TELLUS

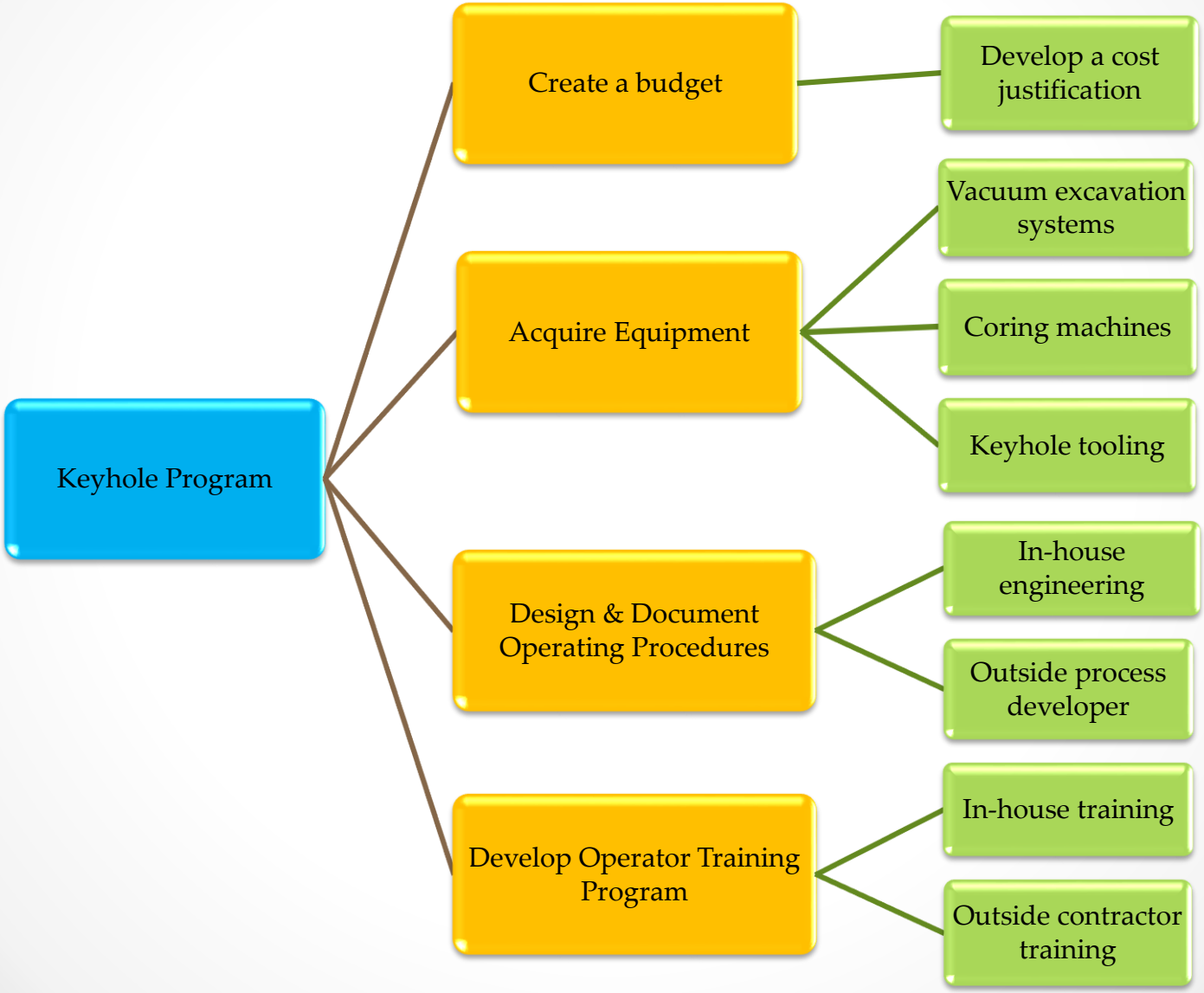
UNDERGROUND TECHNOLOGY, INC.

- Keyhole Process Design
- Keyhole Tooling
- Vacuum Excavation Systems

Scaling up a Keyhole program

1. **Will the engineering department develop and write operating procedures?**
2. **Will the Keyhole work be performed by company personnel or outside contractors?**
3. **Is it necessary to develop a budget to fund the purchase of vacuum trucks, coring rigs and keyhole tooling?**
4. **Will it be necessary to develop a training & implementation program for in-house personnel or contractors?**

Development of a Keyhole Technology Program



Keyhole Process Timeline

Typical Keyhole process timeline

- **Using Hydro-excavation**

Event	**Time req'd**
1. Locate excavation	20 min
2. Core cut hole	20 min
3. Excavate hole	5 min
4. Perform process	30 min
5. Back-fill & tamp	10 min
6. Mix grout & apply	15 min
7. Reset core	10 min
8. Grout set & open street	30 min
9. Travel time to next job	30 min
TOTAL	170 min (2hrs. 50 min.)

- **Using compressed air excavation**

Event	**Time req'd**
1. Locate excavation	20 min
2. Core cut hole	20 min
3. Excavate keyhole	20 min
4. Perform process	30 min
5. Back-fill & tamp	10 min
6. Mix grout & apply	15 min
7. Reset core	10 min
8. Grout set & open street	30 min
9. Travel time to next job	30 min
TOTAL	185 min (3hrs. 5 min.)

Developing a cost justification

- **Using Hydro-excavation**

Capital item	Qt'y req'd	Cost (ea.)	Total Cost
Vac truck	1	330,000	$ 330,000
Coring machines	2	75,000	150,000
Keyhole tooling	3	15,000	45,000
Crew truck	3	70,000	210,000
Masons dump truck	1	65,000	65,000
		TOTAL	$ 800,000

- **Using compressed air excavation**

Capital item	Qt'y req'd	Cost (ea.)	Total Cost
Vac trucks	3	$135,000	$ 405,000
Coring machines	2	75.000	150,000
Keyhole tooling	3	15,000	45,000
		TOTAL	$ 600,000

Recovery of Costs

- If the time required to perform a process is approximately the same as using conventional methods (180 minutes) then the cost savings would be the elimination of street restoration costs.

  ($500 to $1,000 per job)

- At a cost savings of $500 per job it will take 1,600 jobs to recover the cost of equipment using hydro-excavation methods or 1,200 jobs using dry excavation methods

  ($500/job x 1600 jobs = $800,000) ($500/job x 1200 jobs = $600,000)

- If three crews can perform 9 jobs per day and they work 4 days per week it will take 44 weeks to recover the cost of the hydro-excavation equipment or 33 weeks using dry excavation methods.

  (36 jobs/week x $500/job = $18,000/week)

  ($800,000 ÷ $18,000/week = 44 weeks)

  ($600,000 ÷ $18,000/week = 33 weeks)

Heavy truck designs

26,000 to 60,000 lb. GVWR

HydroVac Truck

Keyhole Truck with screenings bins

Light trucks & Trailer designs

19,500 lb. GVW trucks

10,000 lb. GVW trailers

Tellus filtration system

Never requires cleaning
Hydrophobic filters

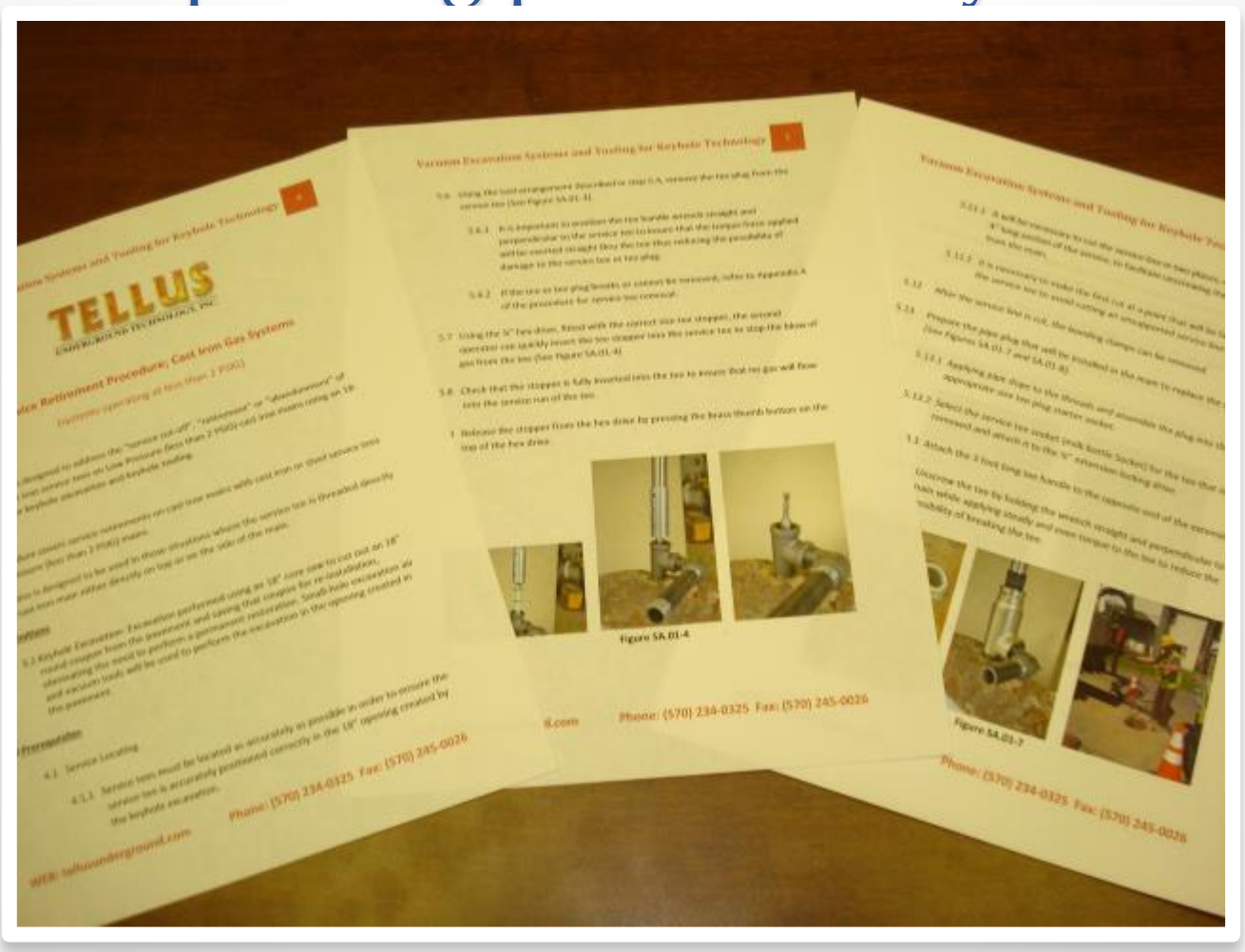
Programmable controller
Wet or dry operation

Tellus Keyhole tooling

Pneumatic & specialized designs

No-blow processes for high & medium pressure

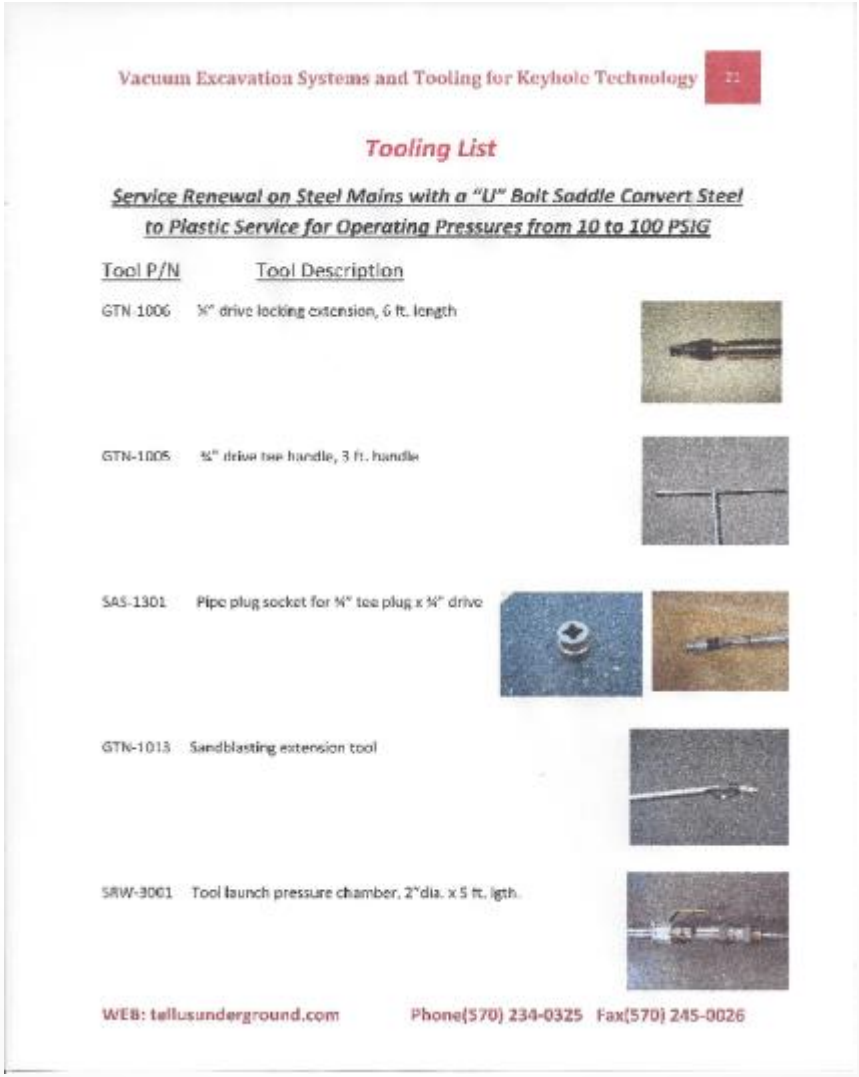
Operating procedure layout



Tellus procedures are written in a way that allows transfer to "Gas Operations Manuals" with little to no revisions

Tooling Lists

part numbers, description & photo of every tool for the process



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Tooling List

Service Renewal on Steel Mains with a "U" Bolt Saddle Convert Steel to Plastic Service for Operating Pressures from 10 to 100 PSIG

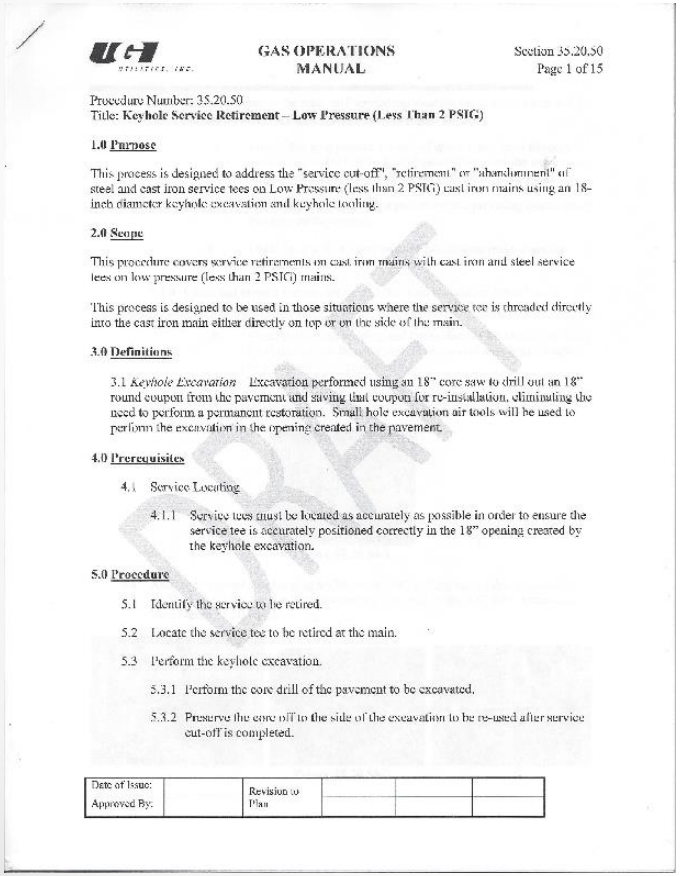
Tool P/N	Tool Description
GTN-1006	¾" drive locking extension, 6 ft. length
GTN-1005	¾" drive tee handle, 3 ft. handle
SAS-1301	Pipe plug socket for ¾" tee plug x ¾" drive
GTN-1013	Sandblasting extension tool
SRW-3001	Tool launch pressure chamber, 2"dia. x 5 ft. lgth.

WEB: tellusunderground.com Phone(570) 234-0325 Fax(570) 245-0026

Process Documentation

In-house engineering document to support the keyhole process

Includes references to operator qualifications



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Procedure Number: 35.20.50
Title: **Keyhole Service Retirement – Low Pressure (Less Than 2 PSIG)**

1.0 Purpose

This process is designed to address the "service cut-off", "retirement" or "abandonment" of steel and cast iron service tees on Low Pressure (less than 2 PSIG) cast iron mains using an 18-inch diameter keyhole excavation and keyhole tooling.

2.0 Scope

This procedure covers service retirements on cast iron mains with cast iron and steel service tees on low pressure (less than 2 PSIG) mains.

This process is designed to be used in those situations where the service tee is threaded directly into the cast iron main either directly on top or on the side of the main.

3.0 Definitions

3.1 *Keyhole Excavation* Excavation performed using an 18" core saw to drill out an 18" round coupon from the pavement and saving that coupon for re-installation, eliminating the need to perform a permanent restoration. Small hole excavation air tools will be used to perform the excavation in the opening created in the pavement.

4.0 Prerequisites

4.1 Service Locating

4.1.1 Service tees must be located as accurately as possible in order to ensure the service tee is accurately positioned correctly in the 18" opening created by the keyhole excavation.

5.0 Procedure

5.1 Identify the service to be retired.

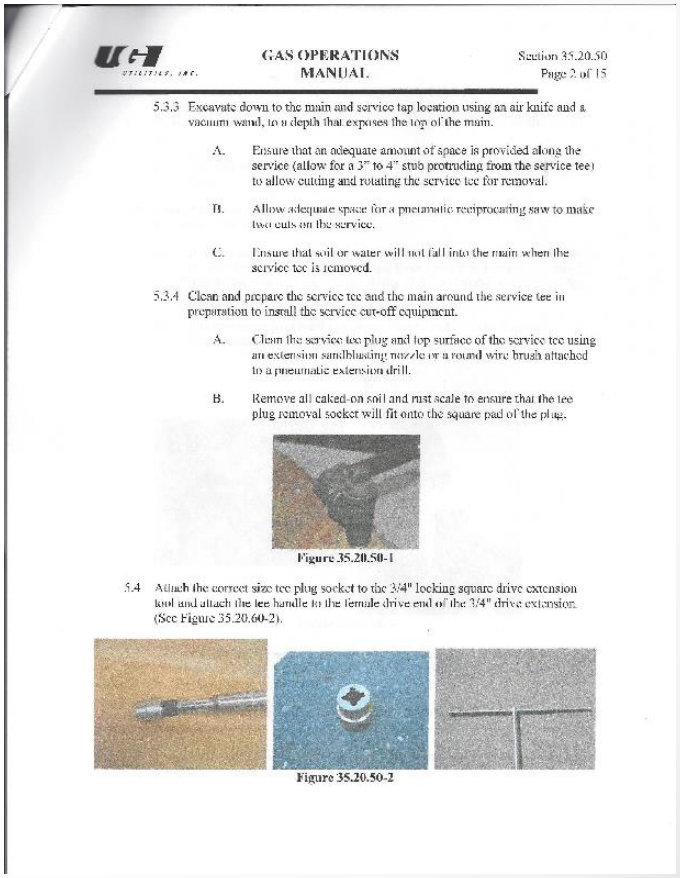
5.2 Locate the service tee to be retired at the main.

5.3 Perform the keyhole excavation.

5.3.1 Perform the core drill of the pavement to be excavated.

5.3.2 Preserve the core off to the side of the excavation to be re-used after service cut-off is completed.

Date of Issue:		Revision to Plan			
Approved By:					



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5.3.3 Excavate down to the main and service tap location using an air knife and a vacuum wand, to a depth that exposes the top of the main.

A. Ensure that an adequate amount of space is provided along the service (allow for a 3" to 4" stub protruding from the service tee) to allow cutting and rotating the service tee for removal.

B. Allow adequate space for a pneumatic reciprocating saw to make two cuts on the service.

C. Ensure that soil or water will not fall into the main when the service tee is removed.

5.3.4 Clean and prepare the service tee and the main around the service tee in preparation to install the service cut-off equipment.

A. Clean the service tee plug and top surface of the service tee using an extension sandblasting nozzle or a round wire brush attached to a pneumatic extension drill.

B. Remove all caked-on soil and rust scale to ensure that the tee plug removal socket will fit onto the square pad of the plug.

Figure 35.20.50-1

5.4 Attach the correct size tee plug socket to the 3/4" locking square drive extension tool and attach the tee handle to the female drive end of the 3/4" drive extension. (See Figure 35.20.60-2).

Figure 35.20.50-2

Operator Training

When keyhole procedures are to be performed by company staff Tellus can assist with training

Measures of Training Success

Training should include actual operating environments

Skills can be evaluated in real operating situations

What Keyhole Processes will be performed

- Leak location & repair
- Service retirement (service cut-offs)
- Corrosion control
- Service renewals
- Anode installation
- Service installation
- Camera launch & inspection
- Underground plant location (daylighting)
- Meter replacement & relocation
- Tracer wire repair
- Tie-overs & main replacement
- Emergency leaks (gas evacuation)

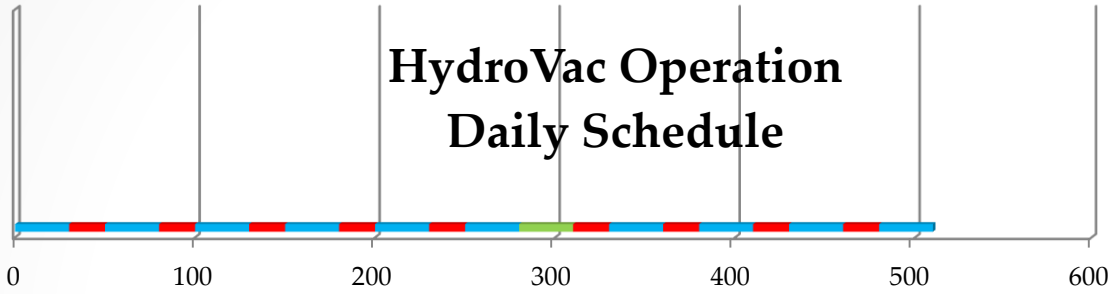
Implementation Teams Make Keyhole Technology Programs Successful

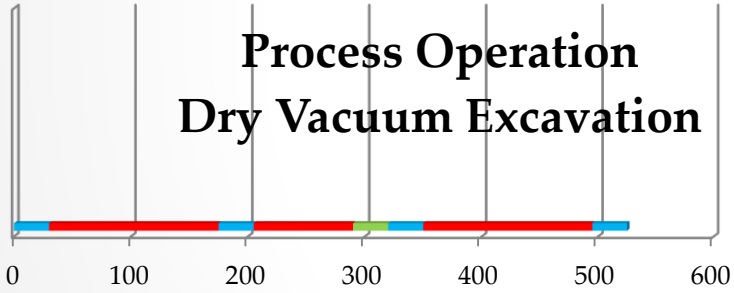
- Enrollment Stage:
  1. Carefully select team members
  2. Explain the reasons for selection
  3. Define clear roles of responsibility
  4. Frame the project as implementing new technology with new procedures
- Preparation Stage:
  1. Conduct joint training sessions
  2. Encourage openness and feedback
  3. Make reasons for changes clear
- Trial Stage:
  1. Seek input
  2. Accept attempts to do things differently
- Evaluation Stage:
  1. Close each week with a debriefing & data review to discuss possible changes

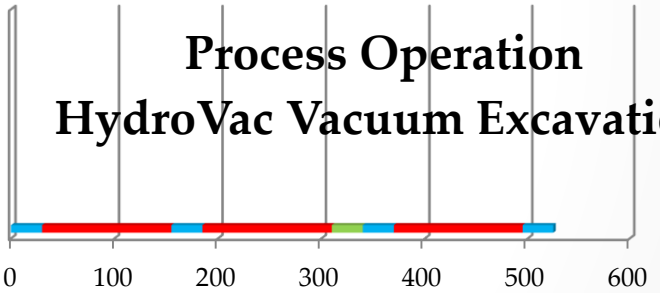
Timeline Charts

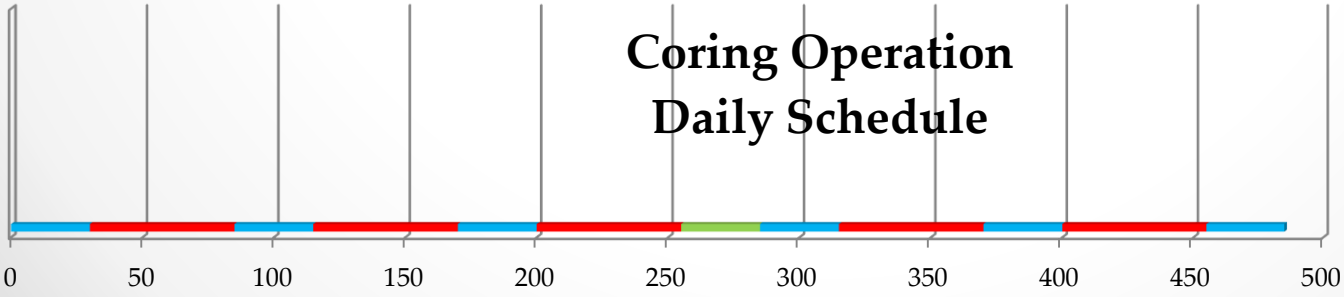
Help to align and match crew capacities

Travel
Process
Lunch break









Be Aware of Implementation Obstacles

1. **Poor Planning and Scheduling of Keyhole Jobs:**

   (One calls, job packages and distance between jobs will have a dramatic effect on the teams job completion rate)

2. **Bad Team Rapport:**

   (The work must take precedence over conflicts or personality clashes)

3. **Weakly Defined Role Clarity for Each Team Member:**

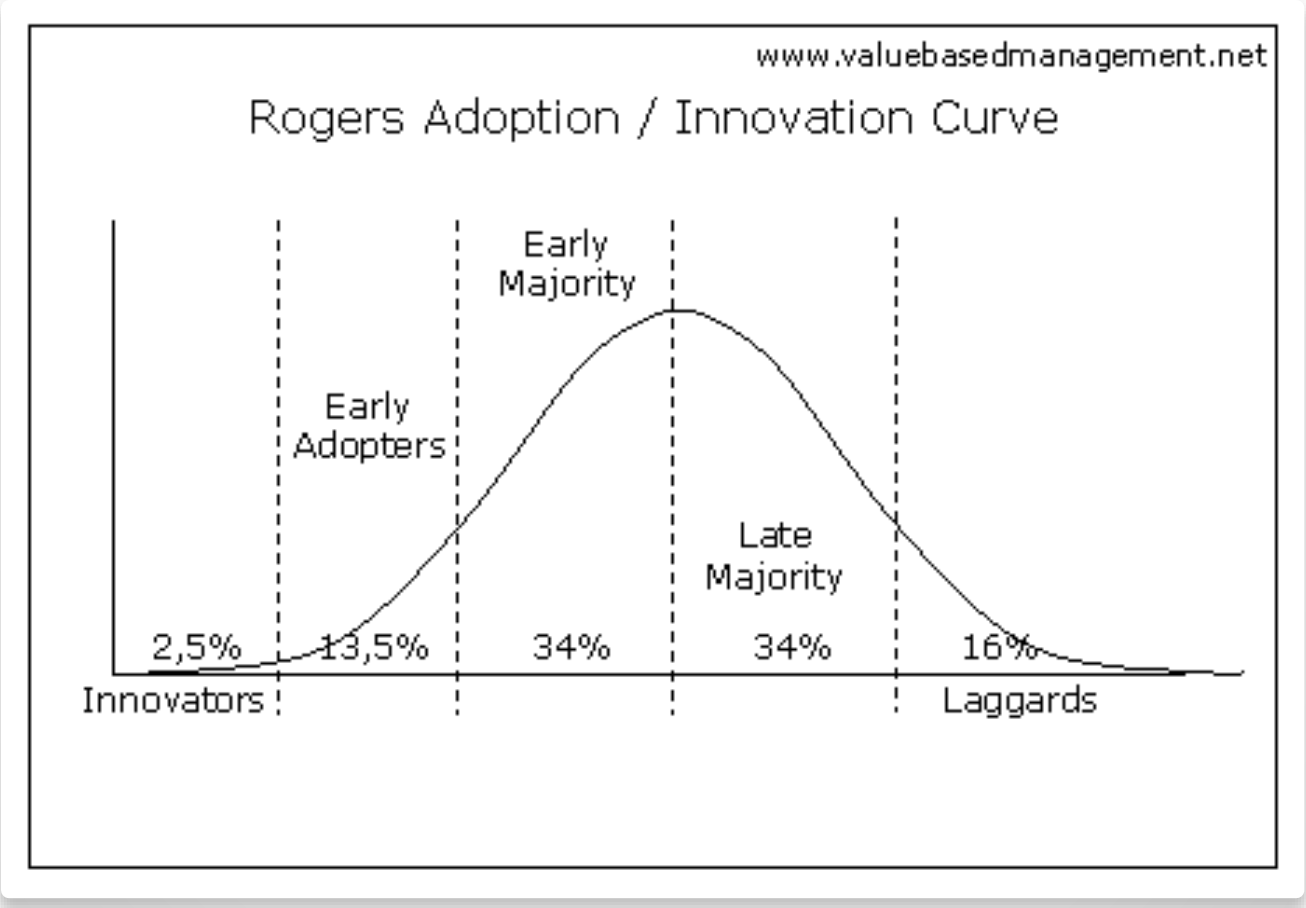
   (Each person must assume a definite task and complete it on schedule to make the team successful)

4. **Inflexible Attitude of Individual Team Members:**

   (Flexibility and adaptability must be intrinsic in implementation teams)

The Move Toward Keyhole Technology

a technology shift



LDC's must demonstrate that they are moving forward by providing value to their customers and shareholders