JOB DEMANDS ANALYSIS

Company: Corporation of Delta **Location:** Works Yard

Job Title: Pipelayer – Sewers - Construction **Classification:** Regular Duty

Purpose of Activities

The Pipelayer is responsible for laying water and sewer pipe for construction jobs within the Corporation of Delta.

Tools and Equipment

The Pipelayer will use the following tools and equipment to perform his duties:

- Shovel (round mouth, cut-off, narrow mouth, etc.)
- Pry bars, hand tamper, sledge hammer(s)
- Stihl saw (14.6-kg, 30 lbs.), power broom (9.1-kg, 20 lbs.), small powered tamper (two-man lift), large powered tamper (lifted by backhoe)
- Blue Brute Plastic pipe – 15 to 122 cm (6 to 48 inch) diameter (20 cm or 8 inch requires a lifting force of 50-kg to lift one end off the ground) the 20 cm (8 inch) pipe is the largest diameter that is maneuvered by hand
- Other PVC pipe, concrete pipe, Asbestos-Clay pipe
- Pipe fittings – elbows, saddles, rubbers, pipe dope, pipe grease
- Tapping machine

Usual Methods

1. If required, traffic control signs and barricades are positioned by the Construction Crew. Flag people are present to control and direct traffic at the construction site.
2. The Excavator Operator and the Padman dig the construction ditch ahead of the Pipelayer. Ditches over one metre deep require by law a protective cage, which protects the Pipelayer from a cave-in.
3. The Pipelayer allows the Excavator to dig approximately three pipe lengths ahead.
4. Backhoe dumps a load of fill material into the ditch.
5. Pipelayer moves this fill material around the bottom of the ditch with a round mouth shovel to make a bed for the pipe. Repeat steps for length of pipe.
6. A Labourer will install saddles and reducing valves at specific locations on the pipe for a mainline to property line connection.
7. With a Labourer, pull the pipe from grade to the ditch, grasp pipe, pull the pipe from grade, lift and lower it into the ditch. Twenty-centimetre pipe is the most commonly used pipe and the heaviest that can be handled by hand. If the ditch is deep the pipe is lowered into the ditch by the Backhoe.
8. Maneuver pipe into position in the bottom of the ditch. Install a rubber gasket into end of pipe and grease the female end of the pipe.

9. Use a pry bar to pull or push the pipe together. Fifty-five kilograms (55-kg, 121lbs.) of force may be required to ensure the pipe has traveled the 20-cm (8 inches) into the bell end of the mainline pipe. To connect larger pipe the backhoe may be used. The Pipelayer will assist with securing chains to the pipe and hand signals from the ditch to the backhoe Operator.
10. Backhoe dumps fill material over pipe. Pipelayer spreads fill material over pipe.
11. Repeat steps 4-9.
12. Push/pull the cage by hand or machine along the ditch to protect the Pipelayer in the ditch.
13. A second Labourer work behind the Pipelayer to tamp the fill material around the pipe and backfill the entire ditch.

The presence of ** indicates non-value added tasks. These tasks do not contribute to the stated purpose of the work.

Administrative Issues

The Pipelayer works from Monday to Friday 0700 to 1530 with a ten-minute rest period in the morning, a 30-minute lunch break and a ten-minute rest period in the afternoon. The Pipelayer is part of the Sewers Construction Crew that includes a Sub-Foreman, Padman, two Labourers, Excavator Operator, Backhoe Operator and contracted truck drivers. The Pipelayer will work overtime and it is common throughout the week. The Sewer Construction Crew will install 50 to 100 metres of pipe per day.

Activity Demand Variables

These variables are tasks that must be carried out by the employee and are implicitly or explicitly required as objectives of the job.

- Shovel or dig around pipe and/or utilities (gas, water, sewer, electric) in the ditch
- Shovel fill material in ditch to create a bed for the pipe, shovel fill material to cover pipe, backhoe dumps fill material in ditch
- Climb up and down a ladder into the ditch that can range from one to seven metres deep, cages are used to protect the Pipelayer and Labourers from a ditch cave-in
- Raise and lower tools and equipment by hand or rope into a ditch that can range form one to seven metres deep
- Lift and carry tools, equipment and pipe from grade to the ditch
- Connect live or dead water and sewer lines, install fittings, etc.
- Kneel, crouch, bend, stoop in a ditch while installing/connecting water or sewer pipe
- Push and/or pull pipe together with a pry bar (55-kg, 121 lbs.) force may be required to connect pipe
- Work in all weather conditions including prolonged periods of rain or heat
- Enter confined spaces that may contain sewer gases
- Work on live sewer and water lines, exposure to raw sewage

Worker Decision Variables

These variables are the sub-routines and cognitive/physical decisions made by the worker in carrying out the objectives of the job.

- Use machine (backhoe, excavator) to lift and place heavy tools, equipment and parts
- Lifting technique in some instances

Accommodative Considerations

1. People with injuries to the spine, in any region, may have difficulty with the static and dynamic movements required to install water and sewer lines.
2. People with shoulder injuries such as rotator cuff tendonitis, bursitis and instability may have difficulty with dynamic and static loading, lifting and reaching activities required install sewers and water lines.
3. People with forearm and elbow injuries such as tennis elbow may have difficulty with the repeated jarring and the static grip forces required to shovel, dig and operate some hand and power tools.
4. People with nerve compression injuries in the upper extremities may have difficulty with the repeated and prolonged use of hand and power tools (compression and vibration).
5. People with a fear of confined spaces will have difficulty working in a ditch that may range from one to seven metres deep.
6. People with injuries to the lower extremities will have difficulty with climbing in and out of the ditch; up and down a ladder; walking on uneven ground and unpacked fill material.

Prepared By: Jeffrey J. McGinn, Kinesiologist May 20, 1999

Summary of Stresses

Metabolic Stresses

The aerobic energy system will supply the major source of energy while performing the duties and responsibilities of the Pipelayer. This energy system will be utilized during the installation of live or dead water or sewer lines. The anaerobic energy system may be required to supply energy for brief intense periods of work, which may include heavy or sustained lifting or carrying; hand digging or towards the end of the day when the aerobic energy system has been depleted. In this last instance, the anaerobic energy system becomes the primary energy source.

Structural Stresses

Spine –Significant loading of the spinal structures are likely in this position. Prolonged loaded and unloaded forward flexion, extension, lateral flexion and rotation of the spine are all movements required by the Pipelayer. Forward flexed postures require no activity from the torso musculature, but increase asymmetrical disc compression and passive stretch on the posterior spinal ligaments and disc fibres. This can contribute to disc integrity problems as well as decondition the torso support musculature. Lateral flexion and/or rotation with or without forward flexion (loaded or unloaded) will significantly increase the shear forces encountered by the discs, fibres and spinal ligaments. The Pipelayer will handle loads from less than one to 55 kilograms.

Neck, Shoulders and Upper Extremity– the Pipelayer will often perform prolonged and repeated static and dynamic movements. These static and dynamic movements through the shoulder and upper extremity require the rotator cuff muscle groups, upper trapezius and scalene muscles of the neck to maintain a significant load. Static loading of the of the forearm flexors, extensors, supinator, pronator teres and the pronator quadratus during tool use (shovel, pry bar, hand and power tools, etc) will increase the risk of injury to these areas. Power tool use, although minimal for the Pipelayer, will also increase the vibration, jarring and compressive forces from the grip to the elbow and shoulder that may lead to over use tendon or nerve injuries.

Hips and Lower Extremities – Standing and walking on dirt, gravel, mud, concrete and asphalt for the entire shift increase the compressive forces through the ankles, knee, hips and spine. The awkward positions required to access pipe and component parts do not allow the Pipelayer to perform the required work from a stable base of support. This in turn will increase the risk of injury for all of the other structures. Climbing in and out of the ditch, up and down a ladder, walking on uneven ground and unpacked fill material will increase the risk of twisting an ankle or knee and slip and fall injuries.

Organic Material Exposure – tapping live sewer lines will expose the Pipelayer to untreated sewage.

Ditch Cave-In – the Pipelayer is exposed to the walls of the ditch caving in. A ditch can range from one to seven metres deep. Aluminum and steel protective cages are lowered into the ditch (deeper than one metre) to protect the Pipelayer and Labourers. The Excavator Operator will also back slope the top portion of the ditch as he digs to decrease

the risk of a cave-in. A cave-in could result in minor to catastrophic injuries to the members of the Sewers Construction Crew.

Electrocution/Natural Gas Explosion – The members of the Sewers Construction Crew are at risk of electrocution from underground or overhead power lines and natural gas explosion as the Excavator exposes or operates around these utilities.

INTERVENTIONS

Recommendations that could be implemented to increase productivity and lessen the risk of injury are listed below:

1. Encourage the Pipelayer to maintain an increased level of fitness away from work that will focus on cardiovascular endurance, muscular strength, muscular endurance and flexibility.
2. Provide regular education in effective use of the body and neutral joint positions for this type of work.
3. Encourage the Pipelayer to ask for assistance (co-worker or backhoe) when handling heavy and/or oversized parts or pieces.
4. Use the backhoe wherever possible to lift and/or maneuver heavy pipe, cages, etc. into the ditch.
5. Purchase a lighter round mouth shovel for use by the Sewers Construction Crew. A heavier shovel will require greater static grip forces and increase the load handled throughout the day by the Pipelayer, Padman, Labourers and Sub-Foreman. The lighter shovel will decrease the load handled throughout the day and will require a decease static grip.
6. Keep all tools and equipment sharp and in good repair.

Referral: Cathy Cook		Organization: Corporation of Delta							Title: Pipelayer Construction
Dept.: Engineering		Division: Sewers							Contact: Steve Spenson
				FREQUENCY*					Date: May 3, 1999
	PHYSICAL DEMANDS	REQD	SIDE	Sel 1	Low 2	Mod 3	High 4	Max. Weight (kg)	Usual Weight (kg)	COMMENTS
STRENGTH	Lifting - Floor to Knuckle	X	B				X	50	<1-50	shovel dirt, lift pipe, tools & equip. in/out of ditch
	Lifting - Knuckle to Waist	X	B				X	50	<1-50	shovel dirt, lift pipe, tools & equip. in/out of ditch
	Lifting - Waist to Shoulder	X	B				X	50	<1-50	shovel dirt, lift pipe, tools & equip. in/out of ditch
	Lifting - Over Head	X	B			X		50	<1-50	lift pipe, tools & equipment in/out of ditch
	Carrying - With Handles	X	B		X			15	15	Stihl saw, power broom
	Carrying - Without Handles	X	D			X		50	<1-50	shovels, bars, pipe, sledge hammer, tamper
	Pushing - Upper Extremity	X	B				X	55	<1-50	shovel in dirt, pipe, pipe fittings, tool use
	Pushing - Hip/Leg Assist	X	B				X	55	<1-50	shovel dirt, connect pipe, push cage, equip.
	Pulling - Upper Extremity	X	D				X	50	<1-50	shovel in dirt, pipe, pipe fittings, tool use
	Pulling - Hip/Leg Assist	X	D				X	50	<1-50	shovel dirt, pipe on grade/in ditch, tool use
	Reach - Shoulder or Above	X	B				X	50	<1-50	shovel dirt, pull/push pipe on grade
	Reach - Sho. or Above extnd	X	B			X		50	<1-50	pull/push pipe from grade to ditch
	Reach - Below Shoulder	X	B				X	50	<1-50	shovel dirt, lift, carry, connect pipe, tool use
	Reach - Bel. Shoulder extnd	X	B				X	50	<1-50	shovel dirt, lift, carry, connect pipe, tool use
	Handling	X	B				X	50	<1-50	shovel, bars, pipe, tapping machine
	Gripping	X	B				X	50	<1-50	shovel, bars, pipe, tapping machine
	Fine Finger Movements	X	D			X		max.	low	tapping machine, install fittings on pipe
ENRG	Aerobic (percent)	X								
	Anaerobic (percent)									
	High Energy Expenditure									
	Low Energy Expenditure	X								
POSTURE+MOBILITY	Neck - Static Flexion	X					X	shovel dirt in ditch, make pipe connection, install fittings		
	Neck - Static Neutral	X				X		stand, walk, sit		
	Neck - Static Extension	X					X	tasks in ditch, from bend/stoop, crouch, look up from ditch		
	Neck - Rotation	X	E				X	shovel dirt in ditch, make pipe connection, install fittings		
	Throwing	X					X	dirt from shovel		
	Sitting	X			X			drive to/from construction site		
	Standing	X					X	at construction site on concrete, asphalt, grass, in ditch, mud		
	Walking	X					X	at construction site, in ditch, to/from construction trailer		
	Running/Jumping	X				X		jump down into ditch from grade (1-1.5 m)		
	Climbing - Arms and Legs	X		X				ladder in/out of ditch to/from grade		
	Climbing - Legs Only	X		X				in/out of shallow ditch		
	Bending/Stooping	X					X	shovel dirt, pipe connections, install fittings in ditch		
	Crouching	X			X			shovel dirt, pipe connections, install fittings in ditch		
	Kneeling	X		X				shovel dirt, pipe connections, install fittings in ditch		
	Crawling									
	Twisting	X	E				X	shovel dirt, pipe connections, install fittings		
	Balancing	X			X			in ditch, on pipe, on ladders, edge of ditch		
GEN	Traveling	X			X			to/from construction site		
	Work Alone							in construction crew with others all the time		
	Interact with Public	X		X				possibly in residential work site		
	Operate Equip/Machinery	X		X				tapping machine, Stihl saw, power broom		
	Irregular/Extended Hours							0700-1530, Monday to Friday		

* Frequency Legend 1 = Seldom; Not Daily 2 = Low Daily Activity; < 1hr
3 = Moderate Demand; Repetition 1 - 3 hrs daily 4 = High Frequency Demand; Repetition > 3 hrs daily

The following shading denotes a HIGH RISK TASK: Modifications should be considered

REQD is marked with an X if the particular demand or category is relevant to the purpose of the job.

SIDE refers to the side or limb required to execute a task. If it is marked **E**, it indicates either side, the most common choice is listed first. **D** refers to dominant and **B** to both sides.

Referral:		Organization:						Title: see 1st page header
Dept.:		Division:						Contact:
				FREQUENCY*				Date:
	PHYSICAL DEMANDS	REQD	SIDE	Sel. 1	Low 2	Mod. 3	High 4	COMMENTS
PERCEPTION	Hearing - Conversations	X					X	Padman, Labourers, Foreman, Backhoe & Excavator Operator
	Hearing - Other Sounds	X					X	trucks, backhoe, excavator, power tools
	Vision - Far	X					X	lay pipe, make connections and install fittings, tap pipe
	Vision - Near							
	Vision - Colour							
	Vision - Depth	X					X	lay pipe, move around construction site, install fittings
	Perception - Spatial	X					X	lay pipe, move around construction site, install fittings
	Perception - Form	X					X	pipe, fittings, utilities in ditch
	Feeling (Tactile)	X					X	shovel dirt away from utilities, push pipe together, tool use
	Reading	X			X			blueprints, drawings
	Writing							
	Speech	X					X	Padman, Labourers, foreman, Backhoe & Excavator Operator
WORK ENVIRONMENT	Inside Work	X		X				possibly in a chamber
	Outside Work	X					X	at construction site above and below grade
	Hot Conditions >25 deg. C	X		X				spring, summer, fall
	Cold Conditions <10 deg.C	X		X				fall, winter, spring
	Humid	X		X				wet weather conditions, in chamber, water in ditch
	Dust	X					X	digging ditch, shovel dirt
	Vapor Fumes	X					X	diesel, oil/gas mix, pipe dope, poisonous gases in chambers
	Hazardous Machines	X		X				Stihl saw, power broom, tamper
	Proximity to Moving Object	X					X	near trucks, excavator, backhoe, ditch cave-in
	Noise	X					X	trucks, excavator, backhoe, traffic noise
	Electrical Hazard	X		X				overhead wires and underground utilities
	Sharp Tools	X					X	shovel, broken pipe, utility knife
	Radiant/Thermal Energy	X		X				sun burn
	Slippery Conditions	X		X				in wet ditch, chamber, wet weather
	Vibration and Related	X					X	jarring from shovel use, vibration from tamper
	Chemical Irritants	X				X		pipe dope, natural gas
	Organic Substances	X		X				live sewer construction
	Medical Waste							
	Blood Products							
	Congested Worksite	X					X	in ditch connecting pipe, installing fittings in ditch
	Lighting - Direct	X					X	day light, sun light
	Lighting - Indirect	X					X	day light
	Lighting - Adjustable							
	Lighting - Fluorescent							
	Lighting - Incandescent							
	Lighting - Shadows etc.	X			X			depends on time of day, location in ditch

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For detailed descriptions of each of the different categories, please refer to the reference guide or inquire with Human Effort at 1-888-4EFFORT