSURE 100 PSI

NOTE: PLASTIC VALVES SHOULD NOT BE BURIED UNDERGROUND

* USES BUSHING NOT SHOWN

FOR REFERENCE USE ONLY, SPECIFICATIONS TO CHANGE WITHOUT NOTICE.

SIZE - C	PART NO.	A	B
*1"-NPT	2131-T	6 27/32	4 1/2
*1"-SOCKET	2131-S	6 25/32	4 1/2
1 1/4"-NPT	2132-T	5 21/32	4 1/2
1 1/4"-SOCKET	2132-S	5 5/8	4 1/2
*1 1/2"-NPT	2133-T	8 13/64	6 11/32
*1 1/2"-SOCKET	2133-S	8 13/64	6 11/32
2"-NPT	2134-T	7 1/16	6 11/32
2"-SOCKET	2134-S	7 1/16	6 11/32

ITEM	QTY.	DESCRIPTION	MATERIAL	ASTM
1	1	CAP	PVC	---
2	1	O-RING	BUNA-N	---
3	1	BALL (SINKING)	BUNA-N	---
4	1	BODY	PVC	---
5*	2	BUSHING (NOT SHOWN)	PVC	---

FLOMATIC®
DANFOSS FLOMATIC CORP
GLENS FALLS, N.Y. 12801
PHONE (518) 761-9797
FAX (518) 761-9798

DATE : 11-1-91
DWG. NO.: S2131-34
REV.: G (4/03)

For Commercial and Industrial Applications

Job Name _____ Contractor _____

Job Location _____ Approval _____

Engineer _____ Contractor's P.O. No. _____

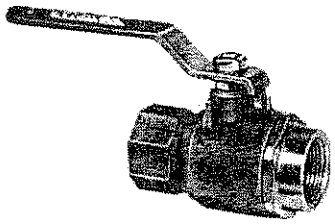
Approval _____ Representative _____

Series B6080, B6081

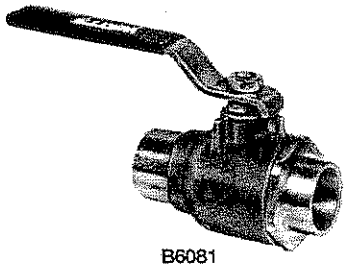
2-Piece, Full Port, Bronze Ball Valves

Sizes: ½" – 2" (15 – 50mm)

Series B6080, B6081 2-Piece, Full Port, Bronze Ball Valves feature virgin PTFE seats and seals. The B6080, B6081's full port orifice ensures minimal pressure drop, while virgin PTFE stem packing seal, thrust washer and chrome plated brass ball provide lasting service.



B6080



B6081

Features

- Virgin PTFE seats and seals are standard
- Suitable for a full range of liquids and gases
- Minimal pressure drop due to full port design
- Blowout proof pressure retaining stem
- Pressure rated at 600psi (41 bar) WOG non-shock; 150psi (10 bar) WSP
- Virgin PTFE stem packing seal and thrust washer
- Vinyl insulator on heavy duty, zinc-plated carbon steel handles
- Fast quarter-turn open or close operation
- Excellent for throttling and balancing applications of non-abrasive fluids where minimum flow is 20% to 100% of valve capacity
- Low operating torque
- Adjustable stem packing
- Each valve factory tested

Models

B6080 ½" – 2" (15 – 50mm) threaded NPT end connections

B6081 ½" –2" (15 – 50mm) solder end connections

Specifications

A 2-piece full port bronze ball valve to be installed as indicated on the plans. The valve must have a blowout proof pressure retaining stem, chrome plated brass ball, virgin PTFE seats, seals, stem packing seal and thrust washer. Valve must have adjustable packing. Valves with O-ring stem seal only is not acceptable. Pressure rating no less than 600psi (41 bar) WOG non-shock, 150psi (10 bar) WSP. Valve shall be manufactured to the MSS-SP-110 standard and shall be a Watts Regulator Company Series B6080 (threaded) or B6081 (solder).

Pressure — Temperature

Temperature Range: 0°F - 350°F (-18°C – 177°C) @ 50psi (3.5 bar)

Maximum Working Pressure: 600psi (41 bar) WOG non-shock; 150psi (10 bar) WSP

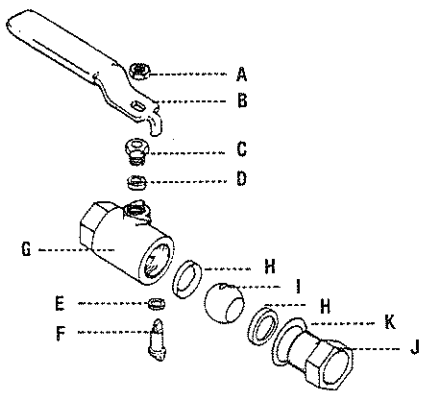
Options

Suffix	
SS –	Stainless steel ball and stem
OV –	Oval handle
RH –	Round handle
SH –	Stainless steel handle and nut
BS –	Balancing stop
XH –	Extended handle
TH –	Tee handle
G –	All SS models (grounded ball & stem)
GS –	Ground washer

*This valve is designed to be soft soldered into lines without disassembly, using a low temperature solder 420°F (215°C). Other solders such as 95/5 tin antimony 460°F (238°C) can be used. However, extreme caution must be used to prevent seat damage. Higher temperature solders will damage the seat material. ANSI B.15.18 states that the maximum operating pressure of 50-50 solder connections is 200psi (14 bar) at 100°F (38°C) and decreases with higher temperature.
Apply heat with the flame directed **AWAY** from the center of the valve body. Excessive heat can harm the seats. After soldering, the packing nut may have to be tightened.

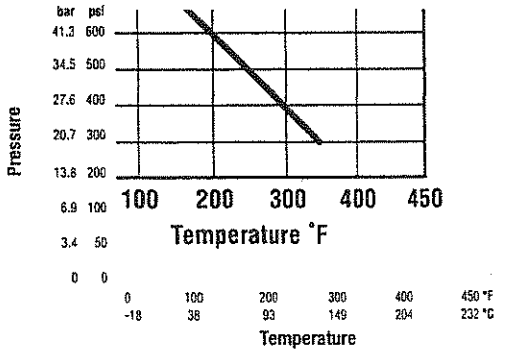
WATTS®

Materials



A	**Handle Nut**	Zinc Plated Carbon Steel
B	**Handle**	Zinc Plated Carbon Steel with Vinyl Insulator
C	**Packing Nut**	Brass ASTM B16, C36000
D	**Stem Packing**	PTFE
E	**Thrust Washer**	PTFE
F	**Stem**	Brass ASTM B16, C36000
G	**Body**	Bronze ASTM B584, C84400
H	**Seats**	Virgin PTFE
I	**Ball**	Chrome Plated Brass
J	**Adapter**	Brass ASTM B16, C36000
K	**Body Seal**	PTFE (1¼" – 2")

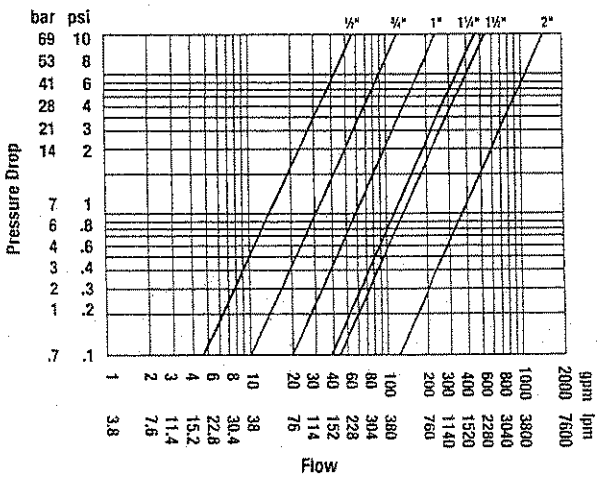
Valve Seat Rating



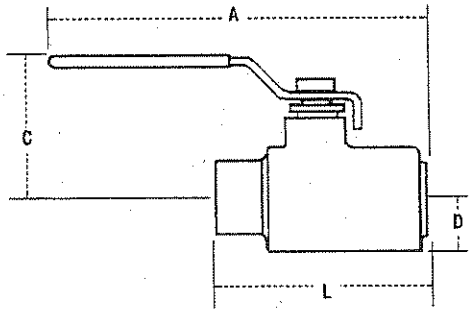
Valve Torque Rating

SIZE (DN)		OPERATING TORQUE		
in.	*mm*	*in.– lbs.*	*N-m*	*Cv*
½	15	60	6.8	15
¾	20	150	16.95	30
1	25	200	22.60	60
1¼	32	250	28.25	110
1½	40	320	36.16	130
2	50	500	56.50	360

Pressure Drop vs. Flow



Dimensions — Weights



SIZE (DN)		DIMENSIONS														WEIGHTS	
		Ball Orifice		A (B6080)		A (B6081)		C		D		L (B6080)		L (B6081)			
in.	*mm*	*in.*	*mm*	*in.*	*mm*	*in.*	*mm*	*in.*	*mm*	*in.*	*mm*	*in.*	*mm*	*in.*	*mm*	*lbs.*	*kgs.*
½	15	½	13	4 25/32	121	4 7/8	124	1 5/8	41	7/8	22	2 9/32	58	2 9/16	65	0.6	0.3
¾	20	¾	19	5	127	5 5/16	135	1 3/4	45	1	25	2 13/16	71	2 13/16	71	1.0	0.5
1	25	1	25	5 7/16	138	5 11/16	145	2	51	1 1/4	32	3 9/16	91	3 7/8	98	1.8	0.8
1¼	32	1¼	32	7 9/16	192	7 9/16	192	2 7/8	73	1 1/2	38	4 1/8	105	4 5/16	110	4.0	1.8
1½	40	1½	38	7 11/16	195	7 7/8	200	3	76	1 5/8	41	4 7/16	113	4 3/4	121	5.5	2.5
2	50	2	51	10 11/16	272	11	279	4	102	2	51	5 3/8	137	6	152	10.0	4.5

WATTS®

Water Safety & Flow Control Products

ISO 9001 CERTIFIED

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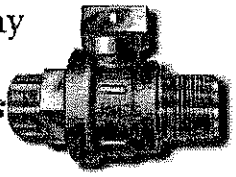
Canada: 5435 North Service Rd., Burlington, ONT. L7L 5H7; www.wattscanada.ca

James Jones Company

Corporation Stops Products



SECTION B

Corporation Stops - Ball Valves - Bronze

Pipe wrenches should not be used to install Corporation Stops. Smooth jaw wrench should be used on the flat area of the body.

It is recommend that all pressure testing be done prior to backfilling.

Replacement components for compression fittings are available from you Jones distributor; see Section H for descriptions.

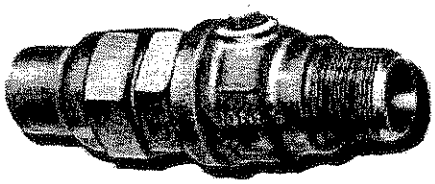
Box quantities are located in the Trade Net Sheet.

All compression nut threads on Jones corporation Stoops are Copper flare threads.

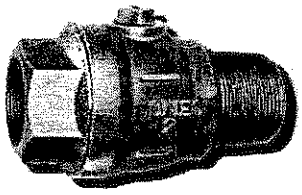
Super Grips (SG) nuts in 1 1/2" and 2" sizes have special threads and require a Jones adapter.

Maximum working pressure on ground key valves in 100 psi on 3/4" an d1" valves, and 80 psi on 1 1/2" and 2" valve. These pressures are in accordance with AWWA C-800-89.

Ball valve working pressure is rated at 300 psi

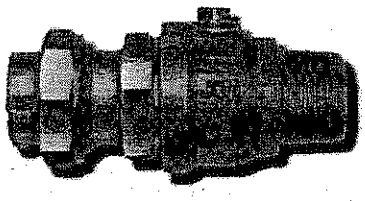


J-1930

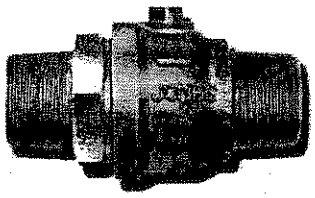


J-1931

J-NO.	DESCRIPTION	SIZES			
J-1929	Inlet M.I.P. Thread; Outlet for Flared Copper. (Not Shown)	3/4"	1"	1 1/2"	2"
J-1930	Inlet Male Corporation Stop Thread; Outlet for Flared Copper.	3/4"	1"	1 1/2"	2"
J-1931	Inlet M.I.P. Thread; Outlet F.I.P. Thread.	3/4"	1"	1 1/2"	2"
J-1932	Inlet Male Corporation Stop Thread; Outlet F.I.P. Thread. (Not Shown)	3/4"	1"	1 1/2"	2"



J-1935



J-1943

J-NO.	DESCRIPTION	SIZES			
J-1935	Inlet M.I.P. Thread; Compression Connection for TUBE SIZE PLASTIC or Copper Tubing.	3/4"	1"	1 1/2"	2"
J-1936	Inlet M.I.P. Thread; Compression Connection for PIPE SIZE PLASTIC. (Not Shown)	3/4"	1"	-----	-----
J-1937	Inlet Male Corporation Stop Thread; Outlet, Compression Connection for TUBE SIZE PLASTIC OR Copper Tubing. (Not Shown	3/4"	1"	1 1/2"	2"
J-1943	Inlet M.I.P. Thread; Outlet Same Size M.I.P. Thread.	3/4"	1"	1 1/2"	2"
J-1944	Inlet Male Corporation Stop Thread; Outlet Same Size M.I.P. Thread (Not Shown).	3/4"	1"	1 1/2"	2"

ROMAC INDUSTRIES, INC.

STYLE 101NS & 202NS SERVICE SADDLE

SUBMITTAL INFORMATION

MATERIALS

Casting	The saddle body is cast from ductile (nodular) iron, meeting or exceeding ASTM A 536, Grade 65-45-12.
Gasket	Gasket is made from Nitrile Butadiene Rubber (NBR) compounded for water and sewer service and a tolerance of petroleum products in accordance with ASTM D 2000 MBC 610. Other compounds available for special applications.
Straps	Type 304 (18-8) heavy gauge Stainless Steel per ASTM A 240. Straps are two inches wide to spread out clamping forces on the pipe. GMAW and GTAW welds. Passivated for corrosion resistance.
Bolts, Nuts	For sizes 1-1/2" through 3", 1/2" UNC roll thread Type 304 (18-8) Stainless Steel bolts with heavy hex nuts. 4" and above use 5/8" UNC roll thread Type 304 (18-8) Stainless Steel bolts with heavy hex nuts. Rod for bolts are per ASTM A 240 and nuts are per ASTM A 194. All welds fully passivated for enhanced corrosion resistance. Nuts coated to prevent galling.
Washers	Flat, type 304 (18-8) heavy gauge Stainless Steel.
Coating	Casting is coated with fusion bonded black nylon, 10-12 mils thick, with a dielectric strength of 1,000 v/mil.
PRESSURE RATING	Ductile iron, cast iron and steel pipe: rating of pipe up to 350 psi maximum, pipe sizes up through 24 inch, larger than 24 inch up to 30 inch pressure rating is 150 psi. PVC and asbestos cement pipe: rating of pipe up to 235 psi maximum. For other applications please consult your representative.
AWWA STANDARDS	These service saddles meet the requirements of ANSI/AWWA C800, Underground Service Line Valves and Fittings.
SIZES AND RANGES	See Catalog. 7/07

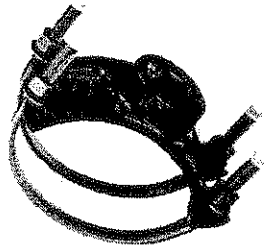
Romac Document Number 25-8-0003

This information is based on the best data available at the date printed above, please check with Romac Engineering Department for any updates or changes.

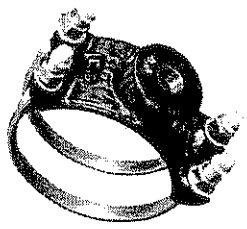
ROMAC INDUSTRIES, INC.
1-800-426-9341

MADE IN U.S.A

Double Strap Service Saddles



Style 202U
Painted Saddle
with U-Bolts



Style 202NU
Nylon Coated Saddle
with U-Bolts

Style 202S
Painted Saddle
with Stainless Steel Straps

Style 202NS
Nylon Coated Saddle
with Stainless Steel Straps

NOMINAL PIPE SIZE	O.D. PIPE RANGE	½" I.P, ¾" & 1" I.P. or C.C. TAP						1 ¼" – 1 ½" – 2" I.P. or C.C. TAP (2 ½" IP ONLY)						
		202U	202NU	CTN QTY	202S	202N	CTN QTY	202	202NU	CTN QTY	202S	202NS	CTN QTY	APPROX. WEIGHT ea. (lbs.)
2"	2.38 - 2.50[1]	$30.93	$48.11	10	$75.40	$92.57	10	$32.46	$52.19	10	$81.77	$101.49	10	3.5 #
3"	3.50[2]	36.80	54.64	8	75.55	93.38	8	47.71	62.60	8	86.79	101.68	8	5.0 #
	3.45 - 4.05[2]	36.80	54.64	8	75.55	93.38	8	47.71	62.60	8	86.79	101.68	8	5.0 #
4"	4.00 - 4.50	41.00	58.33	5	76.05	93.38	6	51.81	66.43	5	87.05	101.68	6	7.5 #
	4.50 - 4.80	41.00	58.33	5	76.05	93.38	6	51.81	66.43	5	87.05	101.68	6	7.5 #
	4.50 - 5.40[3]	43.39	60.03	5	76.05	93.38	6	55.15	69.04	5	87.05	101.68	6	7.5 #
6"	6.00 - 6.63	45.48	67.17	6	85.59	107.27	5	56.60	76.67	6	96.44	116.52	5	9.0 #
	6.63 - 6.90	45.48	67.17	6	85.59	107.27	5	56.60	76.67	6	96.44	116.52	5	9.0 #
	6.63 - 7.60[3]	53.46	75.14	6	85.59	107.27	5	65.02	85.10	6	96.44	116.52	5	9.0 #
8"	8.00 - 8.63	54.99	75.91	4	103.84	124.77	4	70.50	83.97	4	119.51	132.99	4	10.0 #
	8.63 - 9.05	54.99	75.91	4	103.84	124.77	4	70.50	83.97	4	119.51	132.99	4	10.0 #
	8.63 - 9.80[3]	58.35	77.64	4	103.84	124.77	4	72.79	90.49	4	119.51	132.99	4	10.0 #
10"	10.00 - 11.10	75.42	99.95	4	126.14	150.66	6	96.02	114.15	4	144.26	162.39	6	11.5 #
	11.10 - 12.12	75.42	99.95	4	126.14	150.66	6	96.02	114.15	4	144.26	162.39	6	11.5 #
12"	12.00 - 13.20	90.47	119.58	4	146.25	175.37	4	112.97	133.66	4	167.13	187.82	4	12.5 #
	13.20 - 14.38	90.47	119.58	3	146.25	175.37	4	112.97	133.66	3	167.13	187.82	4	12.5 #
14"	15.30 - 16.80	POA			175.02	204.37	4	POA			177.06	217.71	4	15.3 #
16"	17.40 - 18.90				178.31	240.32	3				200.18	256.88	3	16.0 #
18"	19.50 - 21.10				274.18	334.87	3				290.63	351.58	3	18.0 #
20"	21.10 - 22.70				307.02	374.87	3				325.52	393.75	3	20.0 #
22"	22.70 - 24.30				322.40	393.83	3				341.73	413.45	3	21.0 #
24"	24.30 - 25.90				361.12	441.09	3				382.75	463.06	3	23.0 #
26"	25.70 - 27.30				364.73	444.70	3				386.37	466.68	3	24.0 #
28"	27.30 - 28.90				368.35	448.31	3				389.98	470.29	3	24.5 #
30"	28.90 - 30.50				371.96	451.93	3				393.59	473.90	3	25.0 #
	30.50 - 32.10				375.57	455.54	3				397.21	477.52	3	26.0 #

Prices and weights shown are per saddle.

[1] 202 - 2.50 can accommodate up to 1 ½" I.P. and 1 ¼" C.C.

[2] 202 for 3" nominal size can accommodate up to 2" I.P. and 1 ½" C.C.

[3] Not recommended for iron pipe size PVC or ductile iron size PVC (C-900).

Manufacturer Recommendation:
For PVC pipe, choose the saddle that has the pipe O.D. closest to the top of the saddle's O.D. range.

For Copper pipe, Romac recommends single strap saddles which should be preformed at the factory, or see pg. 3-6 for 304/306 stainless steel saddles.

To Order: Add tap size to the upper range of the saddle.

When ordering for PVC pipe, specify O.D. (D.I. or IPS)

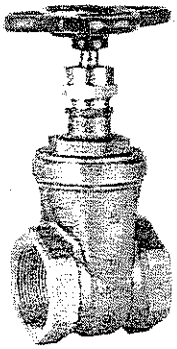
	STYLE	UPPER RANGE	TAP SIZE	TYPE THREAD
Example: Painted Saddle with U-Bolt:	202	– 7.60	x ¾"	IP
Stainless Steel Strap—add letter "S":	202S	– 7.60	x ¾"	IP
Nylon Saddle—add letter "N":	202N	– 7.60	x ¾"	IP

Class 150 Bronze Gate Valves

Screw-in Bonnet • Non-Rising Stem • Solid Wedge

Dezincification Resistant

150 PSI/10.3 Bar Saturated Steam to 366° F/185° C
300 PSI/20.7 Bar Non-Shock Cold Working Pressure

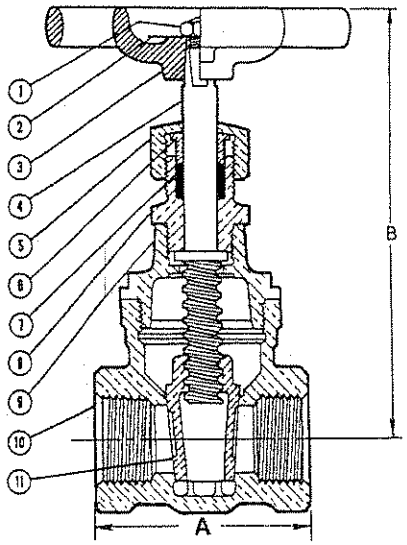


T-133
Threaded

CONFORMS TO MSS SP-80

MATERIAL LIST

	PART	SPECIFICATION
1.	Handwheel Nut	300 Series Stainless Steel
2.	Identification Plate	Aluminum
3.	Handwheel	Malleable Iron ASTM A 47
4.	Stem	Silicon Bronze ASTM B 371 Alloy C69400/C69430 or ASTM B 99 Alloy C65100
5.	Packing Nut	Bronze ASTM B 62 or ASTM B 584 Alloy C84400 or Brass ASTM B 62
6.	Packing Gland	Bronze ASTM B 62 or ASTM B 584 Alloy C84400 or Brass ASTM B 16
7.	Packing	Aramid Fibers with Graphite
8.	Stuffing Box	Bronze ASTM B 62
9.	Bonnet	Bronze ASTM B 62
10.	Body	Bronze ASTM B 62
11.	Wedge	Bronze ASTM B 62



T-133
NPT x NPT

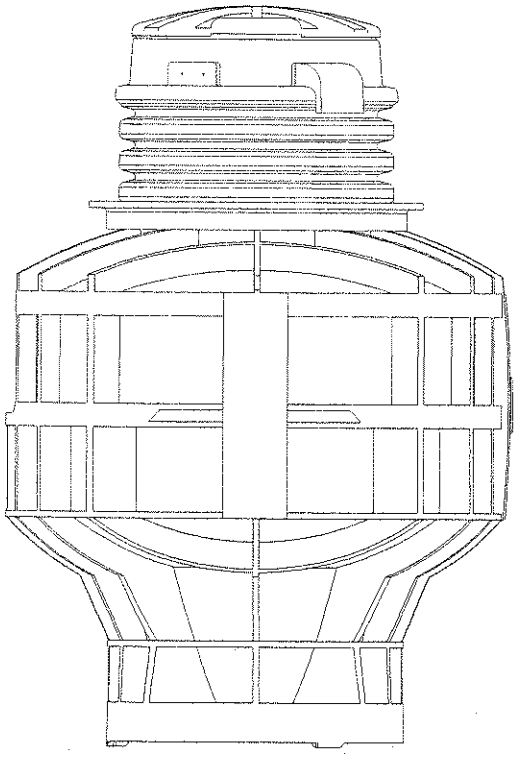
DIMENSIONS—WEIGHTS—QUANTITIES

Size		Dimensions A		Dimensions B		Weight		Master
In.	mm.	In.	mm.	In.	mm.	Lbs.	Kg.	Ctn. Qty.
¼	8	1.96	50	3.63	92	1.02	0.46	50
⅜	10	1.96	50	3.63	92	1.05	0.48	50
½	15	2.31	59	3.63	92	0.93	0.42	40
¾	20	2.51	64	3.91	99	1.40	0.64	30
1	25	2.92	74	4.69	119	2.03	0.92	20
1 ¼	32	3.20	81	5.22	133	2.97	1.35	10
1 ½	40	3.33	86	6.25	159	4.16	1.89	10
2	50	3.44	87	7.06	179	6.75	3.07	6
2 ½	65	4.35	110	8.41	224	10.55	4.79	4
3	80	5.31	135	10.00	254	14.86	6.75	2

Freezing Weather Precaution – Subsequent to testing a piping system, valves should be in an open position to allow complete drainage.

◆ **For detailed Operating Pressure, refer to Pressure Temperature Chart on page 110.**

E/One Sewers™



GP 1012s
SQUAT™ Series

TYPICAL INSTALLATION INSTRUCTIONS & WARRANTY INFORMATION

Environment One Grinder Pump Feature Identification

1. **GRINDER PUMP BASIN** – Polyethylene.

2. **ACCESSWAY COVER** – Fiberglass-reinforced polyester (FRP).

3. **ELECTRICAL QUICK DISCONNECT (EQD)** – Cable from pump core terminates here.

4. **POWER AND ALARM CABLE** – Circuits to be installed in accordance with local codes.

5. **ALARM PANEL** – NEMA 4X enclosure and equipped with circuit breakers. Locate according to local codes.

6. **ALARM DEVICE** – Every installation is to have an alarm device to alert the homeowner of a potential malfunction. Visual devices should be placed in very conspicuous locations.

7. **INLET** – EPDM grommet (4.5" ID). For 4.5" OD DWV pipe.

8. **WET WELL VENT** – 2.0" tank vent.

9. **GRAVITY SERVICE LINE** – 4" DWV, (4.5 OD). Supplied by others.

9a. **STUB-OUT** – 4" X 5' long **watertight** stub-out, to be installed at time of burial unless the gravity serviceline is connected during installation. Supplied by others.

10. **DISCHARGE FTG** – 1-1/4" Female NPT, stainless steel.

11. **DISCHARGE LINE** – 1-1/4" Nominal pipe size. Supplied by others.

12. **CONCRETE ANCHOR** – See Ballast Calculations for specific weight for your station height. Supplied by others.

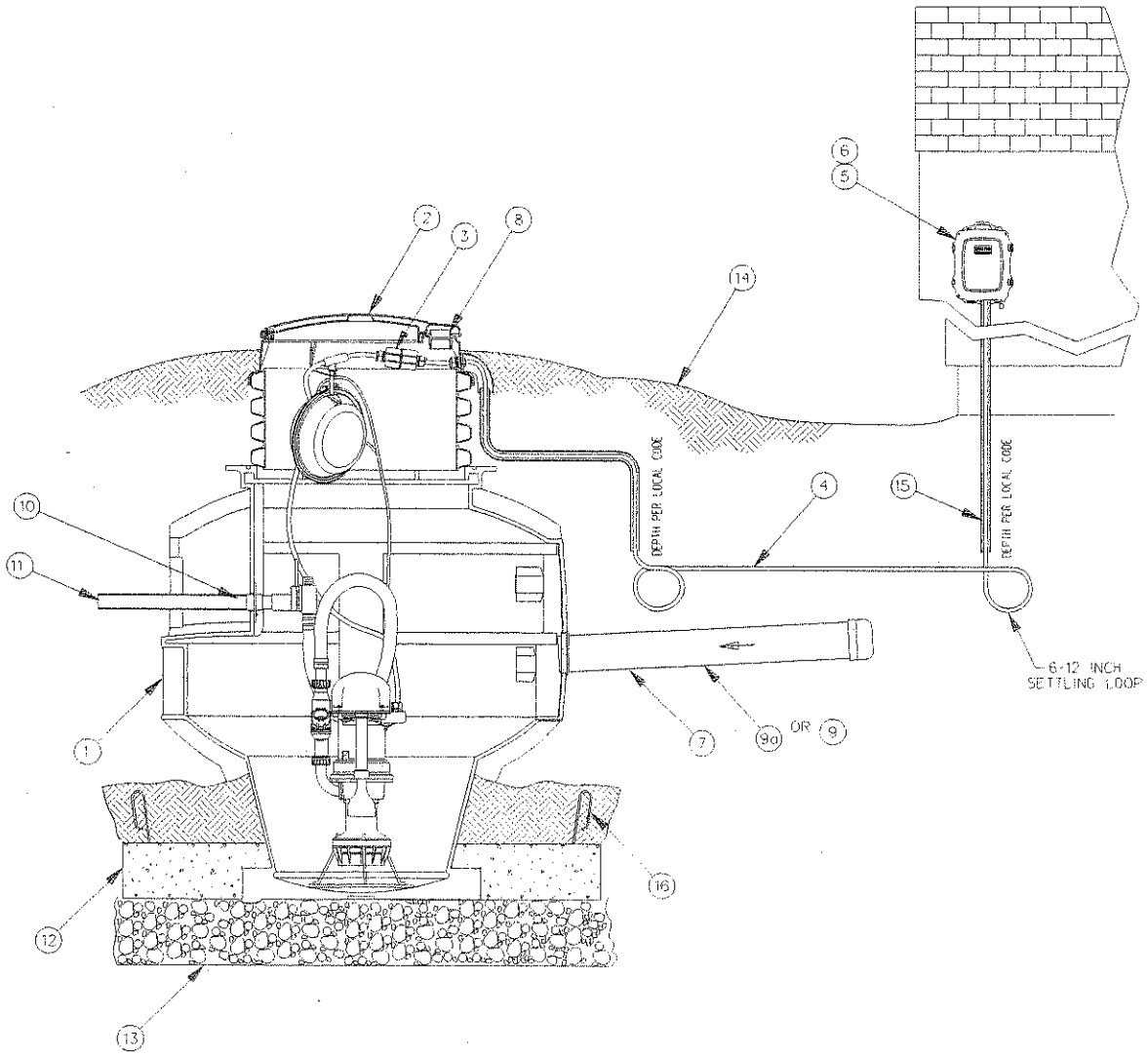
13. **BEDDING MATERIAL** – 6" minimum depth, round aggregate, (gravel). Supplied by others.

14. **FINISHED GRADE** – Grade line to be 1" to 2" below removable lid and slope away from the station.

15. **CONDUIT** – 1" or 1-1/4", material and burial depth as required per national and local codes. Conduit must enter panel from bottom and be sealed per NEC section 300.5 & 300.7. Supplied by others.

16. **REBAR** – Required to lift tank after ballast (concrete anchor) has been attached, 4 places, evenly spaced around tank.

Figure 1a



FAILURE TO COMPLY WITH INSTALLATION INSTRUCTIONS WILL VOID WARRANTY

Installation Instructions for Model 1012s Grinder Pump

The Environment One Grinder Pump is a well-engineered, reliable and proven product: proper installation will assure years of trouble-free service. The following instructions define the recommended procedure for installing the Model 1012s Grinder Pump. These instructions cover the installation of units with and without accessways.

This is a sewage handling pump and must be vented in accordance with local plumbing codes. This pump is not to be installed in locations classified as hazardous in accordance with National Electric Code, ANSI / NFPA 70. All piping and electrical systems must be in compliance with applicable local and state codes.

1. REMOVE PACKING MATERIAL: The User Instructions must be given to the home owner. Hardware supplied with the unit, if any, will be used at installation.

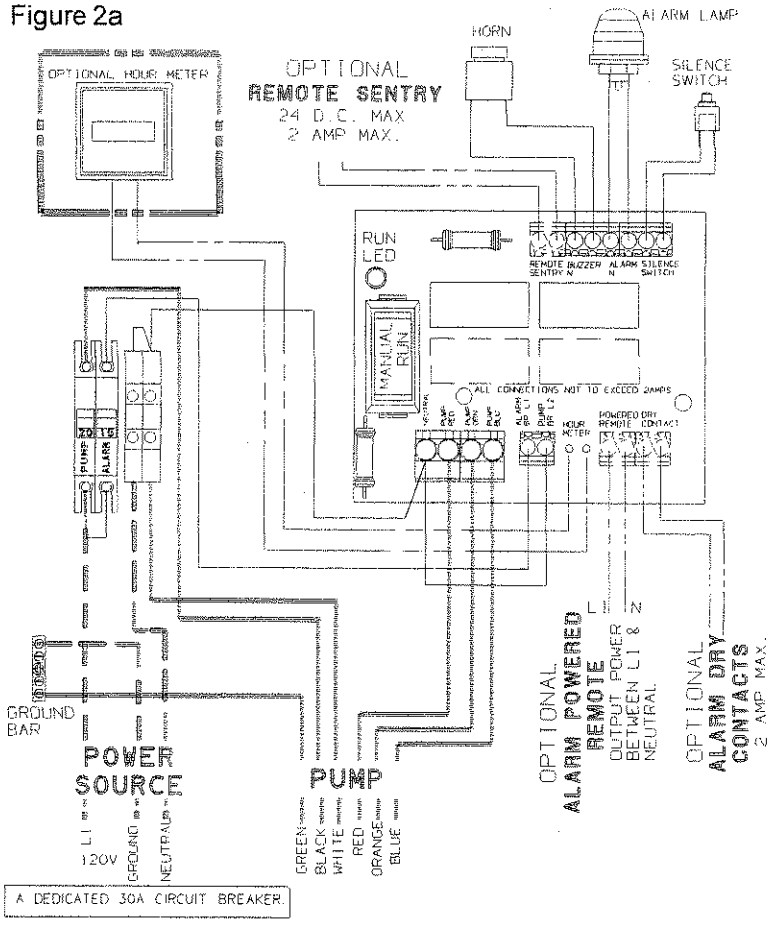
2. TANK INSTALLATION: The tank is supplied with a standard grommet for connecting the 4" DWV (4.50" outside Dia.) incoming sewer drain. Other inlet types and sizes are optional (caution 4" DR-35 pipe is of smaller diameter and won't create a water tight joint with the standard grommet). Please confirm that you have the correct inlet before continuing. If a concrete ballast is attached to the tank lift only by the lifting eyes, (rebar) embedded in the concrete. Do not drop, roll, or lay tank on its side. This will damage the unit and void the warranty.

• **If the tank has an accessway (Fig. 1a):** Excavate a hole to a depth, so that the removable cover extends above the finished grade line. The grade should slope away from the unit. The diameter of the hole must be large enough to allow for a concrete anchor. Place the unit on a bed of gravel, naturally rounded aggregate, clean and free flowing, with particles not less than 1/8" or more than 3/4" in diameter. The concrete anchor is not optional. (See Chart 1 for specific requirements.)

The unit should be leveled and the wet well filled with water to the bottom of the inlet to help prevent the unit from shifting while the concrete is being poured. The concrete must be vibrated to ensure there are no voids. If it is necessary to pour the concrete to a higher level then the inlet, the inlet must be sleeved with an 8" tube before pouring.

3. INLET PIPE INSTALLATION: Mark the inlet Pipe 3 1/2" from the end to be inserted. Inlet pipe should be chamfered and lubricated with a soap solution. Lubricate the inlet grommet with soap solution as well. Insert the pipe into the grommet up to the 3.5"

Figure 2a



120 VOLT WIRING

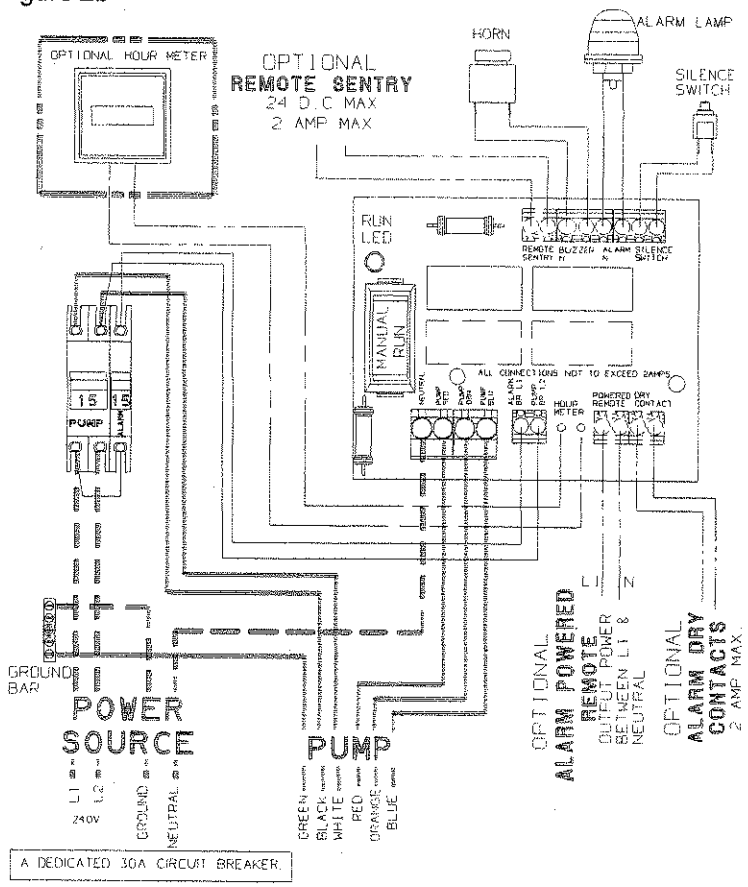
mark. Inspect to ensure the grommet has remained intact and in place.

4. INLET LOCATIONS A 4" DWV inlet grommet was provided with the station for sealing the inlet pipe at the tank wall. If the inlet grommet penetration was not factory installed, the location of the tank inlet must be determined to support final positioning of the tank prior to ballast installation (see Section 3). The inlet pipe location corresponds with the actual or projected point where the 4" building sewer line intersects the tank wall. The grade of the inlet pipe and required burial depth (per national and local code requirements) must be accounted for when determining the inlet location. The supply cable path should be considered when selecting the inlet location (see Section 8). A 5" diameter field penetration of the tank wall is required to support installation of the (standard) inlet grommet. This penetration must not remove or interfere with any of the structural ribbing on the polyethylene tank. The inlet grommet may be installed in any of the allowable locations shown in Figure 5. The inlet penetration **must** be centered in the location selected to prevent interference with the tank ribbing. Typical inlet installation will be on one of the 6.5" wide, raised panels on the tank body. The panels have been marked with a series of locating lines to support centering of the drilled penetration. The center of the 4" inlet location must not be located below the "RECOMMENDED MIN INLET CENTER" line indicated on the raised panels (Figure 5). Any inlet installed in the depressed panels between the horizontal and vertical ribbing must be centered within the panel to provide adequate clearance for the 6" diameter flange on the standard 4" inlet grommet (Figure 5). Once the location of the inlet penetration is selected, mark the inlet center location on the tank and position the tank to line up the inlet location with the inlet pipe path.

5. DISCHARGE: The use of 1.25" PVC pressure pipe Schedule 40 and polyethylene pipe SDR 11 or SIDR 7 are recommended. If polyethylene is chosen use compression type fittings to provide a smooth inner passage. It is recommended that a Redundant Check Valve Assembly (E/One part no. PC0051GXX) be installed between the pump discharge and the street main on all installations. Never use a ball-type valve as a check valve. We recommend the valve be installed as close to the public right-of-way as possible. Check local codes for applicable requirements.

CAUTION: *Redundant check valves on station laterals and anti-siphon/check valve assemblies on grinder pump cores should not be used as system isolation valves during*

Figure 2b



240 VOLT WIRING

line tests.

• **If the tank has an accessway:** There is a slide face disconnect and a quick disconnect pre-installed in the accessway. There is a 1.25" NPT discharge connection on the outside of the tank.

5. BACKFILL REQUIREMENTS: Proper backfill is essential to the long term reliability of any underground structure. Several methods of backfill are available to produce favorable results with different native soil conditions.

The most highly recommended method of backfilling is to surround the unit to grade using Class I or Class II backfill material as defined in ASTM 2321. Class 1A and Class 1B are recommended where frost heave is a concern, Class 1B is a better choice when the native soil is sand or if a high, fluctuating water table is expected. Class I, angular crushed stone offers an added benefit in that it needs minimal compaction. Class II, naturally rounded stone, may require more compactive effort, or tamping, to achieve the proper density.

If the native soil condition consist of clean compactable soil, with less than 12% fines, free of ice, rocks, roots, and organic material it may be an acceptable backfill. Such soil must be compacted in lifts not to exceed one foot to reach a final Proctor Density of between 85% and 90%. Non-compactible clays and silts are **not** suitable backfill for this or any underground structure such as inlet or discharge lines. If you are unsure of the consistency of the native soil it is recommended that a geotechnical evaluation of the material be obtained before specifying backfill.

Another option is the use of a flowable fill (i.e., low slump concrete). This is particularly attractive when installing grinder pump stations in augured holes where tight clearances make it difficult to assure proper backfilling and compaction with dry materials. Flowable fills should not be dropped with more than four feet between the discharge nozzle and the bottom of the hole since this can cause separation of the constituent materials.

6. VENTING: The unit must be properly vented to assure correct operation of the pump.

The units are supplied with a 2" vent opening in the cover assembly. Failure to *properly vent* the tank will result in faulty operation and will void the warranty.

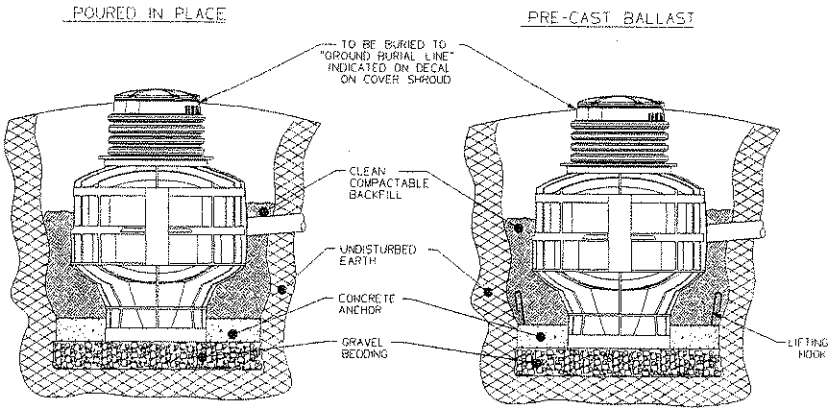
If the water level outside of the station is expected to rise above the surrounding grade (flooding), a cover vent system cannot be used. If flood conditions are expected, an underground (lateral) vent system and solid cover must be used. **Consult the factory if flood conditions are possible where the station is to be installed.**

7. ELECTRICAL CONNECTION: (Supply panel to E/One Alarm Panel) Before proceeding, verify that the service voltage is the same as the motor voltage shown on the name plate. An alarm device is to be installed in a conspicuous location where it can be readily seen by the home owner. An alarm device is required on every installation. There shall be no exceptions.

Wiring of supply panel and Environment One Alarm Panel shall be per Figures 2a and 2b, alarm panel wiring diagrams and local codes.

8. ELECTRICAL CONNECTION: (Pump to Panel) (Fig. 4) The GP 1012s is provided with a cable for connection between the station and the alarm panel (supply

Figure 3



TYPICAL IN-GROUND SECTION VIEW

cable). The supply cable, a six conductor tray cable, meets NEC requirements for direct burial as long as a minimum of 24" burial depth is maintained. Those portions of the cable which have less than 24" of cover must be contained in suitable conduit. This includes the vertical portion dropping to a 24" depth at the station and the length rising out of the ground at the control panel. *NOTE: Wiring must be installed per national and local codes. Conduit must enter panel from bottom and be sealed per NEC section 300.5 & 300.7.*

8a. Installing E/One supply cable:

1) Open the lid of the station and locate the cable and the feed-through connector on the wall of the shroud. Loosen the nut on the connector and pull the supply cable out through the connector until it hits the crimped on stop feature on the cable, approximately 24" from the EQD. ***IMPORTANT: *All but 24" of the cable must be pulled out of the station, and the portion of the cable between the EQD and the molded in cable breather should be secured in the hook provided to ensure that the pump functions properly. Do not leave the excess cable in the station.***

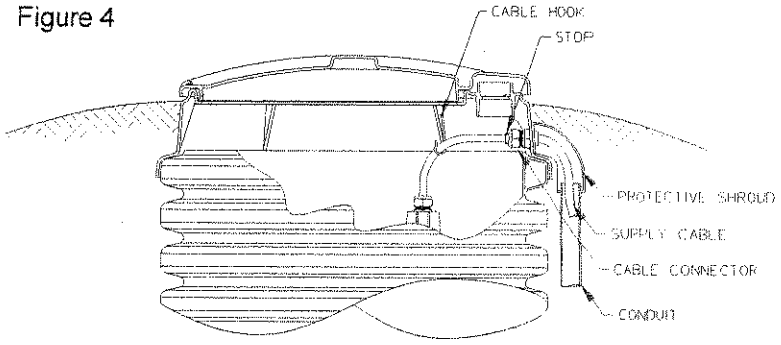
2) Retighten the nut. This connection must be tight or ground water will enter the station.

3) Feed the wire through the length of conduit (contractor provided) which will protect it until it is below the 24" burial depth.

4) Position the conduit vertically below the cable connector along side of the station reaching down into the burial depth. Attach the small protective shroud provided with the station to protect the exposed cable where it enters the station. Four self tapping screws are provided.

5) Run the cable underground, in a trench or tunnel, to the location of the E/One panel. Leave a 6" to 12" loop of cable at each end to allow for shifting and settling.

Figure 4



Supply Cable Voltage Drop:

120 VAC Pump = .195 Volts per Foot of Cable
240 VAC Pump = .098 Volts per Foot of Cable
(Maximum Recommended Length = 100 Feet)

TYPICAL SUPPLY CABLE CONFIGURATION

Connections made at the panel are shown in the panel wiring diagram (Figures 2a and 2b).

9. DEBRIS REMOVAL: Prior to start-up test procedure, the core must be removed and the incoming sewer line flushed to force all miscellaneous debris into the tank. Next, all liquid and debris must be removed. Once tank is clean, reinstall the pump and proceed with the test.

10. TEST PROCEDURE: When the system is complete and ready for use, the following steps should be taken to verify proper installation and operation:

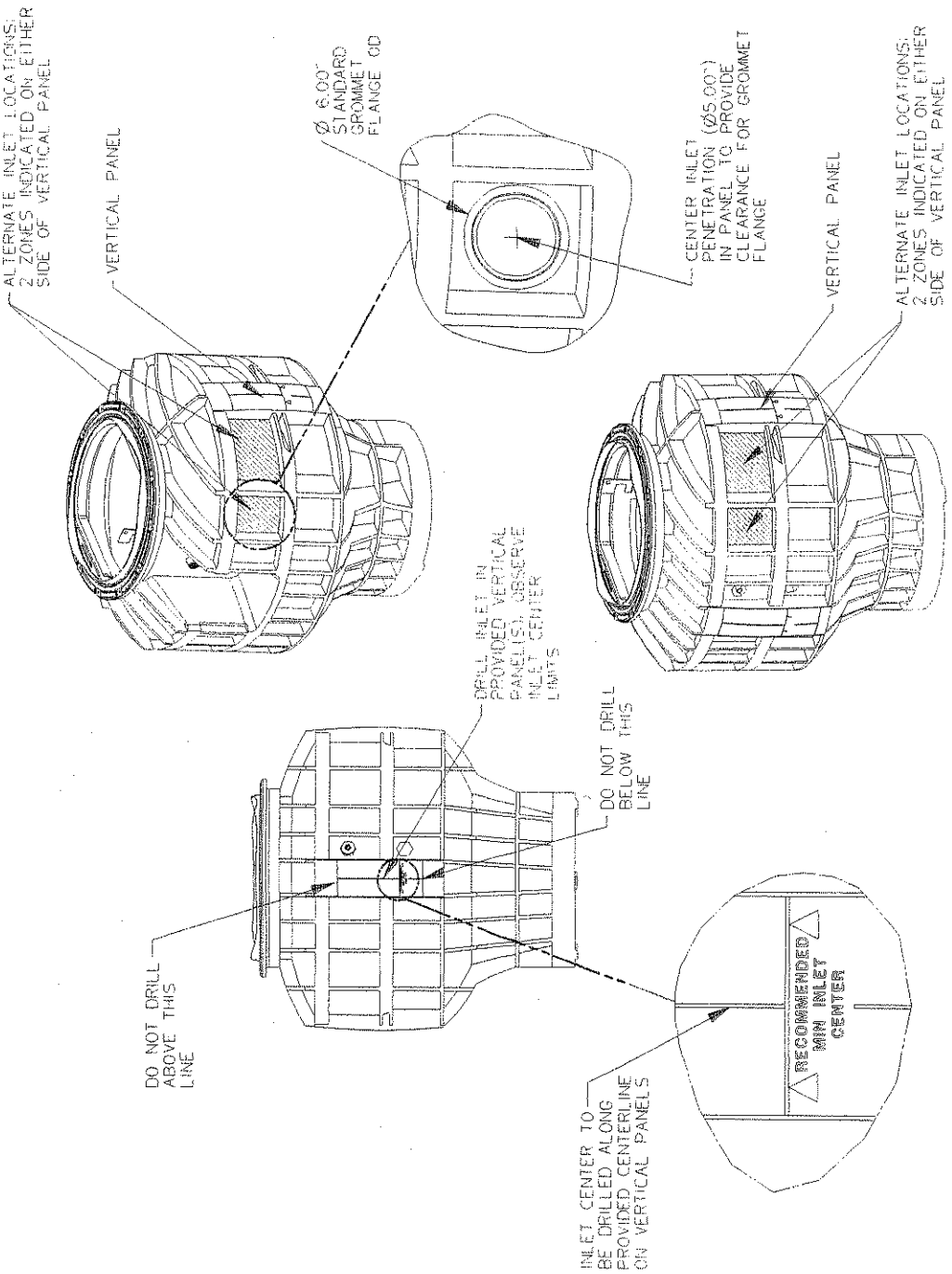
a) Ensure the slide face discharge shutoff valve is fully open. This valve must not be closed when the pump is operating. In some installations there may be a valve, or valves, at the street main that must also be open.

b) Turn ON the alarm power circuit breaker.

c) Fill tank with water until the alarm turns ON. Shut off water.

d) Turn ON pump power circuit breaker; the pump should immediately turn on. Within approximately 4 minutes, the alarm will turn off. Within an additional one minute, the pump will turn off.

Figure 5



ALLOWABLE INLET LOCATIONS

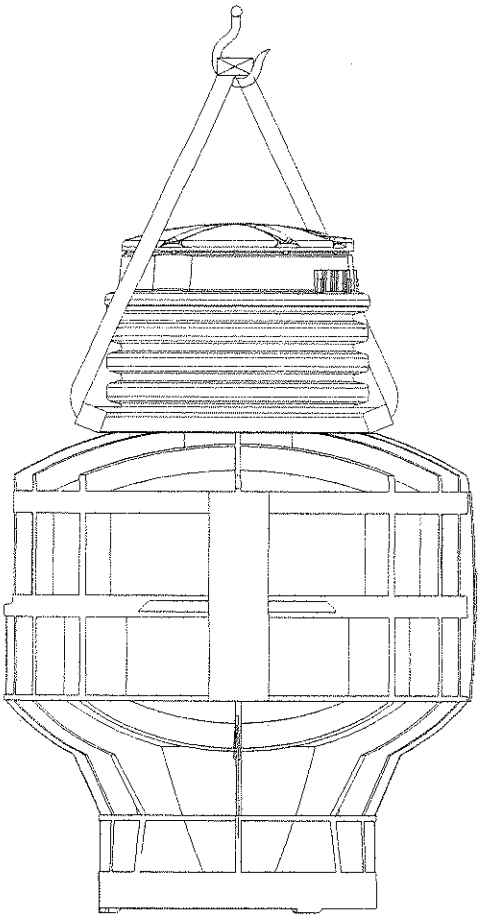
Lifting Instructions

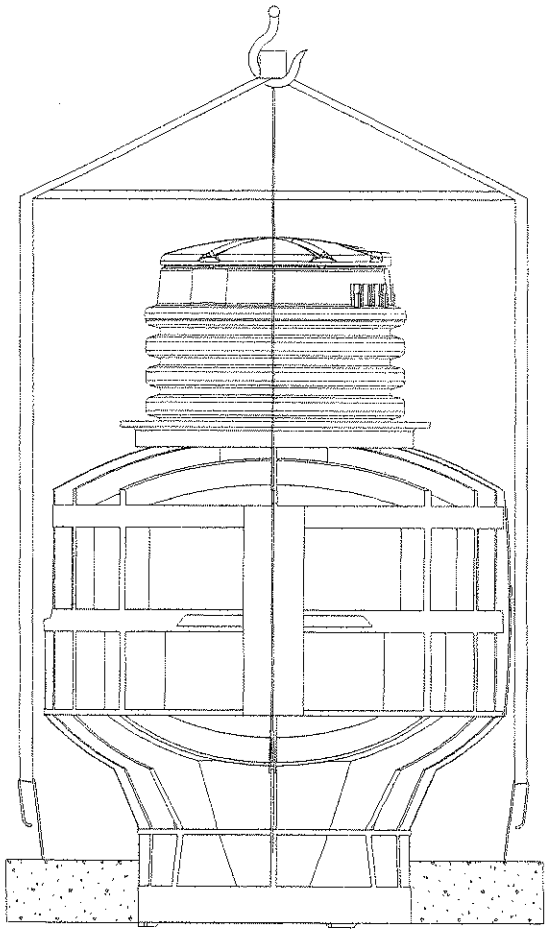
FAILURE TO FOLLOW THESE INSTRUCTIONS COMPLETELY WILL VOID WARRANTY.

1. Transporting unit to installation site: **Always lift a unit from the bottom for the purpose of transportation. The station should be received attached to a pallet for this purpose.** Never roll a station or move it on its side.

2. No Ballast (to be poured in place): If the concrete anchor is to be poured while the station is in place lift the unit using 2 nylon straps wrapped around the accessway making a sling, as shown below. Keep station oriented vertically to avoid any damage. Only lift from the accessway to put unit in hole, not for moving any distance.

3. Precast Ballast: Never lift a station that has a ballast attached by any means except the rebar. The weight of the concrete will damage the station if you attempt to lift it from any part of the station.





E/One 1012s Grinder Pump Station
Ballast Calculations

Any buried vessel that is submerged, or partially submerged, in water will be acted on by an upward buoyant force that attempts to return the vessel to a non-submerged state. The magnitude of this buoyant force is equal to the volume of the vessel that is submerged multiplied by the density of water. On most in-ground installations a ballast, or concrete anchor, of proper volume and weight is required to resist the buoyant force. The amount of ballast required for a given set of installation site conditions may be calculated as follows.

Installation Site Assumptions

1. Water table – under worst case, the ground water level is assumed to be at the finished-grade level.

2. Backfill materials are per E/One Installation Instructions.

3. The consulting engineer should perform a soil test to determine if the assumptions that have been made are valid. If the site conditions differ from these assumptions, then the consulting engineer must revise the calculations as shown in this document.

Physical Constants

1. Density of Water = 62.4 lb/cu ft
2. Density of Concrete = 150 lb/cu ft (in air)
3. Density of Concrete = 87.6 lb/cu ft (in water)
4. Density of Dry Compacted Backfill = 110 lb/cu ft
5. Density of Saturated Backfill = 70 lb/cu ft

Procedure

A. Determine The Buoyant Force Exerted On The Station

1. Determine the buoyant force that acts on the grinder pump station when it is submerged in water.
2. Subtract the weight of the station from the buoyant force due to the submerged tank to determine the net buoyant force acting on the station.

B. Determine The Ballast Force Exerted On The Station

1. Determine the ballast force applied to the station from the concrete, saturated soil and dry soil.

C. Subtract The Ballast Force From the Buoyant Force.

1. Note – if the installation site conditions are different from those listed above, the consulting engineer should recalculate the concrete ballast.

Ballast Calculations

The following calculations are to outline the areas used to determine the volumes of the different materials for the ballast. All sections referred to in the calculations are marked on the accompanying drawing.

E/One 1012s Grinder Pump Station
Ballast Calculations

Sample Calculation, GP 1012s-55 Station

Volume of Station Wet Well = 36.4 cu ft
Station Weight = 213 lbs
Station Height = 4.6 ft

A. Buoyant Force

1. The buoyant force acting on the submerged GP 1012s is equal to the weight of the displaced water for the section of the tank that is submerged.

$$F_{buoyant} = (\text{density of water})(\text{volume of station})$$
$$= (62.4 \text{ lbs/cu ft})(36.4 \text{ cu ft})$$
$$= 2271 \text{ lbs}$$

2. The net buoyant force acting on the station ($F_{net\text{-}buoyant}$) is equal to the buoyant force ($F_{buoyant}$) minus the weight of the station tank.

$$F_{net\text{-}buoyant} = 2271 \text{ lbs} - 213 \text{ lbs}$$
$$= 2058 \text{ lbs}$$

B. Ballast Force

1. Determine the volume of concrete and soil

Section I: Used To Determine The Volume Of Concrete
(Note: 2.50 ft = assumed inside diameter of concrete ballast ring around tank's bottom flange)

$$\text{Volume} = (\text{Height})(\text{Area})$$
$$= (.58 \text{ ft})(\pi)((5.0 \text{ ft})^2 - (2.5 \text{ ft})^2) / 4$$
$$= (.58 \text{ ft})(14.74 \text{ ft}^2)$$
$$= 8.58 \text{ ft}^3$$

Section II: Used To Determine The Volume Of Saturated Soil
(Note: 4.26 ft = assumed inside diameter of soil column around tank's maximum diameter)

$$\text{Volume} = (\text{Height})(\text{Area})$$
$$= (4.6 \text{ ft} - .58 \text{ ft})(\pi)((5.0 \text{ ft})^2 - (4.26 \text{ ft})^2) / 4$$
$$= (4.02 \text{ ft})(5.35 \text{ ft}^2)$$
$$= 21.63 \text{ ft}^3$$

2. Determine the combined ballast

$$\text{Ballast (total)} = \text{Ballast (concrete)} + \text{Ballast (saturated soil)}$$
$$= (V_{concrete})(\text{density concrete in water}) + (V_{soil})(\text{density saturated soil})$$
$$= (8.53 \text{ ft}^3)(87.52 \text{ lbs/ft}^3) + (21.63 \text{ ft}^3)(70 \text{ lbs/ft}^3)$$
$$= 750 \text{ lbs} + 1514 \text{ lbs}$$
$$= 2264 \text{ lbs}$$

C. Subtract the buoyant force from the ballast force to determine the final condition

$$\text{Final Condition} = \text{Ballast Force} - \text{Net Buoyant Force}$$
$$= 2264 \text{ lbs} - 2058 \text{ lbs}$$
$$= 206 \text{ lbs (excess ballast)}$$

E/One 1012s Grinder Pump Station
Ballast Calculations

Sample Calculation, 1012s-55, 1012s-73, 1012s-92 Stations

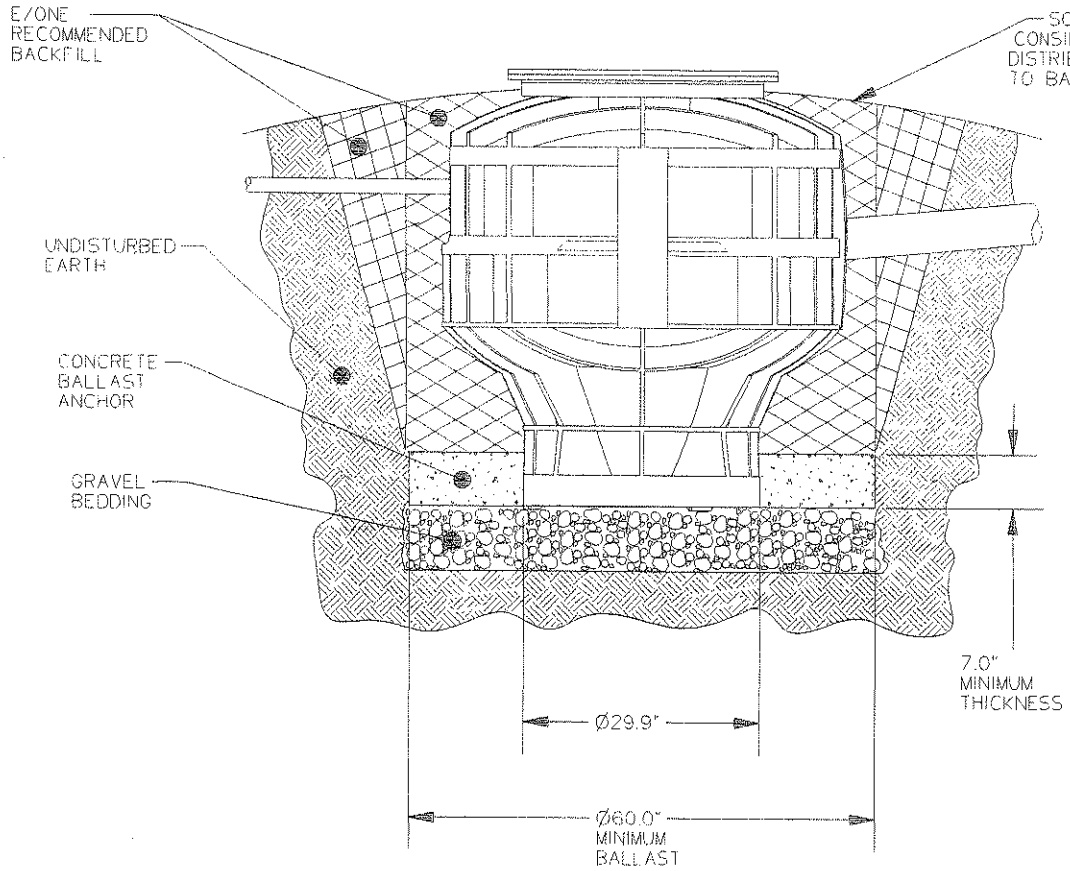
The approach outlined on the previous page may be used
to calculate the ballast requirements listed below.

Chart 1

GP Model 1012s	Station Volume (in.)	FNet Bouyant (lbs)	Tank Weight (lbs)	FBallast (lbs)	Volume Concrete (cu ft)*	Weight Concrete in Air (lbs)*	Minimum Diameter of Concrete Anchor (in.)	Minimum Thickness of Concrete Anchor (in.)
1012s-55	36.4	2058	213	2264	8.58	1287	60	7
1012s-73	40.5	2302	225	2815	8.58	1287	60	7
1012s-92	44.6	2546	237	3416	8.58	1287	60	7

* Volume calculated is for minimum dimensions given. Minimum dimensions must be met or exceeded for actual application.

MODEL 1012s



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DR BY	CHK'D	DATE	ISSUE	SCALE

e/one
SEWER SYSTEMS

MODEL 1012s BALLAST INFORMATION

Adjusting the Height of a 1012s Grinder Pump Station

REMOVE EXISTING COVER ASSEMBLY (Fig. 6)

If your existing station has a welded-on cover shroud, you will need the appropriate replacement cover kit.

1. Turn off all power to the grinder pump station.
2. Remove the tank lid and the electrical shroud.
3. Unplug the electrical quick disconnect (EQD) and remove the EQD from the supply cable. *Note: DO NOT CUT CABLE.* Loosen liquid-tight cable connector and pull the supply cable out through the connector on the side of tank.
4. Remove the soil around the tank, exposing three of the tank corrugations below grade. Use caution not to damage buried cable.

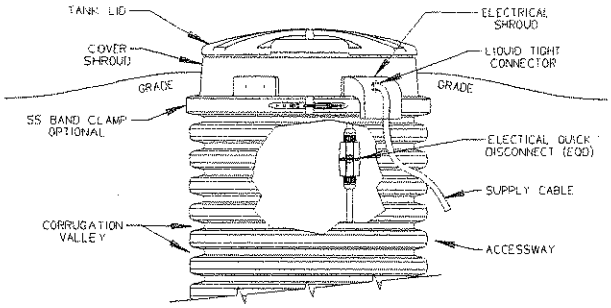


Figure 6

5. Remove existing cover shroud.

5a. Welded-on shroud (standard) — Using a hand saw, cut the tank in the valley between the two corrugations at grade, discard existing welded on shroud and attached corrugations *(shroud is not to be reused). Caution: Be careful not to cut the pump breather cable.*

5b. Clamped-on shroud — Remove band clamp and cover shroud.

REDUCING STATION HEIGHT (Fig. 7)

6. Using a hand saw, cut the tank in the valley between the two corrugations at grade.

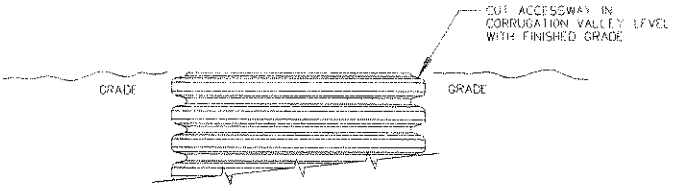


Figure 7

INSTALL REPLACEMENT COVER ASSEMBLY (Fig. 8)

7. Clean top corrugation on accessway extension and mating surface of replacement shroud with acetone.
8. Liberally apply the silicone sealer provided to the under side of the replacement shroud where it will come in contact with the accessway extension.
9. Place SS band clamp around top corrugation and the replacement shroud. Tap with a mallet around clamp to help seat the clamp. Torque stud assembly on band clamp to a maximum 125 inlb.
10. Reinstall the supply cable, EQD, tank lid and electrical shroud and tighten cable connector.
11. Follow start-up procedures to ensure proper pump operation (you will find the start-up instructions in the service manual).

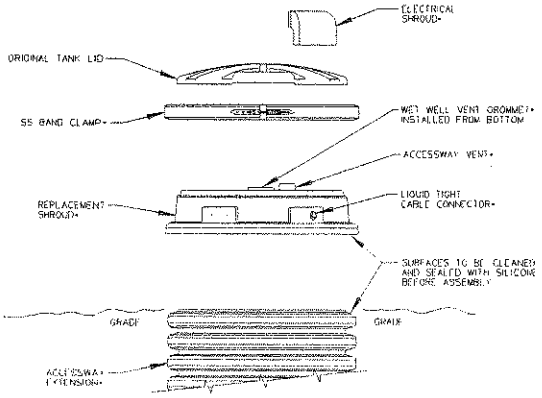
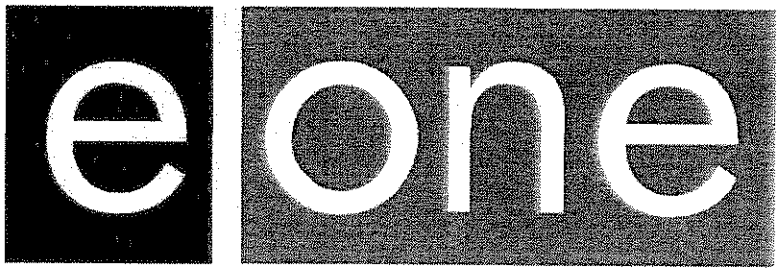


Figure 8



A Precision Castparts Company

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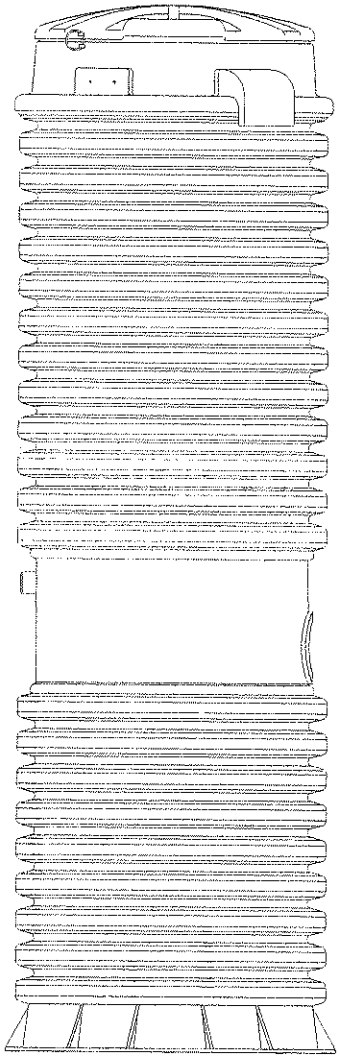
www.eone.com

PA2115P01 Rev –
5/06

User Instructions for the Environment One Grinder Pump



Congratulations on your Environment One grinder pump investment. With proper care and by following a few guidelines, your grinder pump will give you years of dependable service.

Care and Use of your Grinder Pump

The Environment One grinder pump is capable of accepting and pumping a wide range of materials. Regulatory agencies advise that the following items should not be introduced into any sewer, either directly or through a kitchen waste disposal unit:

Glass	Diapers, socks, rags or cloth
Metal	Plastic objects (toys, utensils, etc.)
Seafood shells	Sanitary napkins or tampons
Goldfish stone	Kitty litter

In addition, you must **never** introduce into any sewer:

Explosives	Strong chemicals
Flammable material	Gasoline
Lubricating oil and/or grease	

Periods of Disuse

If your home or building is left unoccupied for longer than a couple of weeks, perform the following procedure:

Purge the System. Run clean water into the unit until the pump activates. Immediately turn off the water and allow the grinder pump to run until it shuts off automatically.

Duplex Units. Special attention must be taken to ensure that both pumps turn on when clean water is added to the tank.

Caution: Do not disconnect power to the unit

Power Failure

Your grinder pump cannot dispose of wastewater without electrical power. If electrical power service is interrupted, keep water usage to a minimum.

Pump Failure Alarm

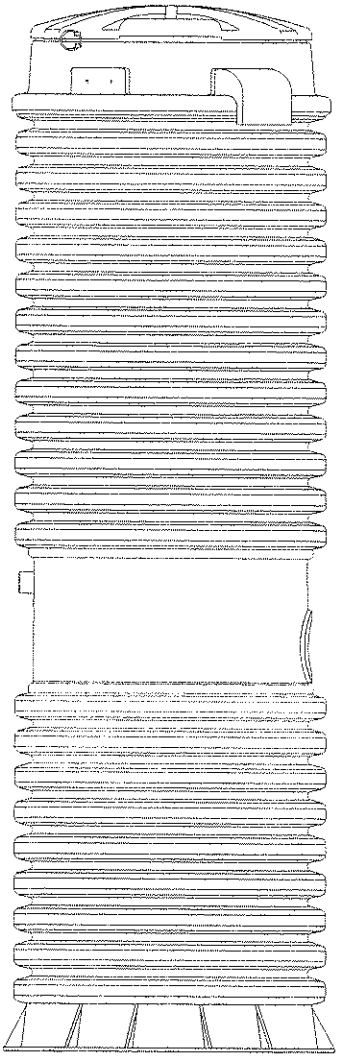
Your Environment One grinder pump has been manufactured to produce an alarm signal (120 volt) in the event of a high water level in the basin. The installer must see that the alarm signal provided is connected to an audible and/or visual alarm in such a manner as to provide adequate warning to the user that service is required. During the interim prior to the arrival of an authorized service technician, water usage must be limited to the reserve capacity of the tank.

For service, please call your local distributor:

General Information

In order to provide you with suitable wastewater disposal, your home is served by a low pressure sewer system. The key element in this system is an Environment One grinder pump. The tank collects all solid materials and effluent from the house. The solid materials are then ground to a small size suitable for pumping as a slurry with the effluent water. The grinder pump generates sufficient pressure to pump this slurry from your home to the wastewater treatment receiving line and/or disposal plant.

E/One Sewers™



Limited Warranty

1000 Series, 2000 Series, AMGP

Environment One Corporation offers a limited warranty that guarantees its product to be free from defects in material and factory workmanship for a period of two years from the date of installation, or 27 months from the date of shipment, whichever occurs first, provided the product is properly installed, serviced and operated under normal conditions and according to manufacturer's instructions. Repair or parts replacement required as a result of such defect will be made free of charge during this period upon return of the defective parts or equipment to the manufacturer or its nearest authorized service center.

Model Number: _____

Serial Number: _____

Installation Date: _____

eone
SEWER SYSTEMS

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(01) 518.346.6161 • www.eone.com

Valley Center Municipal Water District

LOW PRESSURE WASTEWATER COLLECTION SYSTEM MANUAL

INFORMATION
(760) 749-1600

HOMEOWNERS PRIVATE LOW PRESSURE WASTEWATER FACILITY MANUAL

INTRODUCTION

Valley Center Municipal Water District (VCMWD) owns and maintains a pressurized wastewater system that serves your property. This system allows the development to conform to the terrain. This information packet gives guidelines for design and construction of the required system to be installed. There are two wastewater systems in the districts area, the low pressure wastewater pump system and gravity wastewater system. The district provides information and a map to delineate which area the property exists in. All reference manuals should be provided to the homeowner by the contractor or certified installation personnel at the completion of the installation and acceptance process.

PRESSURE SEWERS

The pressure wastewater system is a small diameter, shallowly buried pipeline that travels up and down with the profile of the ground. There are no manholes in this system. The fluid in the wastewater lines is moved by pumping at each connection. The pipeline is under pressure at some locations and at other locations the water falls under the force of gravity.

GRINDER SYSTEM

This system is a pressure system which installs a sizable discharge pipe from the house to the grinder pump which discharges wastewater to the VCMWD pressure system to be discharged. The discharge pipe from the house is sized for back-up or maintenance storage.

SQUAT TANKS

Each connection to the system has a squat tank that acts similar to a conventional septic tank. Each tank is fitted with a small pump. Inside the tank the pump will transfer wastewater to the VCMWD system. There are sensors that turn the pump on when the level in the tank reaches a predetermined depth. The sensors then turn the pump off when the level is pumped down below that maximum depth. There is an alarm that will sound if the level inside the tank rises too high for any reason.

OWNERSHIP AND CONTROL

The wastewater treatment plant, gravity mains and low pressure mains in the streets are owned and operated by VCMWD. The Squat tank, pump and discharge line on private property are owned by the individual property owner. VCMWD requires these privately owned facilities to conform to its' specifications to assure the continued safe, sanitary and economical operation of the VCMWD system.

EASEMENTS

There are no easements on the private property for the on-site pressure wastewater facilities. The property owner is subject to the VCMWD Administrative Code. The planting of large trees or construction of structures near the tank or service lines will impair access or cause damage to the facilities and is prohibited. Most other forms of landscaping, together with walks, and storage areas will usually not interfere with the wastewater facilities.

USE OF THE SYSTEM

The homeowners' use of this pressure system differs little from the use of any other wastewater system. Only common domestic wastewater is to be discharged. A kitchen sink garbage disposal may be used. Never discharge toxic chemicals, flammables, caustics or acids to the system. Avoid discharging large quantities of grease or hair. Plastics, cigarette filters, and other such matter that will not biologically degrade are not to be discharged in this or any other wastewater system. Water softening units that are recharged in the home with rock salt are not permitted to discharge into the system. Do not connect any outside drains, pool drains, or roof drains to the system. Remember, this system is under pressure and can cause damage or injury if not properly installed and connected.

MAINTENANCE

The on-site tank, pump, service line, control panel, and other appurtenances on the private property are owned by and are the responsibility of the private property owner. The property owner will be responsible for the cost of maintaining and repairing damages to the pipes and facilities. Request for service grants VCMWD permission to enter the private property for maintenance and repair. VCMWD will maintain and repair the mechanical and electrical systems and periodically pump out the tank. Until the service personnel arrive, there is a 250 gallon reserve capacity in the system that will allow you to continue normal functions in the home for approximately one day. Conservation of water use during this time will better ensure that you will not be further inconvenienced.

ELECTRICITY

The pump, sensors, and alarm are powered by electricity. If a prolonged power outage occurs or the power is otherwise turned off to the on-site facilities, and water is used in the home, when the power comes back on, the alarm may sound. If this occurs, please wait a short time to see if the system will pump the level in the tank down and shut the alarm off. If the alarm continues for 30 minutes, a service will be required immediately. The homeowner may also connect the alarm to a private alarm system. A plumbing leak in the home will cause the pump to operate excessively, increasing maintenance requirements and use of power. It is, therefore, good practice to periodically check the household plumbing for leaks or drips. The entire on-site facilities are expected to use less than $1.00 worth of electricity per month.