plumbing

This Week's Presentation

> Review: *Worksheet #9*
> *Designing for Heating and Cooling*

> **MEEB:** CHAPTER 22
> LIQUID WASTE...

> Worksheet #10

> This Week's Media Material: *Audience's Choice*

> Case Study: *Clipper Crest Lofts*
> Piping Layout for Typical Construction

Last Week: **HVAC for Smaller Buildings** (Chapter 9)

Worksheet #9

... 1. The acronym "HVAC" stands for:

(a) heating, ventilating, air moving, and cooling

(b) heating, ventilating, air quality control, and cooling

(c) heating, ventilating, and air-conditioning

(d) heating, ventilation, and air-control

Last Week: **HVAC for Smaller Buildings** (Chapter 9)

Worksheet #9

... 2. Advantages of a "local" HVAC system over a "central" system would typically include:

(a) more individual control, smaller equipment units, potential for building conditioning should a single unit fail, no need for a mechanical room

(b) better comfort environment, higher efficiency, more architecturally appealing

(c) no space required for equipment, quiet equipment, easy use of centralized controls

(d) no need for sizing calculations or engineering consultants, hidden equipment

Last Week: **HVAC for Smaller Buildings** (Chapter 9)

Worksheet #9

... 3. The concept of "distribution tree" is used to describe:

(a) the network of sales and delivery locations established to provide HVAC equipment

(b) the flow of design information from architect to consultant to contractor

(c) the continuous flow and cycling of refrigerant in a mechanical cooling system

(d) the means by which cooling and heating are delivered from a central system to conditioned spaces

Last Week: **HVAC for Smaller Buildings** (Chapter 9)

Worksheet #9

... 4. The primary components of a compressive refrigeration cycle include:

(a) evaporator, condenser, compressor, expansion valve

(b) generator, compressor, condenser, absorber

(c) fan, motor, coil, filter

(d) outside air, inside air, distribution tree, controls

Last Week: **HVAC for Smaller Buildings** (Chapter 9)

Worksheet #9

... 5. The primary components of an absorption refrigeration cycle include:

(a) evaporator, condenser, compressor, expansion valve

(b) generator, evaporator, condenser, absorber

(c) absorber, absorbent, circulator, controls

(d) outside air, inside air, distribution tree, controls

Last Week: **HVAC for Smaller Buildings** (Chapter 9)

Worksheet #9

... 6. The fundamental operational difference between a compressive and an absorption refrigeration cycle is:

(a) absorption uses heat as an input (versus electricity for compressive)

(b) absorption can only operate when solar energy is available (versus 24-hours for compressive)

(c) absorption requires a certified operating engineer (versus just a building manager for compressive)

(d) compressive uses renewable resources (versus non-renewable for absorption)

Last Week: **HVAC for Smaller Buildings** (Chapter 9)

Worksheet #9

... 7. The term "unit air-conditioner" refers to:

(a) any individual piece of cooling-only equipment

(b) a window or through-the-wall air-conditioner

(c) any local heating-cooling equipment

(d) a cooling capacity of 1 ton of refrigeration

This week... Liquid Waste...Plumbing!

Where does the word "Plumbing" come from?

Architectural Technology III

This week... Liquid Waste...Plumbing!

> Patterns in the archeological record suggest the emergence o three "obligations" of an urban society, with which we tend to correlate the concept of "civilization."

1) Physical Security

... 2) Food & Water Supply
3) Take Out The Trash!

> The latter two involve the systems which we'll consider today.

Architectural Technology III

This week... Liquid Waste...Plumbing!

Although this week's reading was about "waste," we should also be aware of its counterpart, "supply."

Historically, the fundamental architectural inventions which made urban life possible involved both supply *and* waste.

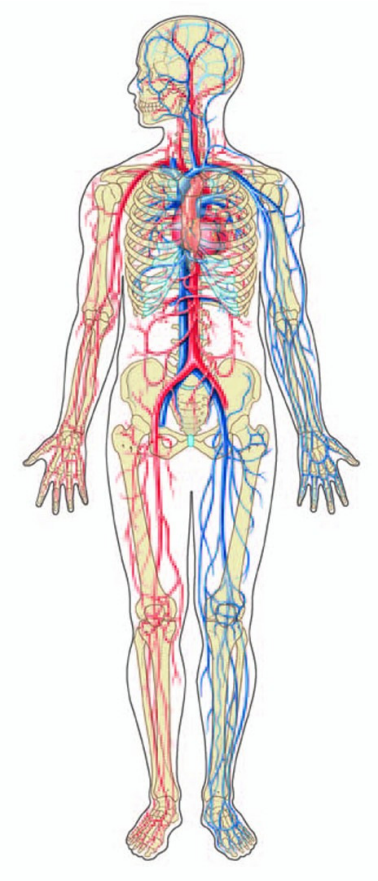
This week... Liquid Waste...Plumbing!

Societies which didn't concern themselves with both supply and waste found themselves... dead, or buried, or both.

Tel at Har Meggido: "Armageddon"

This week... Liquid Waste...Plumbing!

Contemporary environmental technologies for supply and liquid waste removal seems more biological than mechanistic in its extention through space.



This week... Liquid Waste...Plumbing!

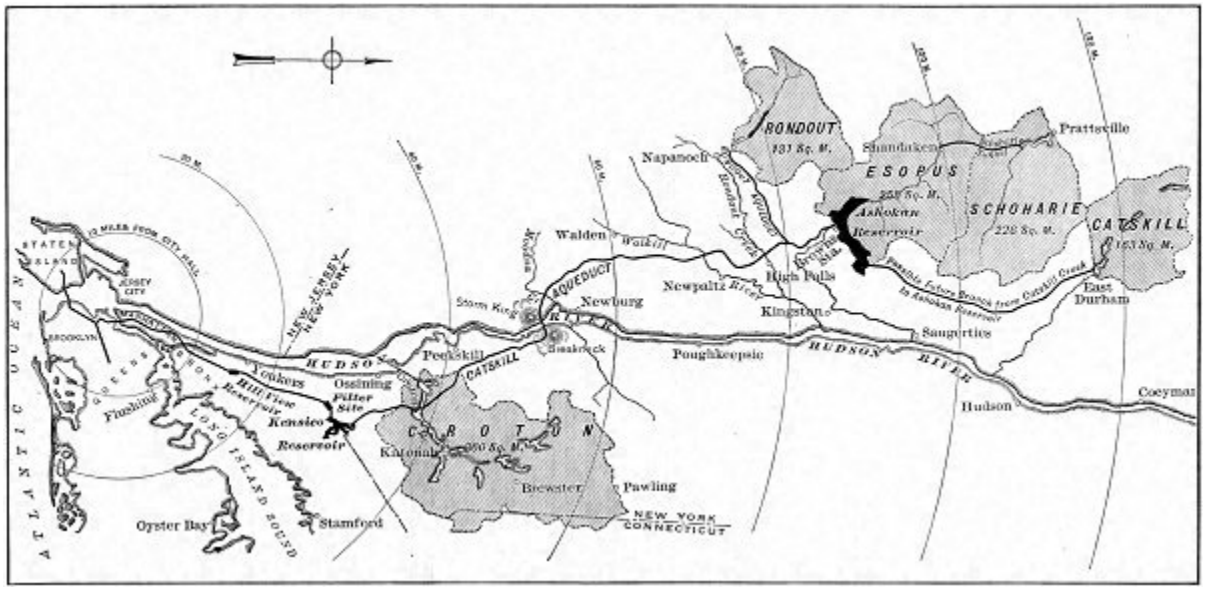
Like biological systems, the systems which supply and remove fluid materials make use of two physical principals:

Gravity & Pressure

This week... Liquid Waste...Plumbing!

In most architectural contexts, bringing water and other "supply" liquids to a point of use requires pressure to assure delivery.

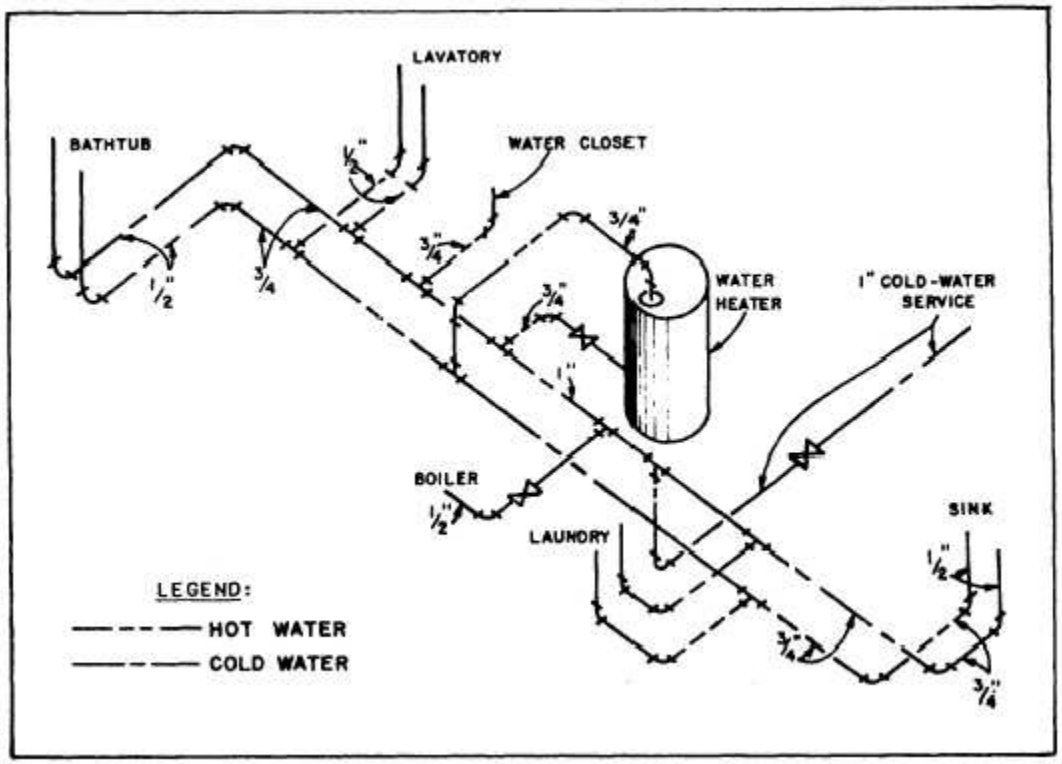
Why?



Over the entire length of the system, some gravity-fed passages may, in fact, exist. Historically, before the introduction of dependable mechanical energy, gravity was in fact used to assure that supply systems remained under pressure at their delivery points -- themselves located always below the source of the supply.

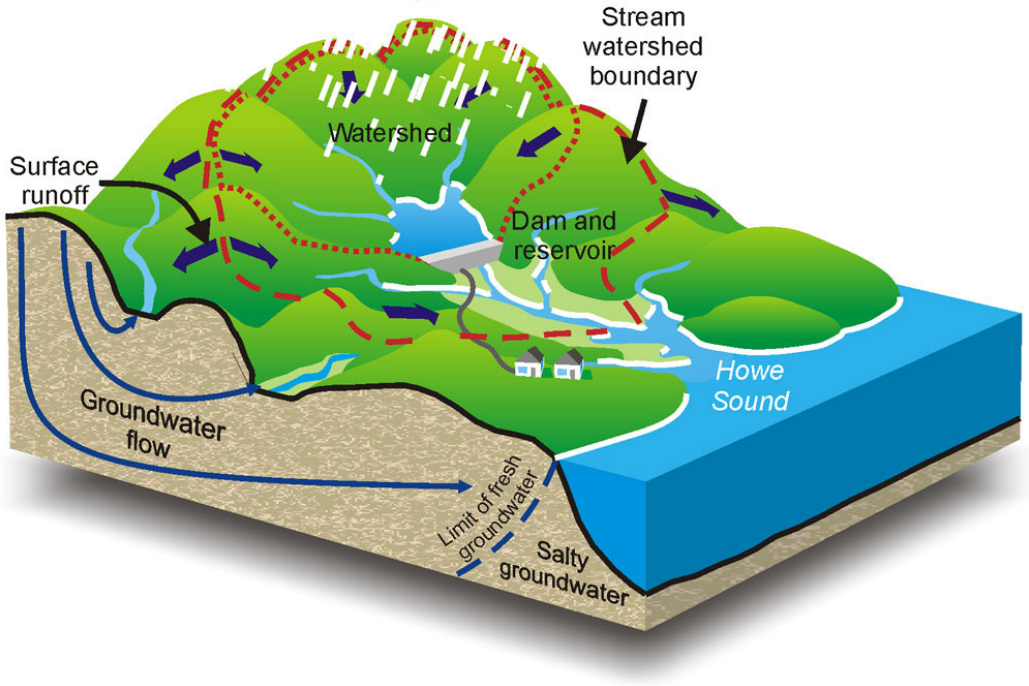
This week... Liquid Waste...Plumbing!

Within specifically architectural contexts, supply lines are almost always under pressure; in most countries, including the USA, supply lines are buried and so much be pressurized to supply points of use at elevations above the ground.



This week... Liquid Waste...Plumbing!

On the other hand, flow within waste lines are most typically gravity-driven. Waste is produced "up high," and may flow naturally towards the lower lines buried below ground. Underground waste lines follow the natural contours of the geographical area, conforming to the local "water shed," a concept which is the nature's own "liquid waste system."



This week... Liquid Waste...Plumbing!

So why should we care about this distinction? Why do we need to be aware about differences among systems under pressure and those under gravity control?

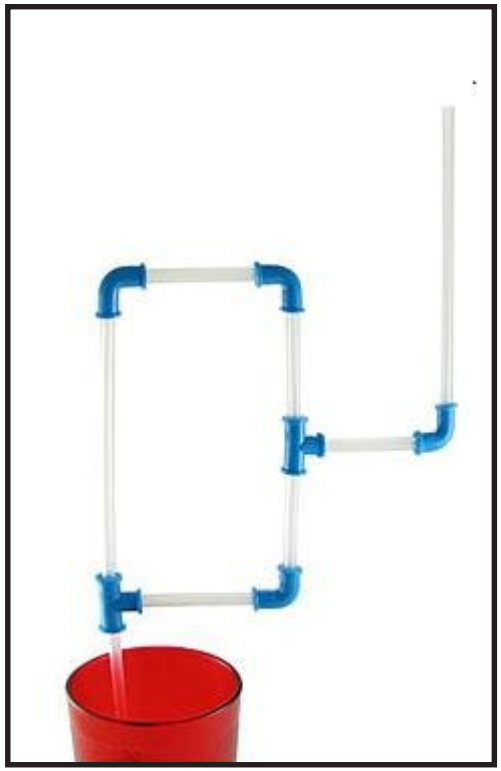
Because: Under pressure, we have fewer constraints upon pathways for our systems;

To use gravity, we have to assure sufficient drop and that means: PAY ATTENTION!

This week... Liquid Waste...Plumbing!

One more point concerning pressure in the context of piping:

Even gravity-drawn systems require awareness of pressure factors to assure continued operation. Since most liquid waste is contained by small-diameter piping, and since liquids will conform to the perimeter of their container,
we must always be assured of pressure equalization to prevent stoppage.



This week... Liquid Waste...Plumbing!

MEEB: Waterless Toilets and Urinals

Before getting down to the nitty gritty, our text presents several alternatives to the typical way of removing liquid waste.

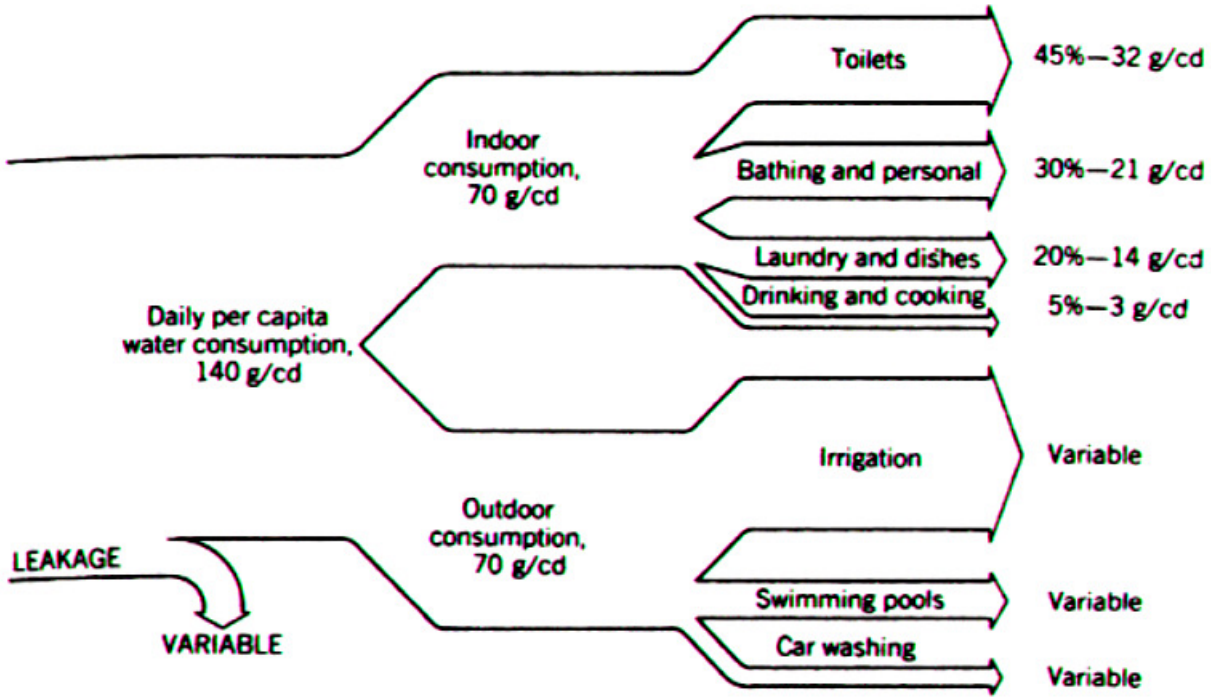
Why is this a significant issue?

(Remember, all water supplied in traditional systems is potable water. The water in your toilet tank is as pure and drinkable as the water you drink from your glass -- or the water with which you irrigate your lawn, wash your clothes, or wash your car.)

This week... Liquid Waste...Plumbing!

MEEB: Waterless Toilets and Urinals

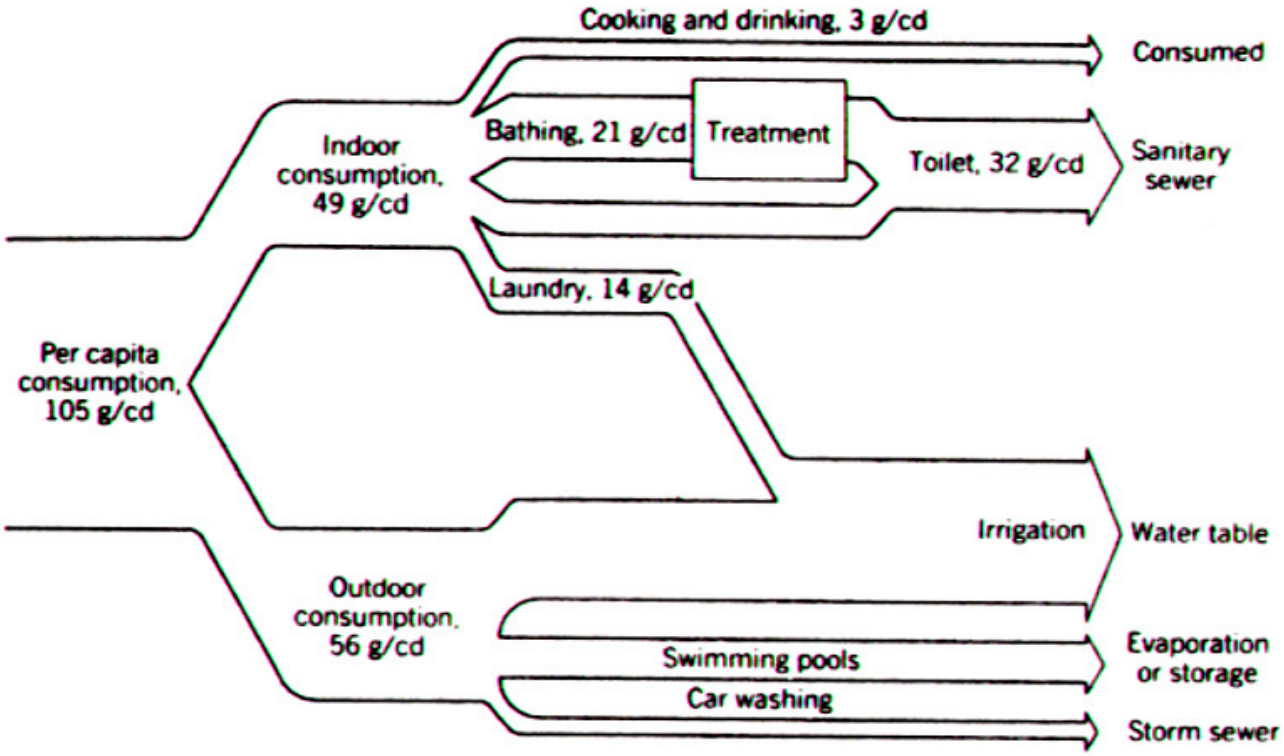
Opportunities for Water Conservation: Typical Consumption



This week... Liquid Waste...Plumbing!

MEEB: Waterless Toilets and Urinals

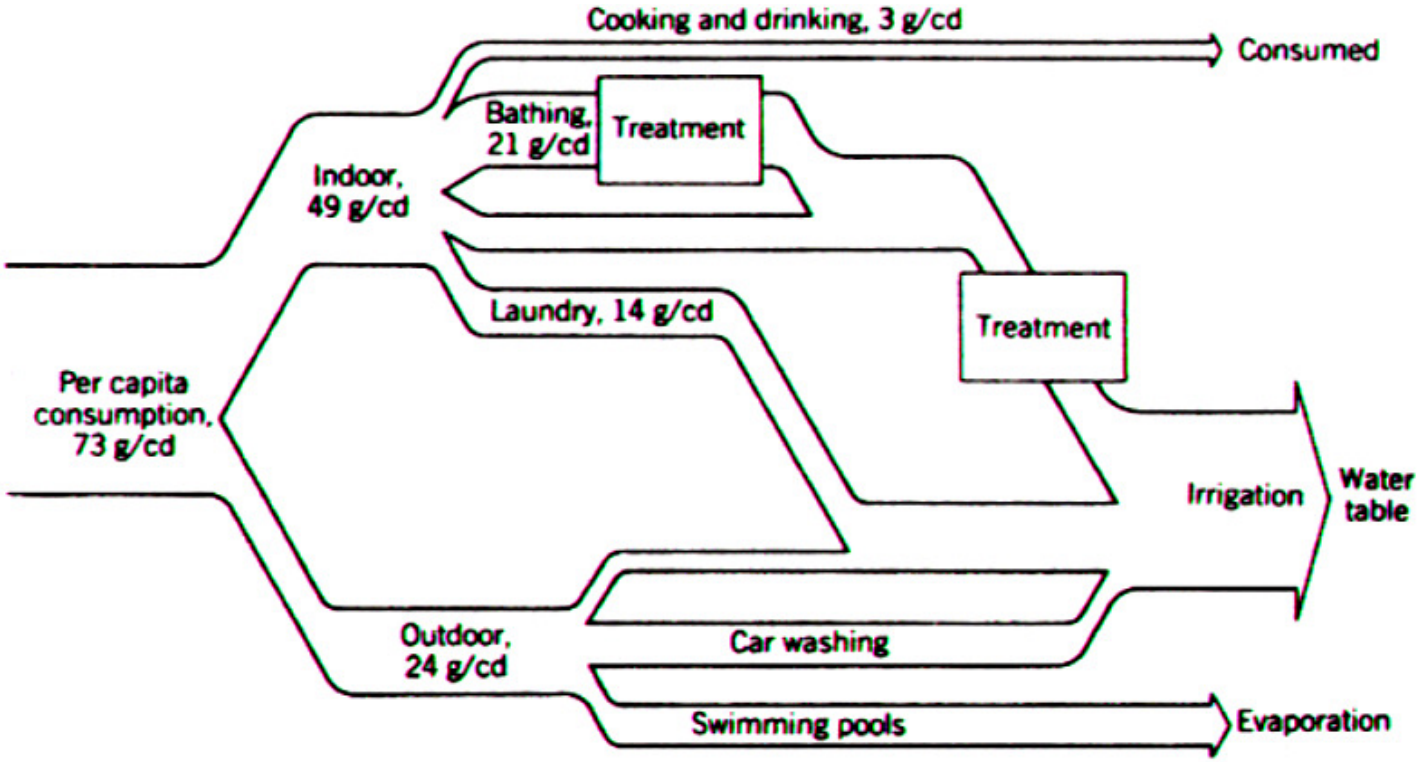
Opportunities for Water Conservation:
Recycling and Quality-Matching (25% Reduction)



This week... Liquid Waste...Plumbing!

MEEB: Waterless Toilets and Urinals

Opportunities for Water Conservation:
Additional Treatment (40% Reduction)



This week... Liquid Waste...Plumbing!

MEEB: Waterless Toilets and Urinals

Systems that "consume" the bulk of liquid waste have the advantage of not requiring clean, potable water for flushing waste.

> Composting Toilets
> Vault-Type Composting Toilets
> Heater-Type Composting Toilets

and... Waterless Urinals (and "Herinals")

This week... Liquid Waste...Plumbing!

MEEB: Waterless Toilets and Urinals

> Composting Toilets

Aerobic Digestion of Waste
By-products: CO_2 (Odorless) & Water

Waste is stirred to assure introduction of oxygen.

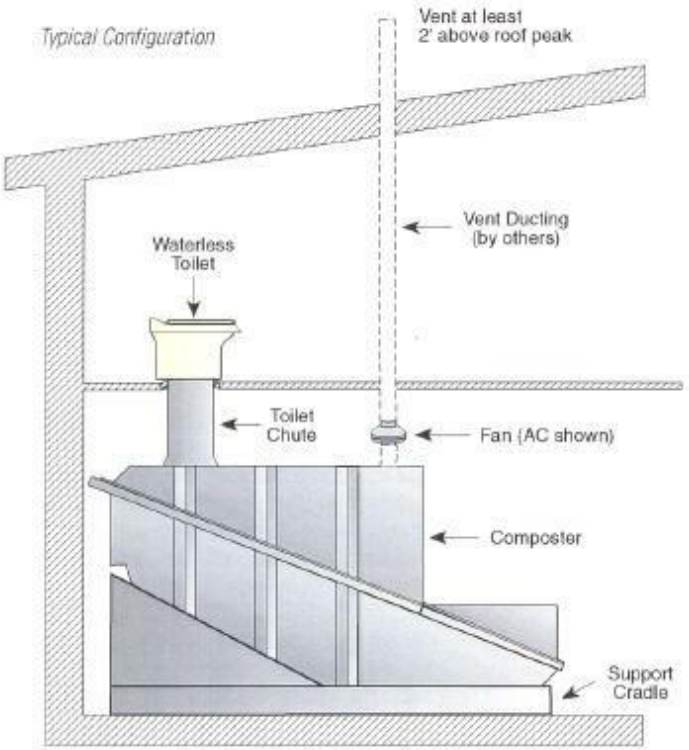
Ventilation removes waste odors and CO_2

Composte must be removed occasionally (and may be used as fertilizing); liquid effluent may be treated and used in grey-water applications.

This week... Liquid Waste...Plumbing!

MEEB: Waterless Toilets and Urinals

> Vault-Type Composting Toilets * *Clivus Multrum* System



> Made by the Clivus Multrum Company
> Familiar from installations at trailheads or parks.
> Prefabricated system includes a sloped surface and baffle to segregate composted material ("humus") from fresh waste.
> Intake air must be heated to assure composting activity.

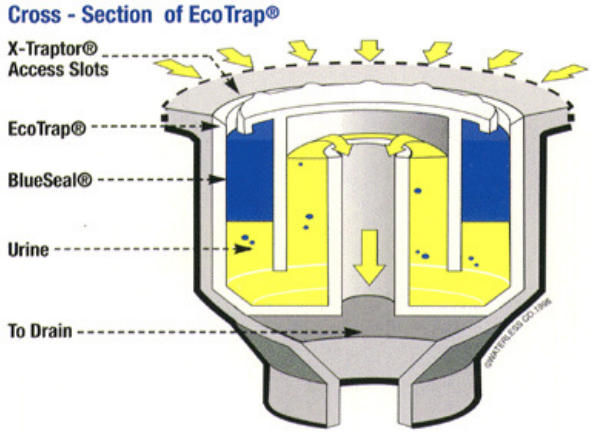
This week... Liquid Waste...Plumbing!

MEEB: Waterless Toilets and Urinals

> Waterless Uninals

> Since waste is entirely liquid, why waste water by flushing?

> An special-fluid seal allows urine to pass through to removal by a typical piped system; the seal prevents infiltration of vent odors into the habitable space.

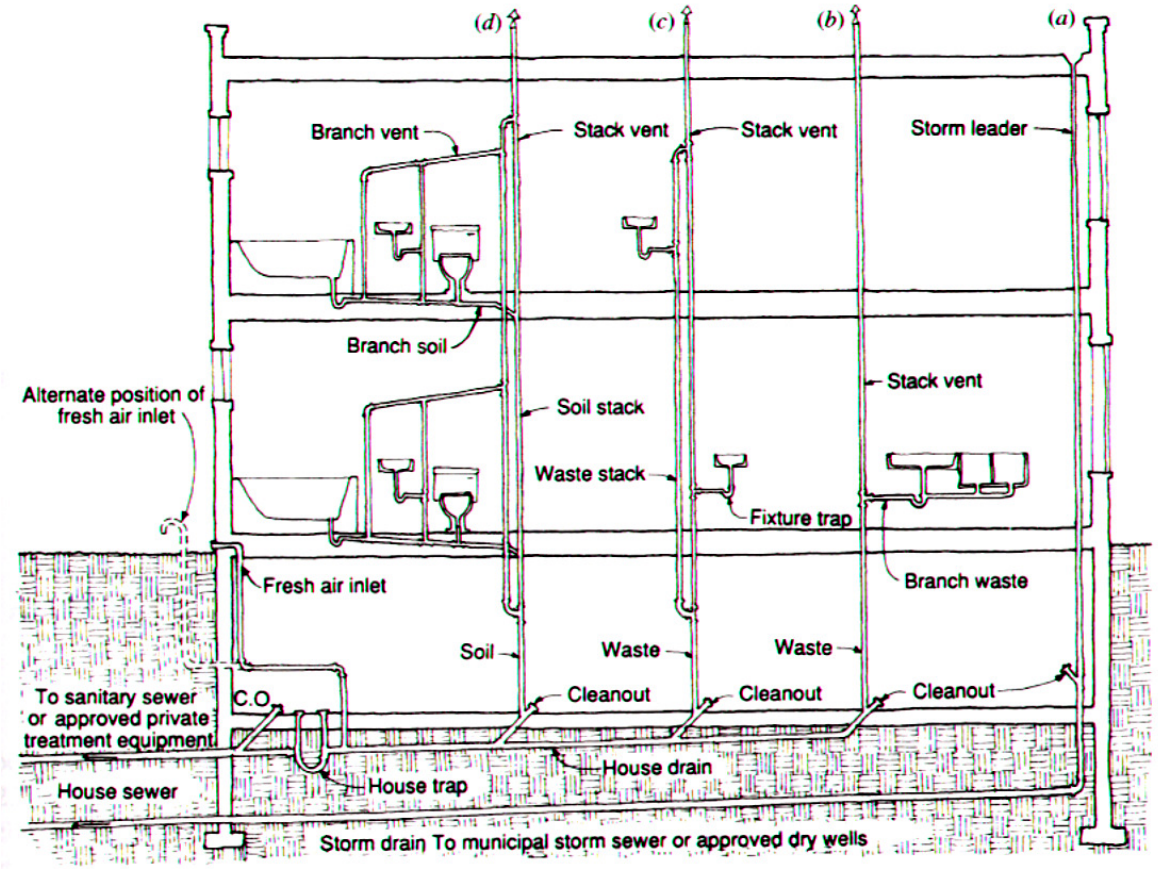


> These items are becoming more and more common in commercial applications, and are significant (and easy) water saving devices.

This week... Liquid Waste...Plumbing!

MEEB: Principles of Drainage

The most typical system to remove liquid waste in buildings is characterized as the DWV system: **Drainage, Waste, & Vent**

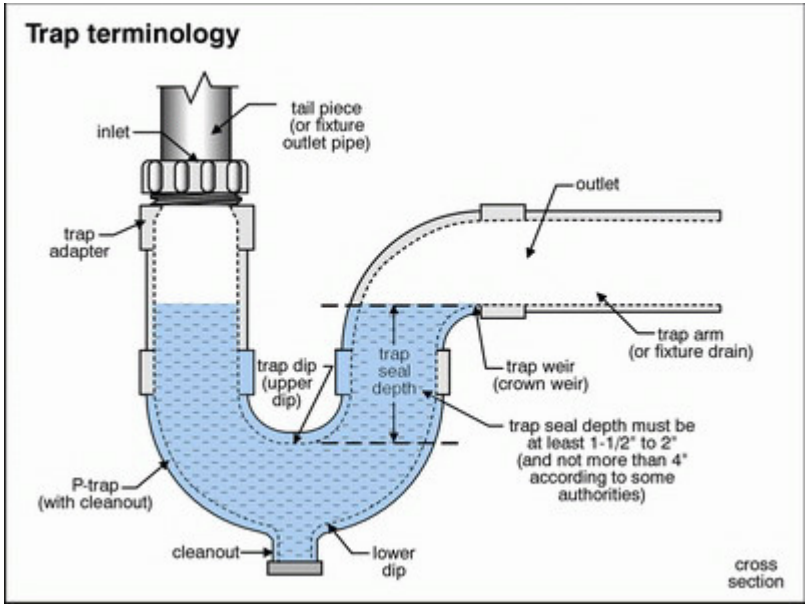


This week... Liquid Waste...Plumbing!

MEEB: Principles of Drainage

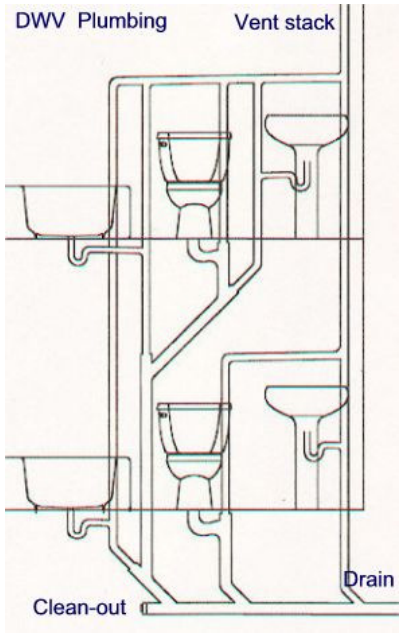
Traps: Prevents back-flow of gases into occupied spaces.

Most fixtures should have their own trap.



Vents: Allow pressure equalization along the fall of drain lines, and provides some ventilation for system pipes.

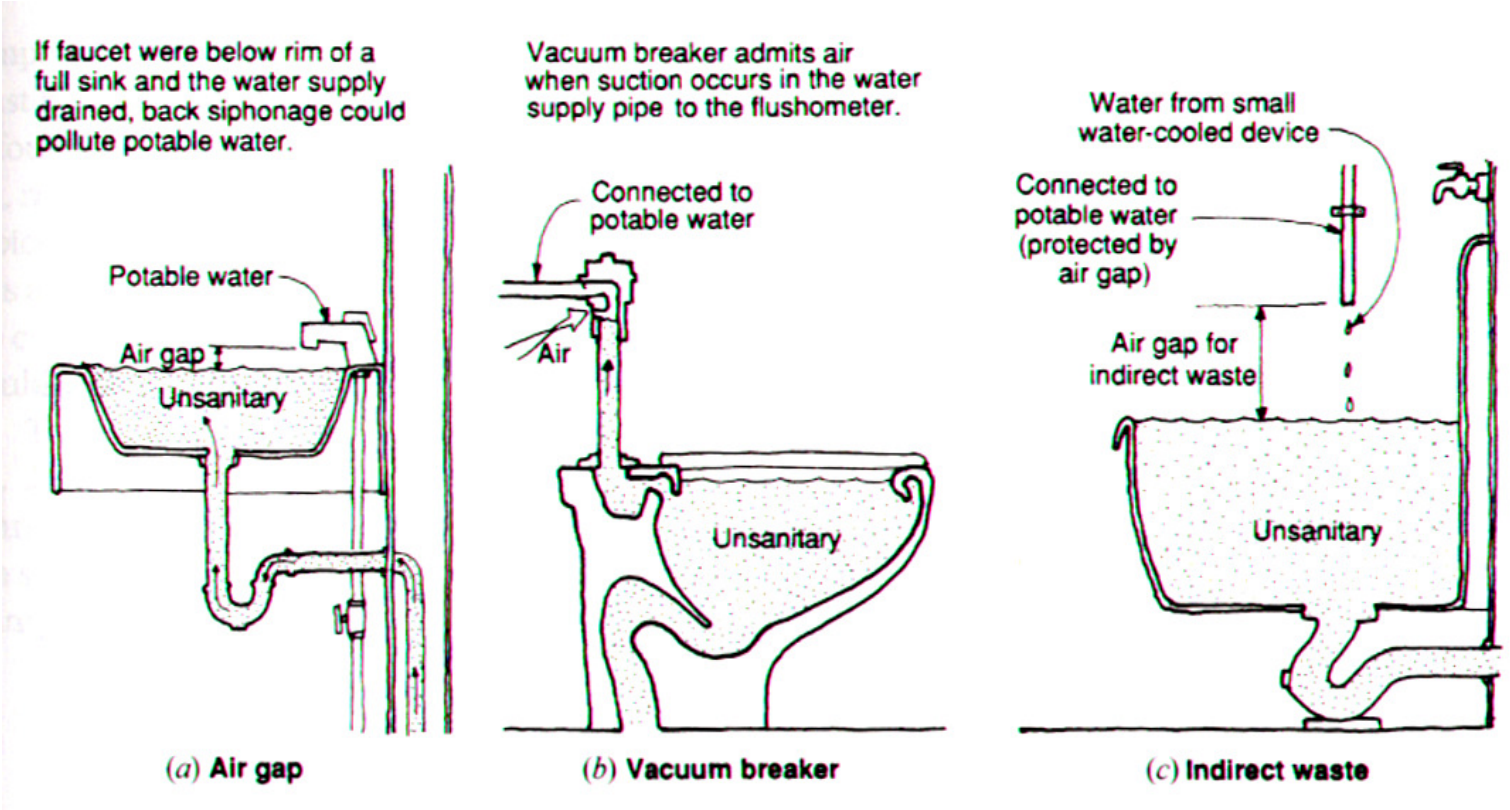
Vents also allow the escape of system gases.



This week... Liquid Waste...Plumbing!

MEEB: Principles of Drainage

Air Gaps and Vacuum Breakers afford assurance that back-flow of sewage and other waste cannot enter the supply system piping.



This week... Liquid Waste...Plumbing!

MEEB: Pipes, Fittings, and Accessories

> **Piping and Fittings**
>
> Cast Iron, Galvanized Steel
> Copper
> **Plastics** (ABS, PVC)
> Silicate (Vitrified Clay, Concrete)

> **Connections**
>
> Threaded
> Solder
> Chemical bond (adhesive, welding)
> Gasket / Lead-and-Oakum

> **Clean Outs**

This week... Liquid Waste...Plumbing!

MEEB: Pipes, Fittings, and Accessories

> **Accessories**

Floor Drains
Backwater Valves
(Backflow Preventers)
Sewage Sumps and Ejectors
Interceptors (e.g., Grease Trap)

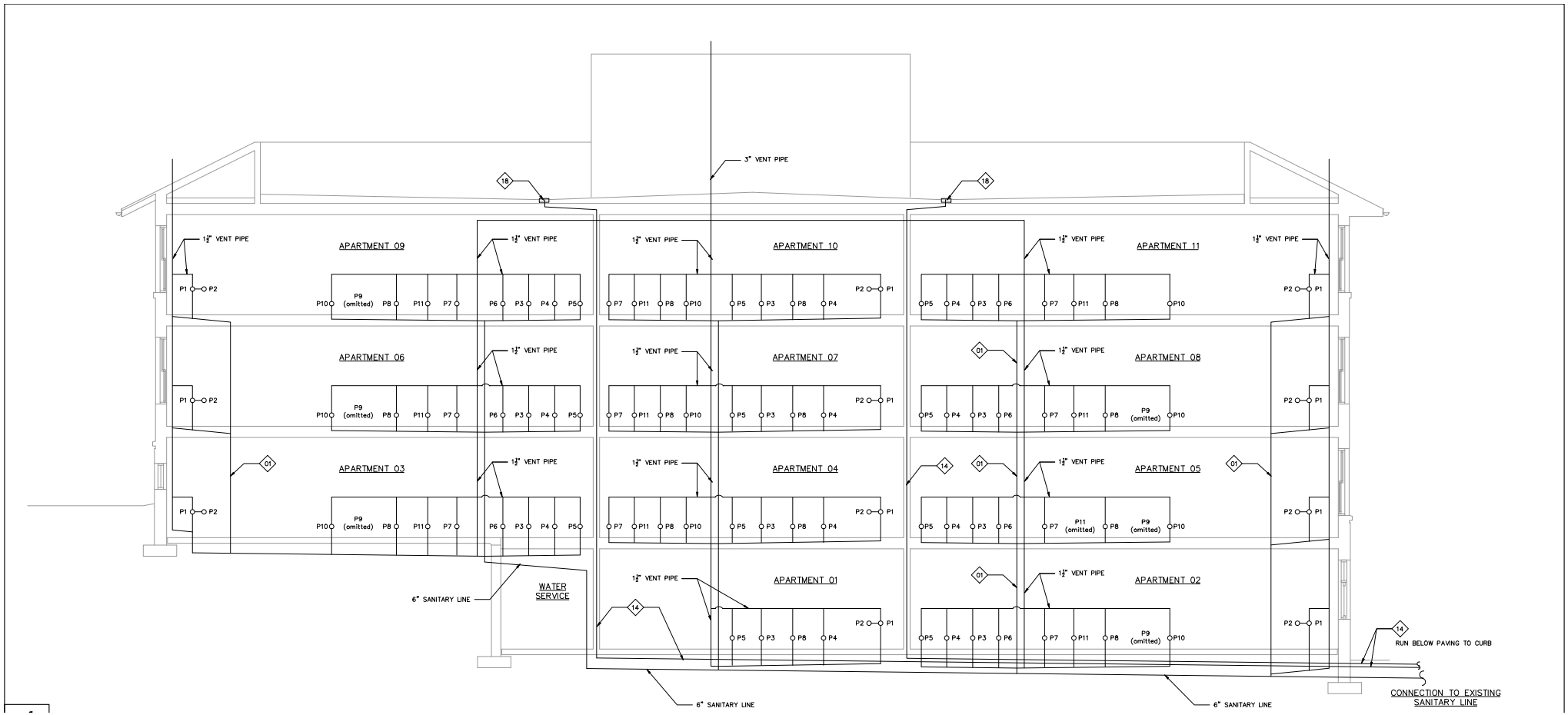
> **Fixtures**

Toilets	(Supply and Drain)
Sinks	(Drain)
Faucets	(Supply)

Each fixture has a corresponding Drainage Fixture Unit, which represents the measure of the drainage load imposed by a given type of fixture.

This week... Liquid Waste...Plumbing!

MEEB: Design of Residential Waste Piping
Plans & Riser Diagrams



This week... Liquid Waste...Plumbing!

MEEB: Design of Large-Building Waste Piping

> Basic Planning... Grouped facilities
Stacked Services
Shafts for vertical groups of pipes
Remove from Exterior Walls

When planning results in an "isolated" item, such as a single water closet remote from other plumbing items, care must be taken for sufficient vertical drop and proper service access if connected to the central core.

This week... Liquid Waste...Plumbing!

MEEB: Design of Large-Building Waste Piping

> Roughing-In

Proposed installation of piping and mountings must anticipate interference with both structure and other systems. Penetrations through those systems must not compromise their function; and planned openings must be large enough to accomodate both pipes, connections, and variations due to constructional tolerances.

> Solvent Drainage

Creates a "plungerless" foam from liquid effluent, so that requirements for venting are greatly reduced.

This week... Liquid Waste...Plumbing!

MEEB: On-Site Individual Building Sewage Treatment

> Septic Tanks -- The "Anaerobic" version of composting.
> A PRIMARY treatment system: First, solids precipate down, and decomposition proceeds, producing methane. Liquids continue to second tank, after which the effluent leaves the septic tank for secondary treatment.
>
> Afterwards, effluent is leached into surrounding soil via seepage pit, disposal field, leaching mound, or buried sand filter.
>
> Increased dilution and flow decrease effectiveness of septic system.

This week... Liquid Waste...Plumbing!

MEEB: On-Site Multiple-Building Sewage Treatment

> Open Sand Filters, Recirculating Sand Filters, and Lagoons

> Advanced Integrated Wastewater Pond Systems...

> Constructed Wetlands

> Greenhouse Ecosystems

> Pasveer Oxidation Stream

This week... Liquid Waste...Plumbing!

MEEB: Large-Scale Sewage Treatment Systems

> The book describes community-size sewage treatment systems, the principles of which include multiple instances of the smaller-scale systems described earlier:

Filter/Screens, Sediment Tanks, Clarifiers, Classifiers, Hauling of solid waste, continued purification of liquid effluent, purifiers, and eventual release to the environment. Chlorine injection may be used at the end of the process, as a "tertiary" stage treatment upon the treated wasted before release.

This week... Liquid Waste...Plumbing!

MEEB: Recycling and Greywater

Graded classifications of water in buildings:

> Potable Water (for drinking and all other consumption)
> Rainwater (unpolluted, but restricted for drinking)
> Graywater (includes pathogens, but may be reused with simple treatment for uses excluding drinking)
> Blackwater(High concentrations of human waste)
> Dark Graywater (waste from high-toxic streams, such as laundry with diapers, or foodservice sources
> Clearwater (Byproducts of condensation, unpurified)

This week... Liquid Waste...Plumbing!

MEEB: Stormwater Treatment

This is an extremely significant part of this topic, since the capital investment typically spent on handling stormwater is high and, in fact, relates to infrastructure far beyond the boundaries of individual buildings. But for persons not connected with the building professions, Stormwater Management is practically "invisible," even which having a large impact on the appearance of our environment.

This week... Liquid Waste...Plumbing!

MEEB: Stormwater Treatment

As may have been mentioned in passing during the first part of the semester, each new building creates an impervious surface upon land which previously allowed some if not most water to enter the soil and the complex geologic systems of the site.

Now that we have prevented rainwater from being absorbed by the soil, where does it go? Without planning for the additional run-off, each stormwater event creates damage, flooding, and un-controlled erosion of both developed and remaining, undeveloped areas.

This week... Liquid Waste...Plumbing!

MEEB: Stormwater Treatment

Traditional methods of handling stormwater includes channelizing it for re-use (cisterns for drinking, canals for irrigation) or simply for removal to a close-by "natural" canal: a river or stream.

With the historically small-scale impact of human habitation, these worked well or less-well, but did not contribute to significant degredation of the natural surroundings. With increased human dispersion, and with the explosion in the scale of human settlements, what could previously be absorbed by surrounding, natural eco-systems soon overwhelmed them.

This week... Liquid Waste...Plumbing!

MEEB: Stormwater Treatment

Ironically, modern methods of stormwater management tended to discard opportunities for re-use, since new energy sources afforded relatively in-expensive supplies of water. Stormwater treatment focused instead upon management of the huge surge volumes created at the peak innundations. This water needed to be contained, held, and then dispersed. Where urban and suburban sprawl created larger and larger open, impervious surfaces -- parking lots, industrial roofs, playing fields -- these areas were accompanied with large, recessed collecting volumes (retention ponds, underground storage tanks, &c.) and engineered channels the function of which was soley to channel stormwater from those volumes for removal over time to a natural environment poorly prepared to receive it.

This week... Liquid Waste...Plumbing!

MEEB: Stormwater Treatment

We've seen in our discussion of sustainable technologies new trends to reintroduce "pervious" surfaces where before our architecture was only impervious to storm water. Other recent design ideas include greater attention to landscaping (both hardscape and greenscape) as a way to filter and direct stormwater into the local soil, instead of removing to from the site.

All efforts to reuse stormwater on-site will contribute to the reduction of what has become a bizarre, Rube-Goldberg kind of problem caused only by our impulse to simple, unthinking technical solutions for complex environmental challenges.

This week... Liquid Waste...Plumbing!

Now in Class:

Worksheet #10:
(Chapter 22)

Audience's Choice

PBS Video Series: ***Design E²***

This week's showing: ???

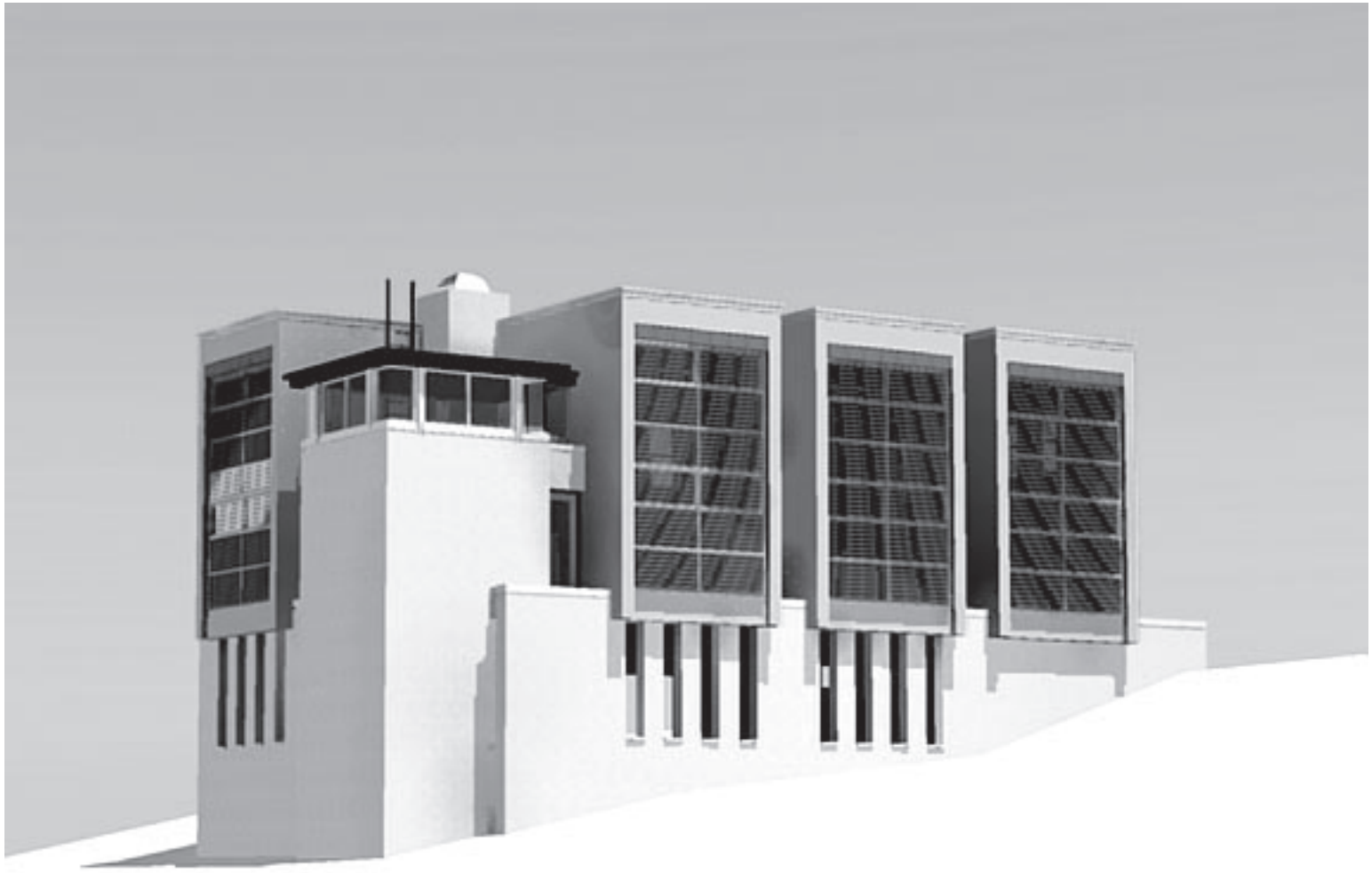
This week... Liquid Waste...Plumbing!

Case Study of a Small Apartment Building

This week we'll examine the plumbing plans for a small apartment building of only 4 Units, 3-stories high: Clipper Crest Lofts.

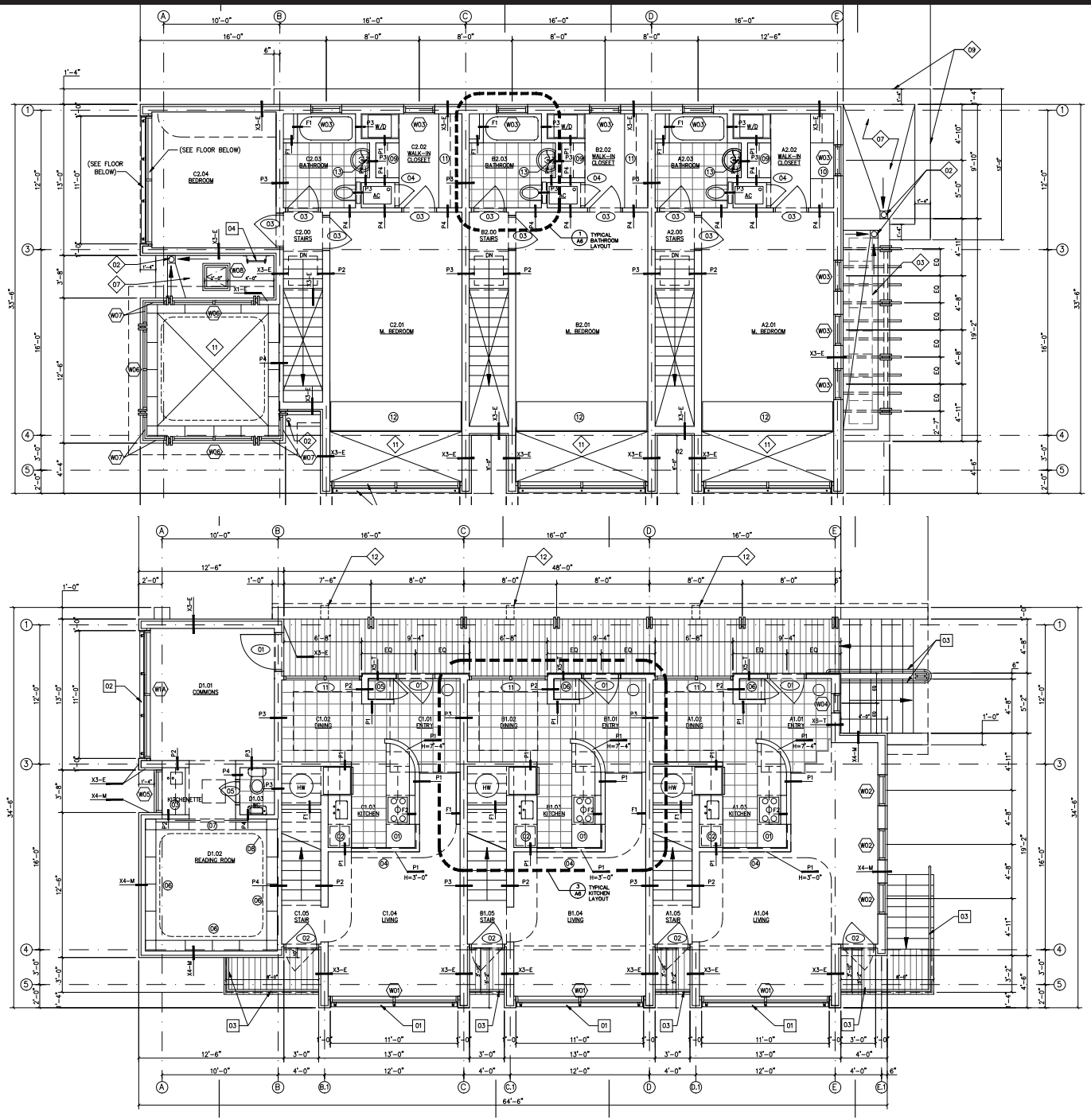
This project, as currently planned, calls for both a planted roof and for solar heating of domestic hot water. Other "plumbing" systems are conventional, and domestic waste water is connected simply to the city sewer system.

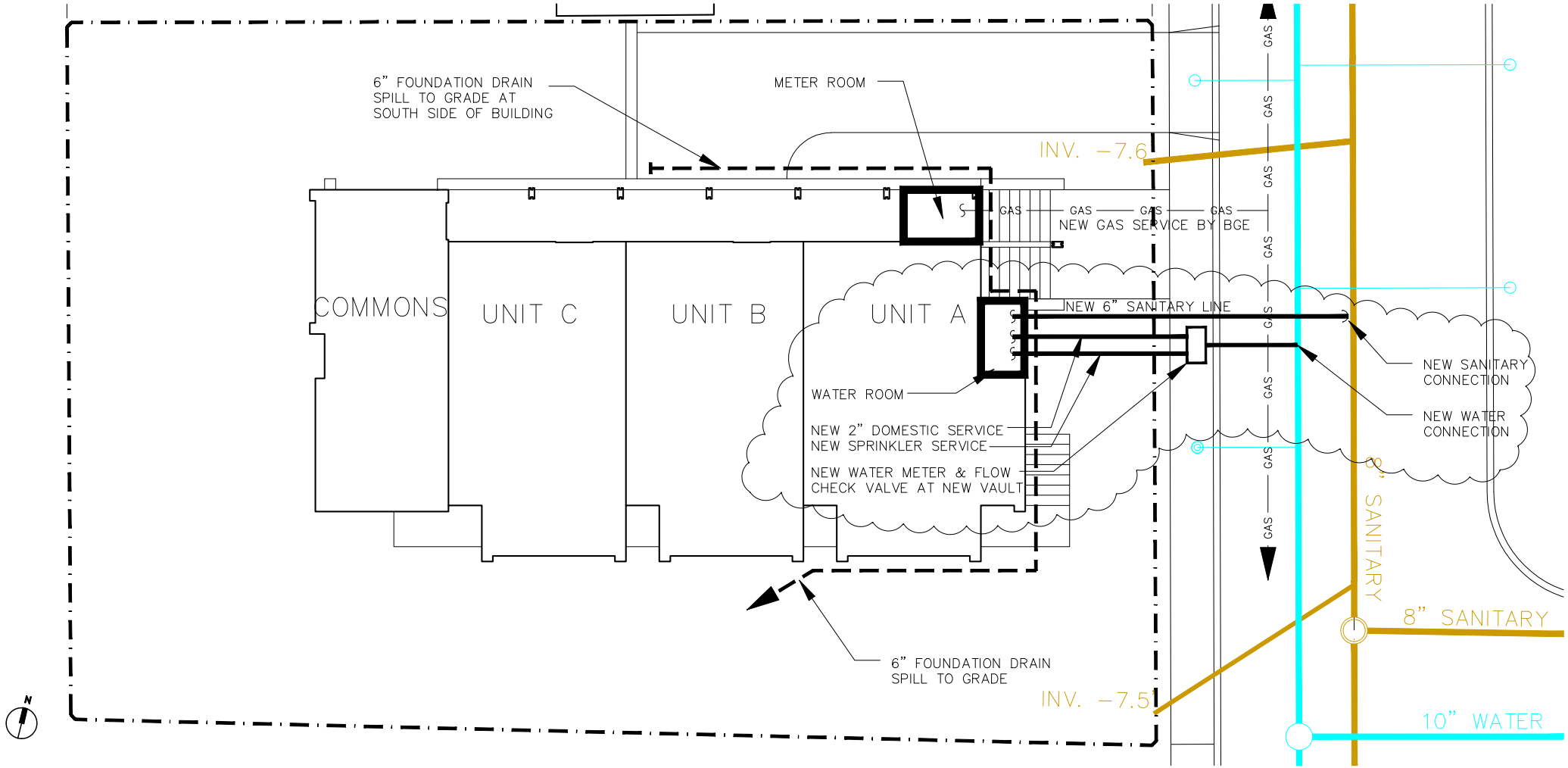
No irrigation of exterior plantings is called for; the area of disturbance is small enough (<3000 sf) not to require specific stormwater management features. Nevertheless, in lieu of stormwater recapture, the planted roof should address most of the problems caused by the new development.



Clipper Crest Lofts

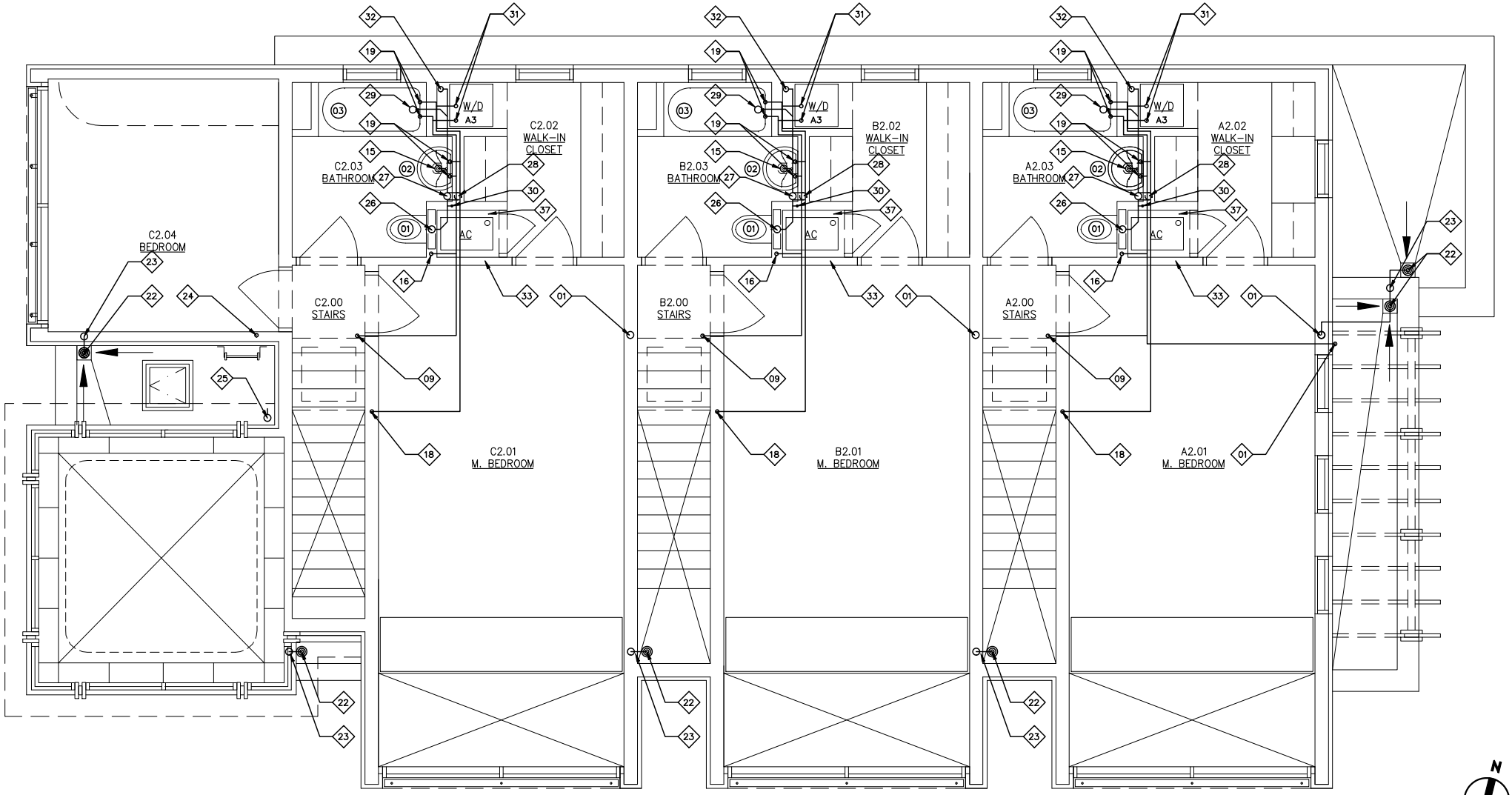
Architectural Technology III





SITE DEVELOPMENT PLAN: SEWAGE, STORMWATER, AND FOUNDATION DRAINS, $\frac{3}{16}$" = 1'0"

1

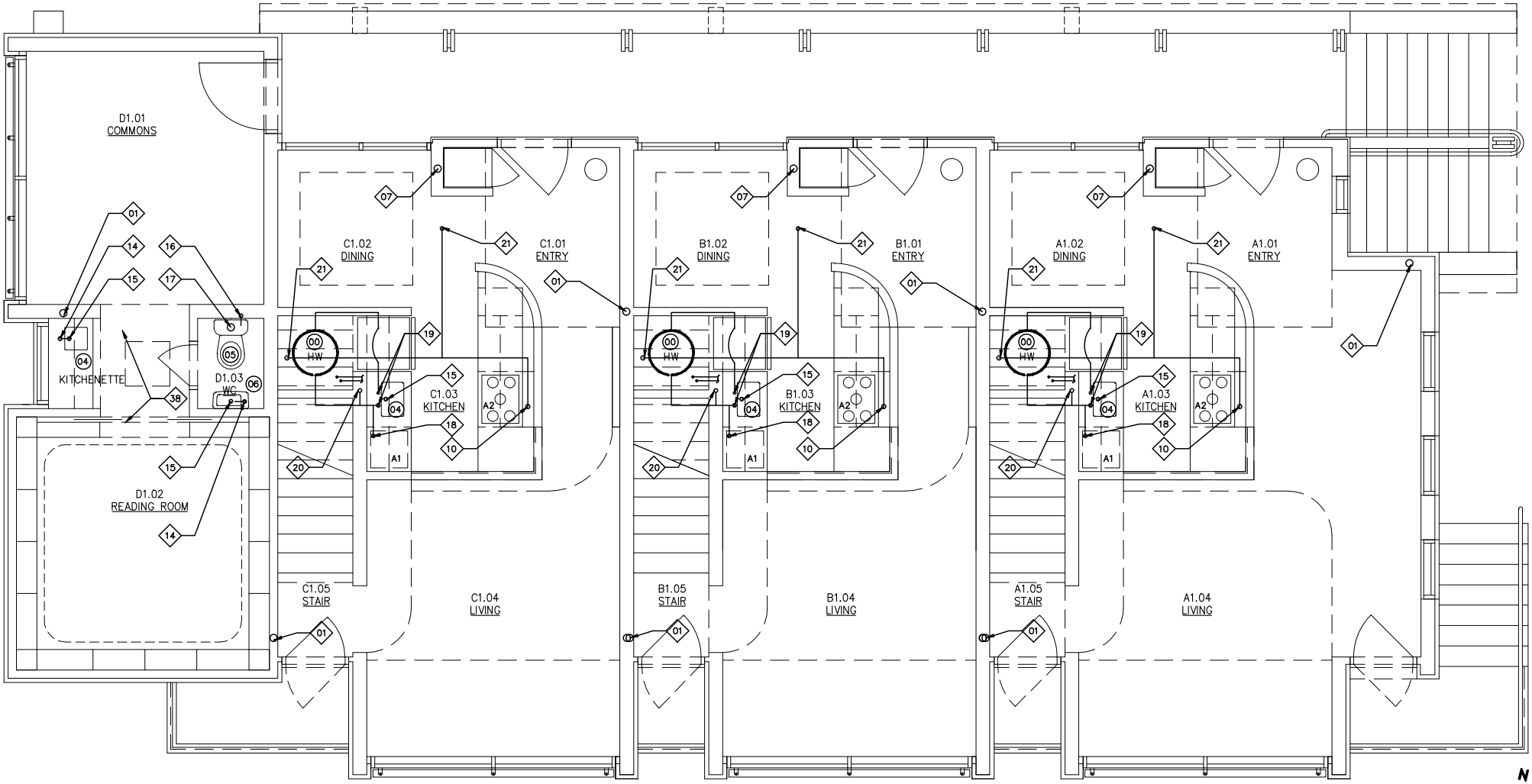


PIPING PLAN: UPPER LEVEL, $\frac{1}{4}$" = 1'0"

3

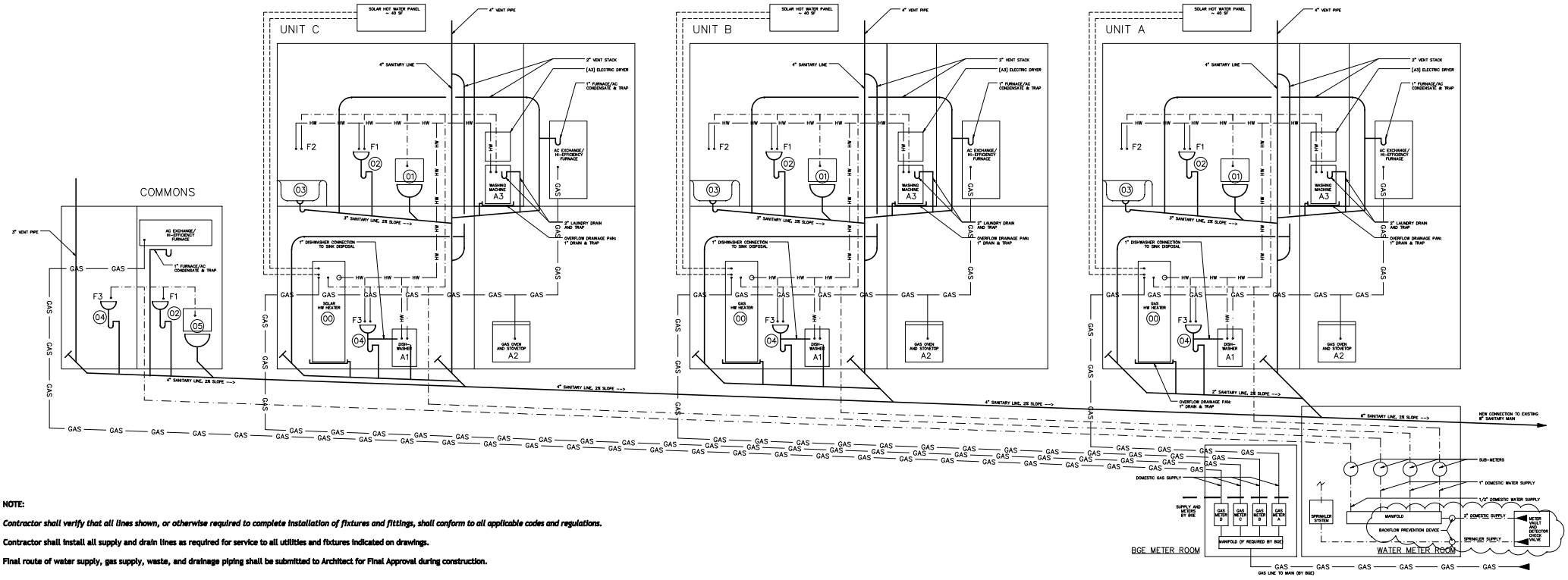
Plumbing Annotations

NOTE:



PIPING PLAN: ENTRY LEVEL. ½" = 1'0"

2

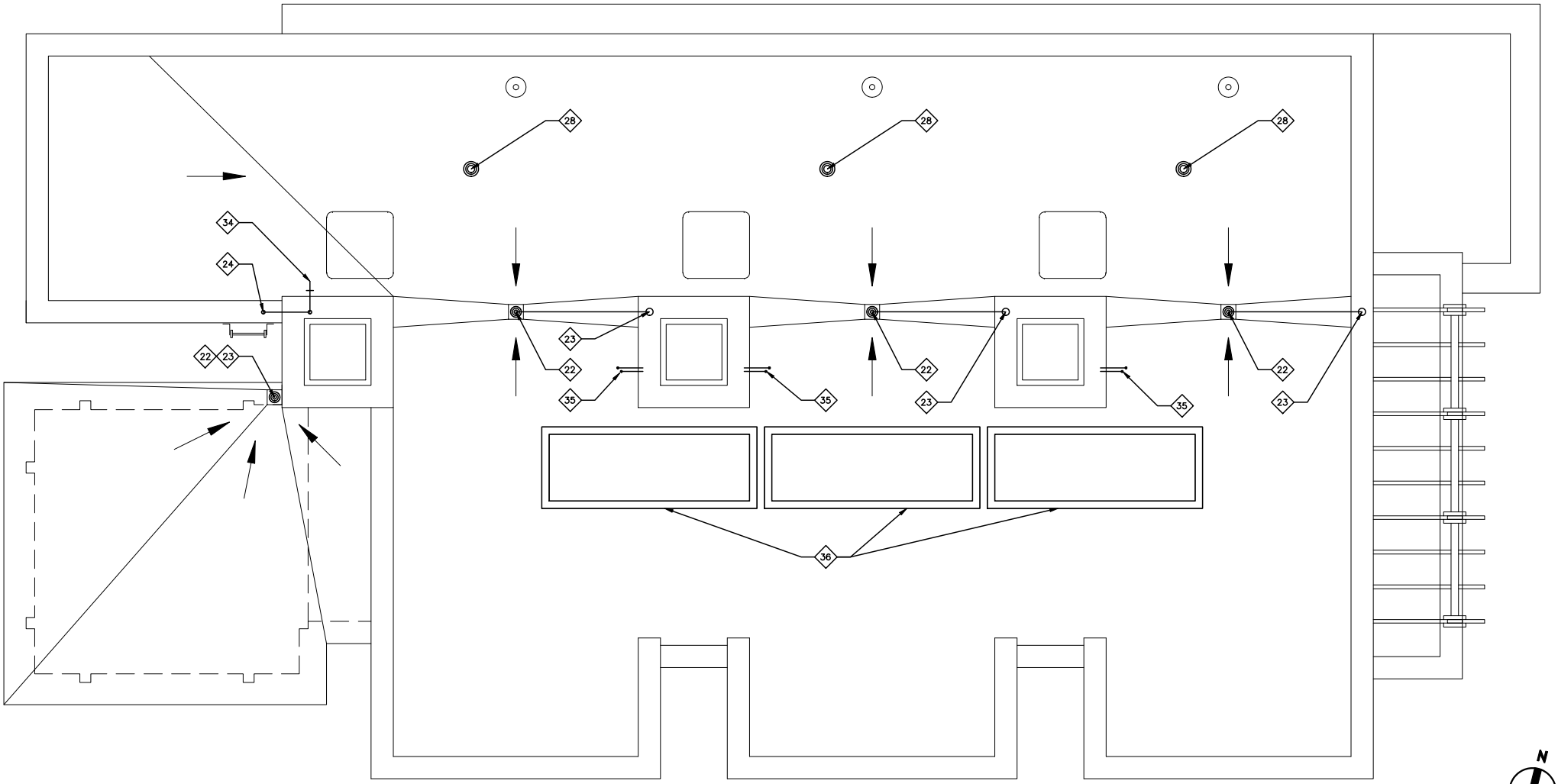


NOTE:

Contractor shall verify that all lines shown, or otherwise required to complete installation of fixtures and fittings, shall conform to all applicable codes and regulations.

Contractor shall install all supply and drain lines as required for service to all utilities and fixtures indicated on drawings.

Final route of water supply, gas supply, waste, and drainage piping shall be submitted to Architect for Final Approval during construction.



PIPING PLAN: ROOF LEVEL, $\frac{1}{4}$" = 1'0"

4

Next Week: Chapters 27 & 28...!

Electrical Wiring