Dulles Rt. 28, Pacific & Commercial crossing 2
4-180’ x 60” RCP

Introduction

At the request of Thomas Brault of Woodside Ventures & Realty Services, acting as the agent for Lerner Enterprises, four(4)- 60” storm water culverts 180 feet long were inspected for their condition and structural integrity. The files on the project held at Christopher Consultants were reviewed to gather any pertinent information on the project. Several plan sheets were obtained which show the plan, profile, grading and specifications for the culvert pipes. The appropriate FHWA guidelines were reviewed and copies of pictures taken by Ian Fraser of VDOT were reviewed.

An initial preview inspection meeting was held on the site on July 27, 2005 with Richard Thomasson(PB), John Michels(PB), Thomas Brault(Woodside Ventures), James Bishoff(Urban Engineering & Associates) and Ian Fraser(VDOT). A thorough inspection of the 4 culvert pipes was conducted on August 4, 2005.

Inspection

There were four basic conditions which were detected in the inspection which require corrective action. Two areas of overstressing of the pipe have resulted in crown cracks. These areas will require structural repair. Five (5) joints are open more than their tolerance level. These joints need to be grouted to prevent water and soil entry into the pipe. Two joints are broken exposing rebar which can deteriorate over time. These joints need to be properly finished to prevent deterioration in the future. There are three (3) side connections which were not properly finished when connected to the main culvert pipe.

These connections require proper finishing to provide smooth flow and to protect exposed rebar.

Existing Conditions

The following listing shows the number and type of problem identified in the inspection. A drawing showing the location of all significant problem areas is attached.

Pipe Line 1
1st joint, 1-3/4" open at bottom- at threshold of allowable tolerance
2nd joint, 1-3/4" open top- at threshold of allowable tolerance
5th pipe, 12" diameter side connection@ 3 o'clock position- spalled with rebar exposed
6th pipe, patches @ 3 o'clock position-finished properly
8th joint, 2 "open @ 3 o'clock position- open more than allowable tolerance
15th joint, broken area 1 foot long 3 o'clock position-spalled with rebar exposed
21st pipe 27" diameter side connection@ 3 o'clock position- spalled with rebar exposed

Pipe Line 2
1st joint, 2-1/4" open full circumference-open more than allowable tolerance
23rd pipe, crown crack entire length- approximately 1/32" overloading of pipe
24th pipe, crown crack entire length- approximately 1/32" overloading of pipe

Pipe Line 3
2nd pipe, crown crack entire length- approximately 1/32" overloading of pipe
3rd pipe, crown crack entire length- approximately 1/32" overloading of pipe

Pipe Line 4
10th joint, 1-3/4" open 7 o'clock to 12 o'clock- at threshold of allowable tolerance
18th joint, broken joint 2 sf. area 12 o'clock- spalled and exposed rebar
21st pipe, 15" side connection 9 o'clock- spalled with exposed rebar

Four specific types of problems were identified in the inspection, as shown below.

1-crown cracks indicating over loading of the pipe

2-joints which are open more than tolerance allowance

3-broken joint areas

4-connections to the main culvert pipes are not finished properly

The crown cracks are of concern for possible future structural degradation. Imminent structural failure is not a concern. The crown cracking occurred in two locations in adjacent sections of pipe at each location. Each pipe section is 7 feet 6 inches in length, making the area of concern 15 feet long. The first location is pipe sections 23 and 24 in pipe line 2. These are the first 2 pipe on the west end of the pipe line 2. The second location is pipe sections 2 and 3 in pipe line 3.These are 1 pipe from the east end of pipe line 3. This will allow easy access for a structural repair of these sections.

The joint openings are of concern because of the potential for water to enter the pipe and cause a loss of soil on the outside of the pipes. Over time this could result in subsidence of the area above the pipes.

The broken joint areas need to be repaired to protect the integrity of the pipe, reinforcement and joint. This will result in the joints and pipe meeting their intended service life.

The unfinished area around the connections and the protruding connections can affect the flow characteristics designed for the pipes. There was exposed rebar in the area of each of the connection areas which can deteriorate from improper protection. The protruding connections can catch debris in large flow situations and result in restricted flow or possible blockage of flow.

The Culvert Inspection Manual FHWA-IP-86-2 was reviewed and rating guidelines were referenced in the inspection process. Although the conditions outlined in the manual are not completely applicable, the rating table on page 148 will result in a rating of 7 for the four culverts inspected. The descriptions are more severe than the observed conditions because of the minimal number of problem areas found in the inspection. The instructions for use of the rating system direct the user to move to the lower rating which covers the different conditions listed. The table is attached for reference as Appendix A.

Recommendations

The pipe sections with crown cracking can be repaired by use of structural lining.

Pipeline 2	Section 23,24	length 15’
Pipeline 3	Section 1,2,3	length 22.5’

The repair in Pipeline 2 would be 15 feet long and would be transitioned on the upstream flow end to provide a smooth flow. The repair in Pipeline 3 should be 22.5 feet long extending from the East opening to the 3rd joint. No transition is required since it is the beginning end of the culvert pipe. A Cured- In- Place Pipe (CIPP) liner would be easily installed and has been used in other locations of VDOT jurisdiction. It is one of the approved methods on list 38 –“Pipe Rehabilitation Methods”. The list is attached for your reference as Appendix B.

Flow analysis can be provided to substantiate the pipes will still meet the designed flow approved in the original project submittals. This repair technique for structural problem areas has been used extensively throughout the country for sanitary sewers and storm sewers. There have been many spot repairs of this nature completed, which resulted in a new useful life being given to the repaired pipes. Although this is described as a repair, it is a fully structural pipe within the older pipe. The service life of this lined area would be rated as a newly installed culvert pipe. Insituform Technologies indicates that this liner will be approximately 1 inch thick for this size pipe. An exact thickness will be determined when authorized to proceed with the work.

The joint areas that are open to a position of questionable tolerance can be corrected by grouting through the joint into the area outside of each joint. A grout which mixes with the soil to form a barrier which does not allow water to flow into the joint will be used. This will preclude any flow through the joint and not allow any loss of soil from outside the pipe. There will be no risk of subsidence above the joint areas from loss of soil around the joint. The installation will take place from inside the pipe and no disturbance will be required on the surface. This repair will result in the service life of the joints being restored to original new installation levels. Contact with VDOT has been made and the list of approved non-shrink grouts is to be provided.

The areas of broken joints can be repaired using VDOT approved hydraulic cement patching material to provide a smooth wall surface and to protect the reinforcing in the pipe. These compounds adhere to the cleaned area and will meet the useful life assigned to a new pipe surface. The VDOT list number 31 gives the approved patching materials for use on VDOT projects and is attached as Appendix C.

The connection area problems can be corrected by cutting off protruding pipes and finishing the wall area as a new installation would be installed. Approved compounds found on list 31 will be used to fill and finish the area of the connections. This will give the service life of a newly installed connection area. No flow problems or debris collection will occur after these connections are finished off properly.

Contact with VDOT has not identified any policy on life expectancy of the culvert pipes. Ian Fraser of VDOT has located a reference from the Transportation Research Board (TRB) 2004 Annual Meeting entitled, “Economic Costs of Culvert Failures” by Joseph Perrin Jr., which gives a average life of Reinforced Concrete Pipe (RCP) of around 75 years. There is no other value for useful life referred to by VDOT. The existing pipe and the newly repaired areas should meet this time frame.

Planning Costs

Contact was made with Insituform Technologies in Odenton, Maryland to gather planning costs for the lining of the two areas of crown cracked pipe which indicate overstressing of the pipe and require structural lining. Each area can be lined with CIPP lining for $35,000 each. The total would be $70,000 for the structural lining repairs. This covers material, labor and mobilization costs. If the project moves ahead, they will

review everything in detail and the costs may come down slightly. The repairs will provide the structural ability of new pipe and will meet the flow requirements for the culvert. Insituform Technologies is presently doing work for VDOT, providing structural lining for culvert pipes.

Contact was made with National Gunite who is presently doing work for VDOT and they gave a planning cost of $2500 a joint to use non-shrink grout to provide soil stabilization around the joints to preclude any water flow or soil loss into the pipe. There are 5 joints for a total of $12,500 for the joint grout work. The contractor will review in more detail when authorized and the cost may come down slightly.

Any labor force can be supervised to provide the connection repairs and concrete repair of the two broken joint areas. A planning level estimate would be $2000 for this work.

The total for the repair work outlined is $84,500.