MWH

BUILDING A BETTER WORLD

MEMORANDUM

TO: **Jason Canady** **DATE: 7/15/2011**

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SUBJECT: **Grants Pass WTP – Inspection of the Clearwell (Inspection Date 5/24/2011)**

Background

On May 24, 2011, MWH conducted a follow-up inspection of the clearwell concrete roof and beams in the original 1930's constructed part of the building. A photo log of this visit is attached as Appendix A. The follow-up was conducted to determine a more-defined extent of the concrete deterioration that was first discovered during the March 2, 2011 inspection. As a reference, the March 2, 2011 report and photo log are attached as Appendix B. It should be noted that the March 2, 2011 inspection was focused on the area of the clearwell that was leaking in groundwater, but some other areas of concern were observed then as well. The leak area and general recommendations from the March 2, 2011 inspection are summarized below:

Clearwell Water Intrusion Repair Recommendations

- MWH recommends that the backfill on the exterior of the wall adjacent to the joint between the 1930 and 1950 construction be removed for further inspection of this joint from outside the building.
- Once the cause of the water intrusion is known for sure, then repairs to the leak should proceed as quickly as possible.
- There is more than one way to repair this leak. These are, but are not limited to:
  - An exterior rubber strip sealed on both sides of the crack and covering over the crack to prevent the migration of the groundwater into the building.
  - Injection grouting into the crack
- One thing that should be considered by the City is to chip away the exterior wall concrete down to the 10 ga galv. iron waterstop and remove it altogether. This will help to eliminate any future rusting of this waterstop and help to prevent the rusting of the waterstop and spalling of concrete.

Clearwell General Inspection Repair Recommendations

<u>Ladder Rungs in Each of the Three Clearwell Manhole Access</u>

- None of the ladder rungs are in a state of immediate collapse. Yet, they should be replaced in the near future. It is important to mitigate any further rusting of the ladder rungs back into the concrete wall. New rungs should be installed with a "drill and epoxy" system. The rungs should be either stainless steel or FRP.

Various Concrete Beams in the Roof of the Octagon Clearwell

- None of the beams have deteriorated to a point where the beams are failing. Yet, they should be repaired in the near future. It is important to mitigate any further rusting of the reinforcement. Once the rusting starts, it will travel over time down the length of the entire bar. They are many different options for the repair of these types of deterioration in concrete. These options will be discussed at length with the City Staff at a time closer to put together a repair plan.

The most recent inspection was completed on Tuesday, May 24, 2011 by Todd Petrik and accompanied by the Treatment Plant Superintendent, Jason Canady. A summary of this visit and recommendations that resulted from it are listed below.

Clearwell - General Structural Inspection

Note: All of the photos referenced in the following text below are included in the attached annotated site photo log, attached as Appendix A.

Generally, the concrete floors, walls, columns, beams, and undersides of the top decks are in good condition. However, a more aggressive approach was taken during the most recent inspection to determine how far-reaching the spalling concrete and corroding reinforcement is that was first encountered during the March 3 inspection. For those areas that do have issues, the extent of the deterioration is worse than originally determined. If certain areas are not repaired, damage could continue to spread and threaten the structural stability and integrity of the clearwell. In turn, this could potentially threaten the ability of the Water Treatment Facility to effectively disinfect water and deliver safe drinking water to the citizens of Grants Pass.

Identification of Various Concrete Beams in the Roof of the Octagon Clearwell

There are four interior concrete columns in the clearwell that divide the roof/beams into nine different panels. Running in the North/South direction, there are north, middle and south beams. Running in the East/West direction, there are east, middle and west beams. These beams and the exterior walls of the clearwell define the 9 different panels. Reference the attached sketch presented as **Figure 1**. The summary below makes use of the labeling defined above and shown in **Figure 1**.

Common/Typical General Concrete Repair Methods

One common, and often-used, method for the repair of concrete structural elements is to use a bonded fiberglass reinforced plastic (FRP) system. This practice is governed by ACI 440.2R and is widely used throughout the engineering community. For this report, this process will be referred to as FRP Repair.

Repair Priority

MWH has determined that the repairs presented below fall into two different Priority categories.

Priority 1: Denoted by “P1”, this is the higher of the two levels. These repairs should be made in the next Low-Water demand period. These repairs should be given a higher priority to prevent the conditions from growing worse which could lead to a failure of the structural systems in the clearwell ceiling.

Priority 2: Denoted by “P2”, this is the lower of the two levels. These issues have much less of an impact on the structural system in the clearwell ceiling. Not completing these repairs will result in worsening of the condition, yet it is not urgent that these repairs take place in the next Low-water demand period,

1. West-South Beam (Photos 0070 to 0074)

The bottom-west corner of this beam has rock pockets that extend south about 30-inches in length from the interior column. There is no visible reinforcement. It appears that the concrete was never consolidated in this corner during the initial construction.

P2-Repair: Sand blast clean and fill the pockets with a non-shrink epoxy grout.

2. South-West Beam (Photos 0075 to 0080)

The bottom-south corner of this beam has rock pockets that extend from the west wall for about half the length of the beam to the east. There is no visible reinforcement. It appears that the concrete was never consolidated in this corner during the initial construction. On the south side of this beam, there is an abandoned steel floor drain. It is rusting and starting to spall the concrete around it.

P2-Rock Pocket Repair: Sand blast clean and fill the pockets with a non-shrink epoxy grout.

P2-Pipe Repair: Cut off the drain pipe and burn it back up into the concrete a minimum of 1-1/2 inches. Grout over the hole with a non-shrink epoxy grout.

3. West-Middle Beam (Photos 0082 to 0085)

The bottom-west corner of this beam from the north column to 48-inches south has significant concrete spalling and deteriorated reinforcing bars. The east side of the beam has a short, 12 to 16-inch section of rock pockets in the mid-span of the lower corner. On the east side of this beam, there is an abandoned steel floor drain. It is rusting and starting to spall the concrete around it.

P1-Reinforcement Repair: Chip back the concrete until clean, bright reinforcement is encountered. Remove the rusted reinforcement. Build back up the deteriorated concrete beam with a non-shrink grout and the use of the FRP repair method to bring back the integrity of this beam.

P2-Rock Pocket Repair: Sand blast clean and fill the pockets with a non-shrink epoxy grout.

P2-Pipe Repair: Cut off the drain pipe and burn it back up into the concrete a minimum of 1-1/2 inches. Grout over the hole with a non-shrink epoxy grout.

4. South-Middle Beam (Photos 0089 to 0096)

At the west end of this beam and in the center of the beam, there is a hole from unconsolidated concrete that has resulted in exposed reinforcing bars. The two exposed bars are rusting. The rusting of these bars is causing further spalling of the concrete. Along the north side of the beam, there is a rock pocket that extends for about a 5 foot length.

P1-Reinforcement Repair: Chip back the concrete until clean, bright reinforcement is encountered. Remove the rusted reinforcement. Build back up the deteriorated concrete beam with a non-shrink grout and the use of the repair method to bring back the integrity of this beam.

P2-Rock Pocket Repair: Sand blast clean and fill the pockets with a non-shrink epoxy grout.

5. East-Middle Beam (Photos 0097 to 0103)

At the bottom west corner of the beam and for the entire length of the beam, the concrete has spalled off and exposed the reinforcing bar(s). Also, along the east side of the beam, there is a short 6 to 8-inch long section of spalled concrete and exposed reinforcement.

P1-Reinforcement Repair: For the entire length of this beam, chip back the concrete until clean, bright reinforcement is encountered. Remove the rusted reinforcement. Build back up the deteriorated concrete beam with a non-shrink grout and the use of the FRP repair method to bring back the integrity of this beam.

6. Middle-East Ceiling Panel (Photos 0104 to 0110)

There is a 54-foot long section of reinforcement that has rusted and spalled the concrete around it. There is a 2-inch deep hole in the bottom of the floor from a deteriorated wood block. Also, there is an abandoned steel floor drain pipe that is rusting and starting to spall the concrete around it.

P1-Reinforcement Repair: Chip back the concrete until clean, bright reinforcement is encountered. Remove the rusted reinforcement. Build back up the deteriorated concrete floor with a non-shrink grout and the use of the FRP repair method to bring back the integrity of this floor.

P1-Hole Repair: Chip back the concrete until clean, bright reinforcement is encountered. Remove the rusted reinforcement. Build back up the deteriorated concrete floor with a non-shrink grout and the use of the RFP repair method to bring back the integrity of this floor.

P2-Pipe Repair: Cut off the drain pipe and burn it back up into the concrete a minimum of 1-1/2 inches. Grout over the hole with a non-shrink epoxy grout.

7. East-South Beam (Photos 0111 to 0116)

Along the west and east sides of the beam, there are various rock pockets. There is no visible rusted reinforcement showing. Near the center column. there is an abandoned pipe stuffed with some type of insulation. The pipe is rusting and spalling the concrete around it.

P2-Rock Pocket Repair: Sand blast clean and fill the pockets with a non-shrink epoxy grout.

P2-Pipe Repair: Cut off the drain pipe and burn it back up into the concrete a minimum of 1-1/2 inches. Grout over the hole with a non-shrink epoxy grout.

8. South-East Beam (Photos 0117 to 0120)

There is no spalling of the concrete or any visible rusting reinforcement on either side or bottom of the beam.

Repair: None required

9. South-East Ceiling Panel (Photos 0121 to 0124)

In the underside of the floor, there is a large circular patch that appears to have the hole filled at two different times. The outer patch is starting to deteriorate and the older concrete is spalling off. There is no visible rusting reinforcement.

P2-Patch Repair: Chip out the old concrete to sound, solid concrete. Sandblast the hole clean. Place new non-shrink grout into the hole. If the hole becomes over 12-inches in diameter, there may be a need to drill and epoxy in small reinforcing bars to hold the new grout into place.

10. Clearwell Access hole in East wall (Photos 125 to 131)

In order to expand the clearwell to the East, a hole was cut in the wall. When the hole was cut, it appears that reinforcing bars were left exposed. These reinforcing bars are now rusting and spalling the concrete around them. While there is no real structural significance to this, it is worth cleaning out the old bars and patching up the edges of the hole.

P1-Repair: Chip the concrete back to expose clean bright reinforcement. Cut off all rusted reinforcement and burn the bars back into the solid concrete a minimum of 1-1/2 inches. Drill in new, short #4 dowels around the edge of the opening. Form a new opening and cast in new non-shrink grout.

11. North-West Beam (Photos 0132 to 0136)

On the north side of the beam and on the west end, the bottom corner has spalled off and rusted reinforcement is visible.

P1-Reinforcement Repair: For the entire length of this beam, chip back the concrete until clean, bright reinforcement is encountered. Remove the rusted reinforcement. Build back up the deteriorated concrete beam with a non-shrink grout and the use of the FRP repair method to bring back the integrity of this beam.

12. North-West Ceiling Panel (Photo 138)

There is a small hole that has spalling concrete around it. There is no visible rusting of reinforcement.

P2-Hole Repair: Chip back the concrete until clean, bright reinforcement is encountered. Remove the rusted reinforcement. Build back up the deteriorated concrete floor with a non-shrink grout and the use of the RFP repair method to bring back the integrity of this floor.

13. West-North Beam (Photos 139 to 141)

There is no spalling of the concrete or any visible rusting reinforcement on either side or bottom of the beam. There are a few small rock pockets along the length of the beam.

P2-Rock Pocket Repair: Sand blast clean and fill the pockets with a non-shrink epoxy grout.

14. North-Middle Beam (Photos 142 to 148)

There is no spalling of the concrete or any visible rusting reinforcement on either side or bottom of the beam. There are a few small rock pockets along the length of the beam. At the west end of the beam, adjacent to the large patch in the ceiling, there is a small hole in the corner where the beam meets the ceiling. There is a 2 to 3-inch long piece of reinforcement that is visible. This reinforcement is not rusting and the concrete is not spalling.

P2-Rock Pocket Repair: Sand blast clean and fill the pockets with a non-shrink epoxy grout.

P2-Small Hole Repair: Sand blast clean and fill the hole with a non-shrink epoxy grout.

15. North-Middle Ceiling Panel (Photos 149 to 153)

Up tight against the north wall of the clearwell, there are two exposed bars that are rusting and starting to spall the concrete. The west bar is exposed for about 6 to 8-inches. The East bar is exposed for

about 14 to 16-inches. And there is an abandoned steel floor drain pipe that is rusting and starting to spall the concrete around it.

P1-Reinforcement Repair: Chip back the concrete until clean, bright reinforcement is encountered. Remove the rusted reinforcement. Build back up the deteriorated concrete floor with a non-shrink grout and the use of the FRP repair method to bring back the integrity of this floor.

P2-Pipe Repair: Cut off the drain pipe and burn it back up into the concrete a minimum of 1-1/2 inches. Grout over the hole with a non-shrink epoxy grout.

16. North-East Beam (Photos 154 to 159)

There is one hole in the middle of the underside of the beam. It is about 2-inches in diameter and about 2-inches deep. There is rusting reinforcement visible in the hole. The rest of the beam is in good conditions.

P2-Hole Repair: Chip back the concrete until clean, bright reinforcement is encountered. Remove the rusted reinforcement. Build back up the deteriorated concrete floor with a non-shrink grout and the use of the FRP repair method to bring back the integrity of this floor.

17. North-East Beam (Photos 0160 to 0165)

On the east end of the beam, along the bottom south corner for 3 feet, the concrete is spalling off and rusted reinforcement is visible. Also, there is a 12- to 14-inch long section of spalling concrete and rusting reinforcement in the center of the beam.

P1-Reinforcement Repair: For the entire length of this beam, chip back the concrete until clean, bright reinforcement is encountered. Remove the rusted reinforcement. Build back up the deteriorated concrete beam with a non-shrink grout and the use of the FRP repair method to bring back the integrity of this beam.

18. North-East Ceiling Panel (Photos 0166 to 0169)

There are three smaller holes in the ceiling, each having a small section of rusting reinforcement visible in the hole. There are also several small rock pockets with no visible reinforcement.

P1-Reinforcement Repair: Chip back the concrete until clean, bright reinforcement is encountered. Remove the rusted reinforcement. Build back up the deteriorated concrete floor with a non-shrink grout and the use of the FRP repair method to bring back the integrity of this floor.

P2-Rock Pocket Repair: Sand blast clean and fill the pockets with a non-shrink epoxy grout.

19. Clearwell East of the 1930 octagon (Photos 0170 to 0194)

There did not appear to be any visible spalling of concrete or exposed and rusting reinforcement.

Repairs: None required.

20. Clearwell west opf the 1930 Octagon (Photos 195 to 198)

There did not appear to be any visible spalling of concrete or exposed and rusting reinforcement.

Repairs: None required.

Summary

MWH strongly recommends that the P1 level repairs presented in this memo occur during the next low demand period of operation as the repairs will most likely require the clearwell to be taken out of service and dewatered for a period of time. Should the City choose to move forward with repairs, a detailed set of repair plans and specification that can be used for construction should be prepared. In addition, during the next low demand period, the clearwell is slated to be dewatered for construction related to the installation of a new redundant filter backwash pump. Combining these projects may provide significant savings to the City in mobilization costs of similar contractor types, and common construction periods for both categories of work while the clearwell is dewatered.

During any of the repairs stated above, the floor deck and possibly the adjacent beams are to be shored to limit the possibility of the floor deflecting.

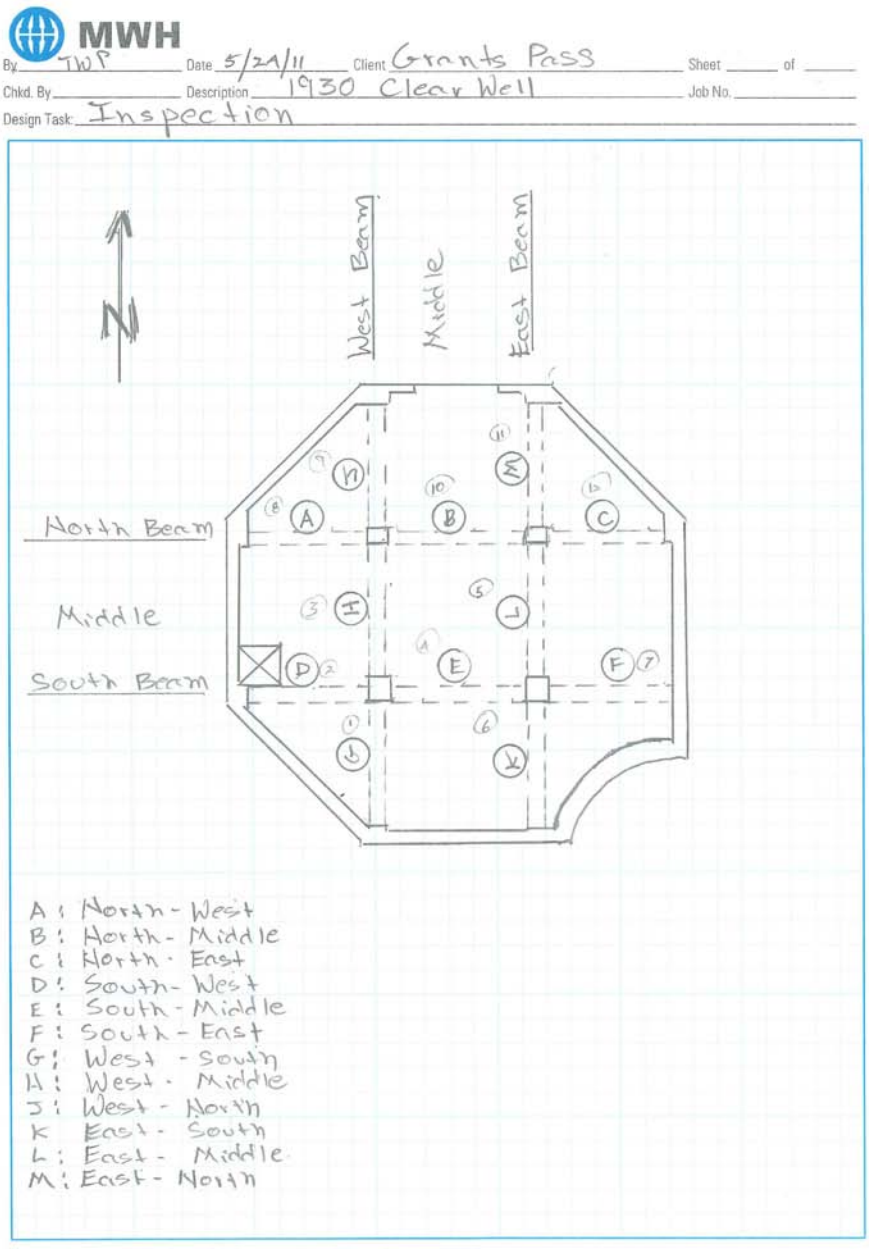
MWH
By TWP Date 5/24/11 Client Grants Pass Sheet of
Chkd. By Description 1930 Clear Well Job No.
Design Task: Inspection
West Beam
Middle
East Beam
North Beam
Middle
South Beam
A : North - West
B : North - Middle
C : North - East
D : South - West
E : South - Middle
F : South - East
G : West - South
H : West - Middle
J : West - North
K East - South
L : East - Middle
M : East - North

Figure 1