Technical Memorandum No. 2 – Bench Section Inspection Report

Prepared for
Vista Irrigation District
Vista, California
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List of Abbreviations

AGL	above ground level
BC	Brown and Caldwell
COA	Certificate of Authentication
FAA	Federal Aviation Administration
lf	linear feet
NASSCO	National Association of Sewer Service Companies
PACP	Pipeline Assessment and Certification Program
UAS	Unmanned Aircraft Systems
VID	Vista Irrigation District

Executive Summary

The preliminary planning and alignment phase of the Flume Replacement Alignment Study (Study) includes condition assessment of the Vista Flume's bench sections, and if needed the siphon sections, to help evaluate the alignment alternatives regarding the necessary timing requirements for replacement and the ability to phase each reach of the final Flume Replacement Project. This report describes the inspection performed and the resulting condition assessment and recommended repairs for each bench section. See Section 1 for additional details on the Introduction and Background for this report.

The work was performed by using an Unmanned Aerial System (UAS), or drone, to identify "red flag" areas of concern and to provide valuable data in establishing a baseline condition of the bench sections. During the UAS Drone Survey the Brown and Caldwell field team visually inspected the exposed exterior surfaces of each flume bench section. The field team attempted to capture imagery of all exposed flume bench section surfaces but focused inspection and documentation efforts on locating and documenting defects and areas of concern. See Section 2 for additional details on the UAS Drone Inspection Approach.

Each flume bench section was reviewed for significant defects. Due to the sizeable number of observations noted during review of the drone footage, less significant defects were not individually defect coded. Significant defects observed during review were documented in a defect log, included as Appendix A. Structural defects identified during this inspection included cracks, fractures, holes, and reinforcement visible/projecting/corroded. There were a significant number of patched cracks and fractures indicating historic structural issues. Other defects included staining and exfiltration, typically caused by a structural issue, and vegetation overgrowth. See Section 3 for additional details on the Data Analysis Approach.

Repair recommendations were developed based on the type, severity, and quantity of defects observed for each bench section. These recommendations were based solely on the defects visually observed from the drone footage since visual inspection of the interior of the flume was not performed as part of this inspection. A summary of the repair recommendation is included in Table ES-1 below. See Section 4 for additional details on the Condition Assessment and Repair Recommendations for each bench section.

Table ES-1 Repair Recommendations Summary

Flume Bench Section	Approximate Length (LF)	Inspection Date	Video Files	Repair Timeframe* (yrs)	Repair Recommendations
Jack Creek Bench	394	4/23/21	DJI_0507.MP4 – DJI_0514.MP4	1	The failed patch at ~Station 128+88 (DJI_0509.MP4, 0:29) should be repaired within one (1) year by removing any detached patch material and applying new patch material. The reinforcement, if visible, should be assessed for corrosion and renewed if required. In addition, overgrown or fallen vegetation should be removed seasonally. Cracks and fractures throughout this bench should be monitored and patched as necessary on an annual basis until this bench section has been replaced.

Table ES-1 Repair Recommendations Summary

Flume Bench Section	Approximate Length (LF)	Inspection Date	Video Files	Repair Timeframe* (yrs)	Repair Recommendations
Tunnel Bench	3,750	4/23/21	DJI_0515.MP4 – DJI_0547.MP4	1	The hole at ~Station 177+55 (DJI_0517.MP4, 1:19) should be repaired within one (1) year by dowling in new reinforcement and applying patch material. Existing reinforcement should be assessed for corrosion and renewed if required. In addition, overgrown or fallen vegetation should be removed seasonally. Cracks and fractures throughout this bench should be monitored and patched as necessary on an annual basis until this bench section has been replaced.
Daley Bench	3,241	4/23/21	DJI_0476.MP4 – DJI_0506.MP4	1	The missing gunite and projecting/corroded reinforcement at ~Station 234+68 (DJI_0486.MP4 , 0:32) should be repaired within one (1) year by applying patch material. Existing reinforcement should be assessed and renewed if required. Fractures and suspected exfiltration at ~Station 214+90 (DJI_0492.MP4, 4:56) should be further investigated and repaired within one (1) year. In addition, overgrown or fallen vegetation should be removed seasonally. Cracks and fractures throughout this bench should be monitored and patched as necessary on an annual basis until this bench section has been replaced.
Kornhauser Bench	1,321	4/22/21	DJI_0426.MP4 – DJI_0440.MP4	1	The missing gunite, staining, and suspected hole at ~Station 286+80 (DJI_0430.MP4, 1:12) should be repaired within one (1) year by applying patch material. Existing reinforcement should be assessed and renewed if required. In addition, overgrown or fallen vegetation should be removed seasonally. Cracks and fractures throughout this bench should be monitored and patched as necessary on an annual basis until this bench section has been replaced.
Finkbinder Bench	3,888	4/22/21	DJI_0441.MP4 – DJI_0475.MP4	1	The fracture with suspected exfiltration at ~Station 401+20 (DJI_0447.MP4, 1:36) should be repaired within one (1) year by stopping the exfiltration and applying patch material. Hole in soil next to flume at ~Station 428+80 (DJI_0454.MP4, 4:35) should be investigated. In addition, overgrown or fallen vegetation should be removed seasonally. Cracks and fractures throughout this bench should be monitored and patched as necessary on an annual basis until this bench section has been replaced.
MD Bench	3,290	4/21/21	DJI_0401.MP4 – DJI_0425.MP4	Annually	Remove overgrown or fallen vegetation seasonally. Cracks and fractures throughout this bench should be monitored and patched as necessary on an annual basis until this bench section has been replaced.
Pearson Bench	371	4/20/21	DJI_0344.MP4 – DJI_0351.MP4	Annually	Remove overgrown or fallen vegetation seasonally. Cracks and fractures throughout this bench should be monitored and patched as necessary on an annual basis until this bench section has been replaced.

Table ES-1 Repair Recommendations Summary

Flume Bench Section	Approximate Length (LF)	Inspection Date	Video Files	Repair Timeframe* (yrs)	Repair Recommendations
Beehive Bench	477	4/20/21	DJI_0338.MP4 – DJI_0343.MP4	1	The missing gunite with reinforcement projecting/corroded and suspected hole at ~Station 520+95 (DJI_0338.MP4, 2:57) should be repaired within one (1) year by applying patch material. Existing reinforcement should be assessed and renewed if required. In addition, overgrown or fallen vegetation should be removed seasonally. Cracks and fractures throughout this bench should be monitored and patched as necessary on an annual basis until this bench section has been replaced.
Borden Bench	6,265	4/21/21	DJI_0352.MP4 – DJI_0399.MP4	1-2	The missing gunite with reinforcement projecting/corroded at ~Station 531+78 (DJI_0360.MP4, 2:00) and 561+20 (DJI_0373.MP4, 4:17) should be repaired within two (2) years. The fracture at Station 574+00 (DJI_0373.MP4, 4:17) should be repaired within two (2) years. The missing gunite with reinforcement projecting/corroded and suspected hole at Station 531+85 (DJI_0360.MP4, 3:20) should be repaired within one (1) year. Existing reinforcement should be assessed and renewed if required. In addition, overgrown or fallen vegetation should be removed seasonally. Cracks and fractures throughout this bench should be monitored and patched as necessary on an annual basis until this bench section has been replaced.
Twin Oaks Bench	5,135	4/20/21	DJI_0302.MP4 – DJI_0337.MP4	2	The missing gunite with reinforcement projecting/corroded at ~Station 687+15 (DJI_0322.MP4, 1:47) should be repaired within two (2) years by applying patch material. Existing reinforcement should be assessed and renewed if required. The fractures at ~Station 703+15 (DJI_0316.MP4, 0:11) should be repaired within two (2) years. In addition, overgrown or fallen vegetation should be removed seasonally. Cracks and fractures throughout this bench should be monitored and patched as necessary on an annual basis until this bench section has been replaced.
MW Bench	2,173	4/20/21	DJI_0271.MP4 – DJI_0301.MP4	Annually	Remove overgrown or fallen vegetation seasonally. Cracks and fractures throughout this bench should be monitored and patched as necessary on an annual basis until this bench section has been replaced.

Total Approximate Length (LF) 30,305
Defect locations are identified with Stationing numbers stenciled on flume as well as video name and time in the video where defect is observed
**Repair timeframe is based on external visual inspection results only. Interior condition and any repairs needed are unknown.*

The bench sections evaluated along the Vista Flume have numerous repaired sections, holes, staining, suspected leaks (exfiltration), require increased maintenance, and are no longer functioning as they were when newly constructed. The asset will continue to deliver water, but will be more costly to operate, less efficient, and has a higher risk of failure. The risk of failure will continue to increase as the asset degrades until replacement is performed. The typical design life for this type of asset is 50-75 years, while the actual age of this asset is 90+ years. Therefore, it has been determined that this asset is beyond its anticipated useful service life.

Brown and Caldwell also interviewed District operations and facilities staff for input on on-going maintenance issues and to gain concurrence on the replacement prioritization of each bench section. The District indicated that several bench sections have had and continue to have significant repairs to patch cracks, fractures, and holes.

- The worst condition bench is the Beehive bench due to the degrading reinforcement over the PVC arch within the cover section.
- The Borden and Twin Oaks benches are also in very poor condition due to recurring ongoing repairs to address the degrading reinforcement within the cover. The Borden bench has also experienced slope failure in the past.
- The Daley, Finkbinder, and MD benches are in poor condition due to reoccurring ongoing repairs for cracks and fractures, and failing gunite.
- The Jack Creek, Tunnel, Kornhauser, and Pearson benches are in fair to poor condition with less frequent repairs for cracks and fractures.
- The MW bench is in fair condition due to installation of an HDPE pipe inside the bench section as part of a flume replacement pilot project in 2010.

The replacement prioritization levels assigned are based on both current external inspections and the District's knowledge of historical repairs and maintenance, and assume the repairs recommended in this report will be performed in the timeframe recommended in Table ES-1. See Table ES-2 and Figure ES-3 for the replacement prioritization of each bench section. The prioritization levels assigned include: 1 (very poor), 2 (poor), 3 (fair to poor), and 4 (fair) conditions. Prioritization level 1 bench sections should be the first to be replaced, followed by prioritization level 2, 3, and lastly prioritization level 4.

Table ES-2 Replacement Prioritization

Flume Bench Section	Approximate Length (LF)	Prioritization Level*
Jack Creek Bench	394	3
Tunnel Bench	3,750	3
Daley Bench	3,241	2
Kornhauser Bench	1,321	3
Finkbinder Bench	3,888	2
MD Bench	3,290	2
Pearson Bench	371	3
Beehive Bench	477	1
Borden Bench	6,265	1
Twin Oaks Bench	5,135	1
MW Bench	2,173	4

**Prioritization Level*
1 = Very Poor
2 = Poor
3 = Fair to Poor
4 = Fair

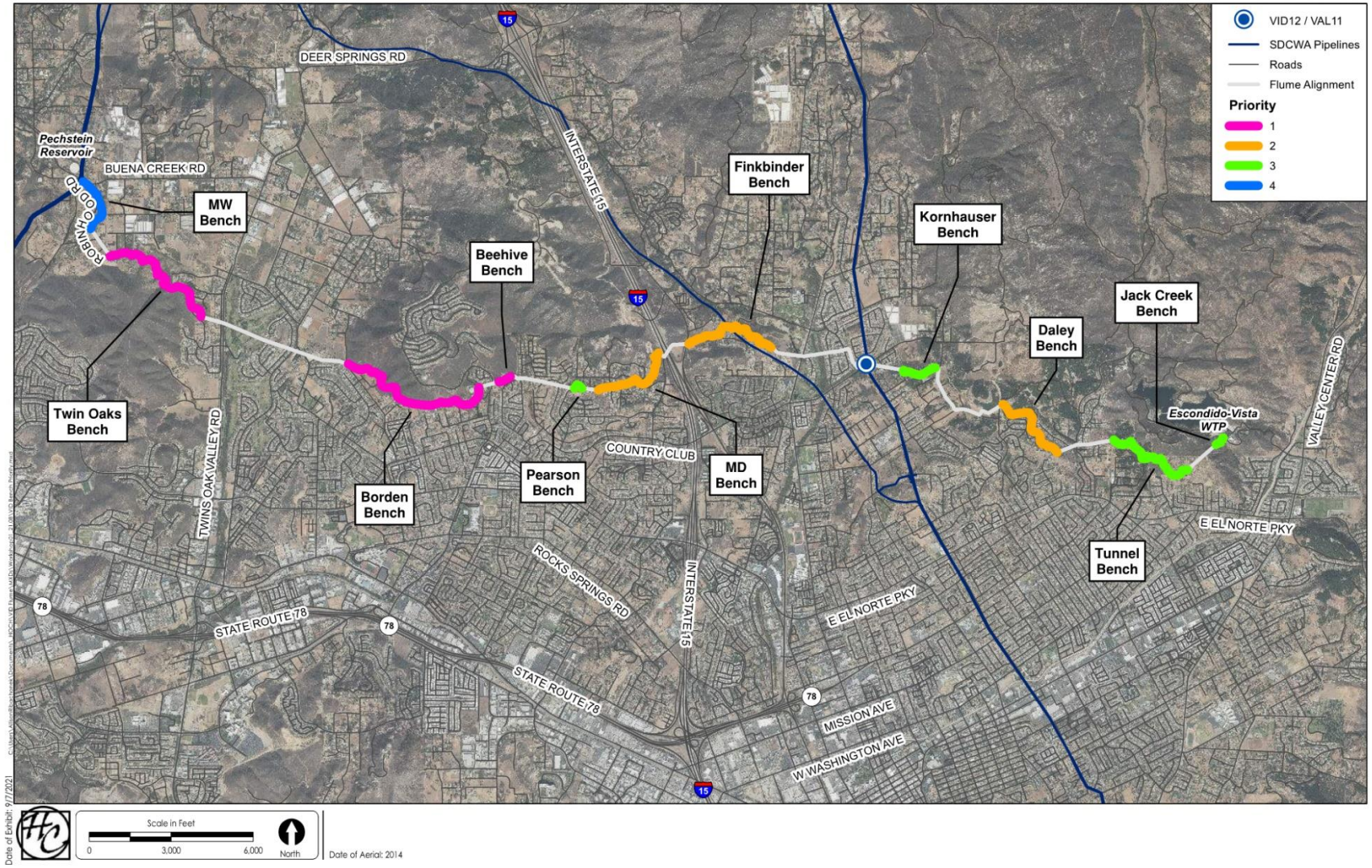

Figure ES-1: Bench Section Replacement Prioritization

Due to this inspection being limited to aerial drone footage with no internal inspection data or structural analysis of the existing bench sections, the prioritization levels are subject to change as additional inspection data is acquired during future inspection efforts.

Further inspections, such as an internal condition assessment, may change the prioritization of bench sections or identify other issues that require the replacement timeframe to be accelerated. Evaluation of the Flume's replacement for criticality, construction sequencing and phasing, bypass considerations, public disruption, and capital budgeting for this project may also change the order/sequence of bench section replacement. These aspects will be considered further during the Coarse and Fine Screening phases of the Flume Replacement Alignment Study. See Section 5 for additional details on the Prioritization and Replacement of the bench sections.

Section 1

Introduction and Background

Brown and Caldwell is contracted by the Vista Irrigation District (District) to complete the Flume Replacement Alignment Study (Study). The purpose of this Study is to develop multiple alignment alternatives, select the preferred alignment, and prepare conceptual design documents describing the methods for executing the future Flume Replacement Project (Project). The preliminary planning and alignment phase of the Study includes condition assessment of the Flume's bench sections, and if needed the siphon sections, to help evaluate the alignment alternatives regarding the necessary timing requirements for replacement and the ability to phase each reach of the Project. This report describes the inspection performed and the resulting condition assessment and recommended repairs for each bench section.

The work was performed by using an Unmanned Aerial System (UAS), or drone, to identify "red flag" areas of concern and to provide valuable data in establishing a baseline condition of the bench sections. There are 11 unique bench sections totaling just over 5.7 miles. Figure 1-1 represents the Flume alignment and bench sections under inspection. In addition, while flying the drone along the bench sections, limited visual inspection by the UAS operators was conducted.

Brown and Caldwell also interviewed operations and facilities staff for input on on-going maintenance issues and to gain concurrence on the replacement prioritization of each bench section.

1.1 Background

The District is embarking on an Alignment Study to replace the Vista Flume (Flume) conveyance system, which conveys the District's local, imported, and treated water supply from the Escondido-Vista Water Treatment Plant (EVWTP) to Pechstein Reservoir. The Flume consists of above-grade unpressurized gunite bench structures (benches), buried pressurized steel or concrete pipelines (siphons), and unpressurized rock tunnels. Constructed in 1926, the Flume made a name for itself with its unique design over challenging terrain. It has provided multiple generations of District customers with local, Lake Henshaw water over its impressive, nearly 100 years of service, but it has now reached the end of its useful life.

In the 2019 Water Supply Planning Study (WSPS), the District, with the help of the Gillingham Water-Brown and Caldwell team, explored the question "To Flume or Not to Flume?" The WSPS weighed the total cost of operating, maintaining, and upgrading the local water supply system from Lake Henshaw to Pechstein Reservoir versus retiring the local system and supplementing with purchased water from the San Diego County Water Authority (Water Authority). The WSPS determined that the "To Flume" option provided the most economical, long-term benefits and recommended that the District continue to use its local supply. The evaluation of the local water system included a Flume replacement assessment in which it as determined that the existing Flume was no longer suitable for continued long-term operations. The WSPS team developed two preliminary alignments for replacing the Flume each detailing considerations impacting project feasible and costs. The District's Board of

Directors approved staff's recommendation, "To Flume", and proceed with a Flume Replacement Alignment Study.

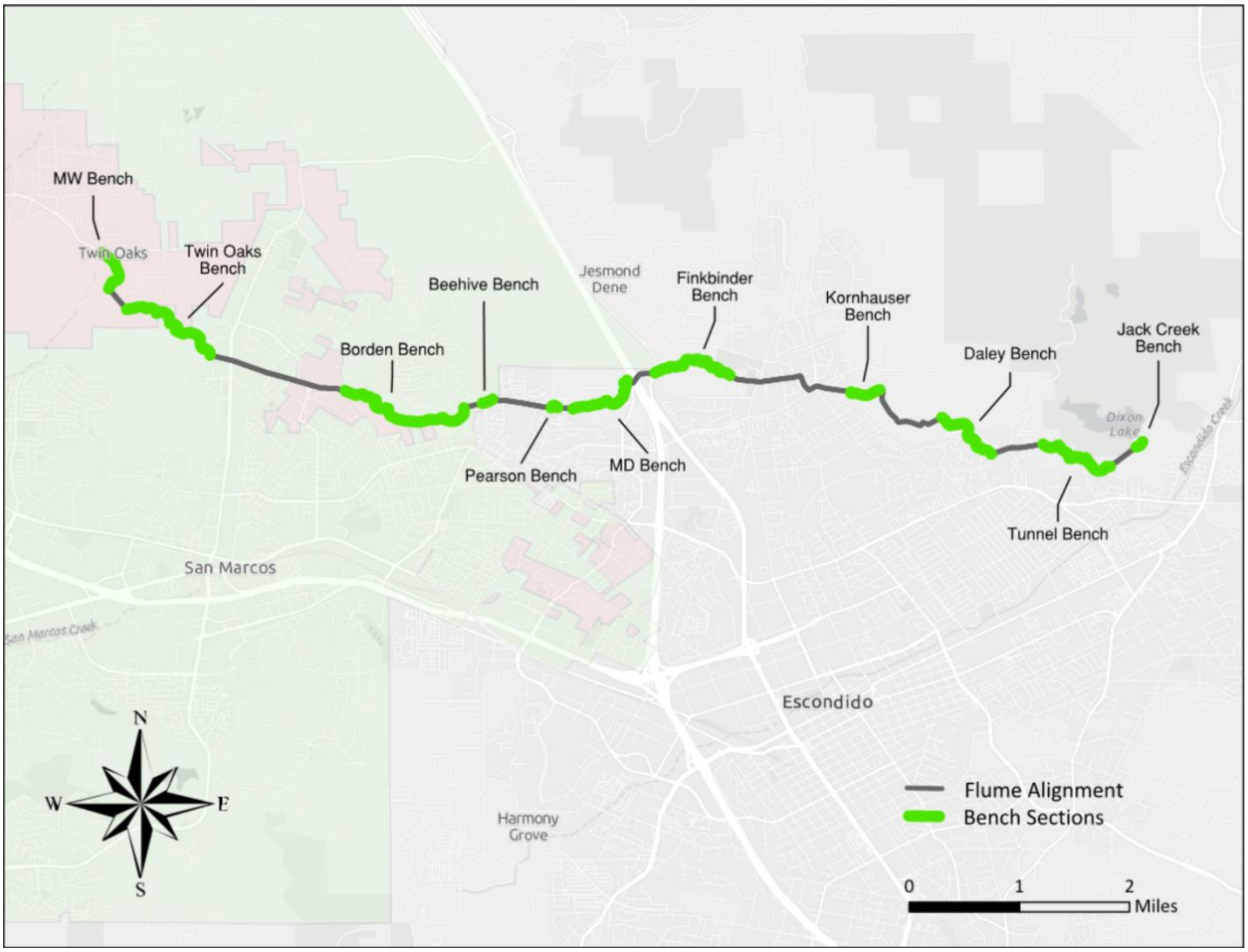

Figure 1-1 - Bench Section Location Map

Section 2

UAS Drone Inspection Approach

During the UAS Drone Survey the field team visually inspected the exposed exterior surfaces of each flume bench section to determine its baseline structural condition. The BC field team attempted to capture imagery of all exposed flume bench section surfaces. The field team focused efforts on locating and documenting defects and areas of concern.

The BC field team used an Unmanned Aircraft System (UAS), to collect video and geospatial data. UAS video resolution was 4k (4096 x 2160) at 30 frames per second. In nearly all instances, the level of detail acquired by use of the UAS was adequate for visual condition assessment. However, the team did encounter situations where the view of the flume bench surface was obscured, usually buried, under vegetation or debris, or beneath pavement of a roadway or pedestrian crossing.

UAS data collection was led by a BC FAA-certified remote operator. Supporting the UAS pilot was a BC visual observer/camera operator, also a FAA-certified remote operator. All field activities complied with Title 14, Part 107 of the Code of Federal Regulations and District guidelines. Federal regulations require that commercial UAS operators obtain a Certificate of Authentication (COA) from the Federal Aviation Administration (FAA) prior to operating in controlled airspace. BC reviewed the bench locations in the inspection area and found that none of the bench sections were located in FAA controlled airspace and required no further coordination or authorization from the FAA to complete UAS Drone Survey operations.

UAS flights generally occurred below 50 ft above ground level (AGL) but extended to higher altitudes when the BC field team felt that it would be beneficial to capture a visually broader perspective for better context of the site. The UAS operating area was typically within close proximity, typically within 5 to 20 feet, of the bench sections. The focus of the UAS data captured was on the bench sections and adjacent District property. However, private property was captured on video and in some imagery, particularly in oblique imagery. BC was careful and considerate of the private properties located around the District assets while keeping focus on the project objective. Inspections were conducted over the course of 4 consecutive days between April 20, 2021 and April 23, 2021. When inspecting bench sections adjacent to private property the field team limited UAS flight hours to between 7am and 6pm. The BC field team was not approached or questioned by private property owners/occupants during the UAS survey.

During the inspection process the field team was able to access all bench sections identified for UAS Drone Survey during the inspection planning phase. Most of the bench sections had unimpeded access but some required coordination with the District to have gates unlocked and opened for BC field team vehicle access.

To mitigate risk and improve safety, at each inspection site, the BC field team implemented a comprehensive Field Work Safety Plan which included practical guidelines and work strategies to mitigate the risk of employee and visitor exposure to COVID-19. Each day, tailgate safety meetings and UAS preflight briefings were held to assess hazards, provide mitigation strategies, and identify unique hazards based on the inspection plan for the day. At each site, prior to conducting UAS operations, the UAS operator reviewed any site-specific hazards identified in the inspection plan and completed the preflight checklist.

Section 3

Data Analysis Approach

3.1 Data Acquisition

The BC field team captured 274 unique videos totaling approximately 20 hours of video during inspections. Each video was reviewed by a National Association of Sewer Service Companies (NASSCO) Pipeline Assessment and Certification Program (PACP) trained and certified condition assessment specialist to identify, code, and geolocate significant defects visually observed on the exterior surfaces of the flume bench sections. Owing to the sizeable number of observations, less significant defects were not individually coded but an overall summary of common defects for each bench section is included. Significant defects observed during review were documented in a defect log, included as Appendix A. Below is a list of the information that was documented for each significant defect observed.

- Video filename
- Timestamp of defect within video
- Defect type
- Feature
- Comments
- Location on exterior channel section (left bank, right bank, etc.)
- Bench name
- Stationing*

**The Stationing was developed using drone latitude/longitude data to interpolate stationing between access point with known stationing numbers. This stationing should be considered approximate with the intent to locate significant defects and not survey grade data.*

3.2 Defect Types and Scoring

NASSCO PACP standards were selected for identification and coding of flume bench section defects. The PACP program provides uniformity in personnel training, terminology, and the standardized assignment of defect type and severity for a variety of pipe and structure materials. All defects and features followed NASSCO PACP coding, when applicable.

Structural defects identified during this inspection included cracks, fractures, holes, and reinforcement visible/projecting/corroded. There were a significant number of patched cracks and fractures indicating historic structural issues. Other defects included staining and exfiltration, typically caused by a structural issue, and vegetation overgrowth.

The defect staining, as identified at various bench sections, refers to water mineralization stains and deposits that may have been caused by rainwater leaching cement from the gunite, or exfiltration (historic or active) depositing minerals on the exterior surface of the bench section, an indication of distress on the bench section wall or cover.

3.3 Inspection Limitations

Each flume bench section was reviewed for significant defects, and repair recommendations were developed based on the type, severity, and quantity of defects observed for each bench section. These repair recommendations were based solely on the defects visually observed from the drone footage since visual inspection of the interior of the flume was not performed as part of this inspection.

Section 4

Condition Assessment and Repair Recommendations

The condition assessment results are summarized by bench section below. The detailed summary of all bench sections including video filename, side, UAS flight direction, defects, and notes are included in Appendix A. Significant defects requiring repair are included in each bench section condition assessment results below.

4.1 Jack Creek Bench

The Jack Creek Bench, shown in Figure 4-2, is located on the southeast side of Dixon Reservoir near the Escondido-Vista Water Treatment Plant (EVWTP), and directly upstream of the Big Tunnel section of the flume. The Jack Creek Bench section is approximately 394 linear feet in length.

Figure 4-2. Jack Creek Bench Alignment

4.1.1 Condition Assessment Results

There were a total of eight (8) videos recorded for the Jack Creek Bench, two (2) of the videos are higher altitude broad perspective videos. The videos are labeled DJI_0507.MP4 – DJI_0514.MP4. The Jack Creek Bench is in fair condition based on the drone inspection. Significant defects include cracks, vegetation overgrowth, staining, and what appears to be a failed patch repair.

The failed patch is shown in Figure 4-3 below:

Figure 4-3. Failed Patch, DJI_0511.MP4 2:35, ~STA 128+88

4.1.2 Repair Recommendations

The failed patch at ~Station 128+88 should be repaired within one (1) year by removing any detached patch material and applying new patch material. The reinforcement, if visible, should be assessed for corrosion and renewed if required. In addition, overgrown or fallen vegetation should be removed seasonally. Cracks and fractures throughout this bench should be monitored and patched as necessary on an annual basis until this bench section has been replaced.

4.2 Tunnel Bench

The Tunnel Bench, shown in Figure 4-4, is located approximately 0.5 miles south of Dixon Reservoir and traverses the hillside above residential properties. The Tunnel Bench section is approximately 3,750 linear feet in length.

Figure 4-4. Tunnel Bench Alignment

4.2.1 Condition Assessment Results

There were a total of 33 videos recorded for the Tunnel Bench, six (6) of the videos are higher altitude broad perspective videos. The videos are labeled DJI_0515.MP4 – DJI_0547.MP4. The Tunnel Bench is in fair to poor condition based on the drone inspection. Significant defects include water staining, cracks, patched cracks, fractures, failed patches, reinforcement projecting/corroded and holes.

A hole with missing gunite and reinforcement projecting/corroded is shown in Figure 4-5 below:

Figure 4-5. Hole with Missing Gunite and Reinforcement Projecting/Corroded, DJI_0517.MP4 1:19, ~STA 177+55

Fractures are shown in Figure 4-6 below:

Figure 4-6. Fractures, DJI_0523.MP4 1:02, ~STA 157+25

4.2.2 Repair Recommendations

The hole at ~Station 177+55 should be repaired within one (1) year by dowling in new reinforcement and applying patch material. Existing reinforcement should be assessed for corrosion and renewed if required. In addition, overgrown or fallen vegetation should be removed seasonally. Cracks and fractures throughout this bench should be monitored and patched as necessary on an annual basis until this bench section has been replaced.

4.3 Daley Bench

The Daley Bench, shown in Figure 4-7, is located in open space just west of La Honda Dr., adjacent to residential neighborhood. The Daley Bench section is approximately 3,241 linear feet in length.

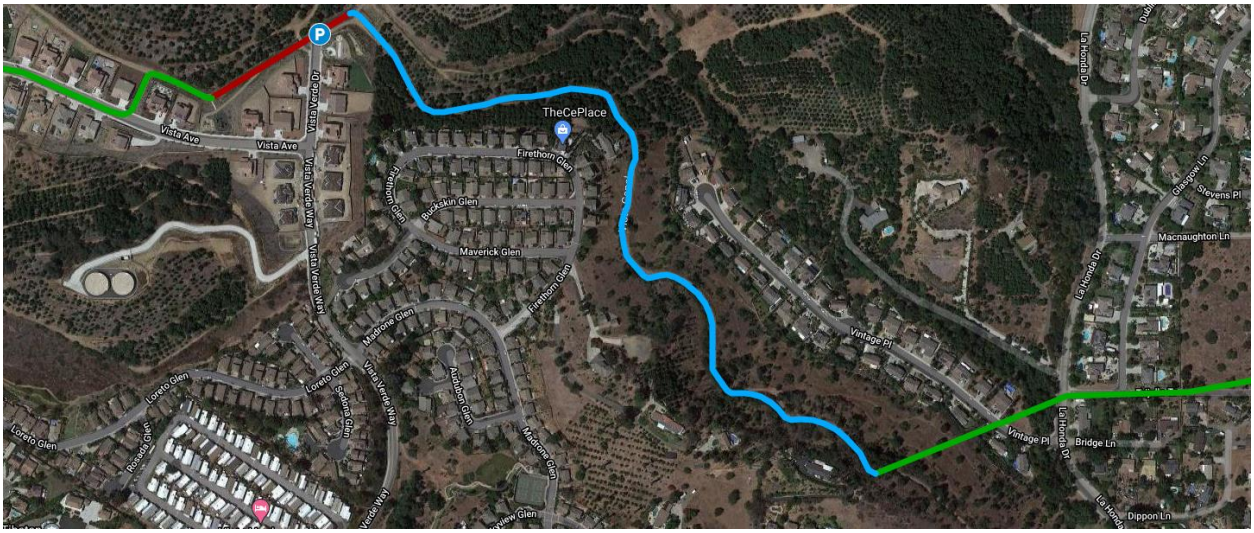

Figure 4-7. Daley Bench Alignment

4.3.1 Condition Assessment Results

There were a total of 31 videos recorded for the Daley Bench, four (4) of the videos are higher altitude broad perspective videos. The videos are labeled DJI_0476.MP4 – DJI_0506.MP4. The Daley Bench is in poor condition based on the drone inspection. Significant defects include cracks, fractures, reinforcement projecting/corroded, and suspected exfiltration of water from the interior of the flume.

An area with missing gunite and reinforcement projecting/corroded is shown in Figure 4-8 below:

Figure 4-8. Missing Gunite and Reinforcement Projecting/Corroded, DJI_0486.MP4 0:32, ~STA 234+68

Fractures and suspected exfiltration are shown in Figure 4-9 below:

Figure 4-9. Fractures and Suspected Exfiltration, DJI_0479.MP4 0:51, ~STA 214+90

4.3.2 Repair Recommendations

The missing gunite and projecting/corroded reinforcement at ~Station 234+68 should be repaired within one (1) year by applying patch material. Existing reinforcement should be assessed and renewed if required. Fractures and suspected exfiltration at ~Station 214+90 should be further investigated and repaired within one (1) year. In addition, overgrown or fallen vegetation should be removed seasonally. Cracks and fractures throughout this bench should be monitored and patched as necessary on an annual basis until this bench section has been replaced.

4.4 Kornhauser Bench

The Kornhauser Bench, shown in Figure 4-10, is located adjacent to recently developed residential properties. The Kornhauser Bench section is approximately 1,340 linear feet in length.

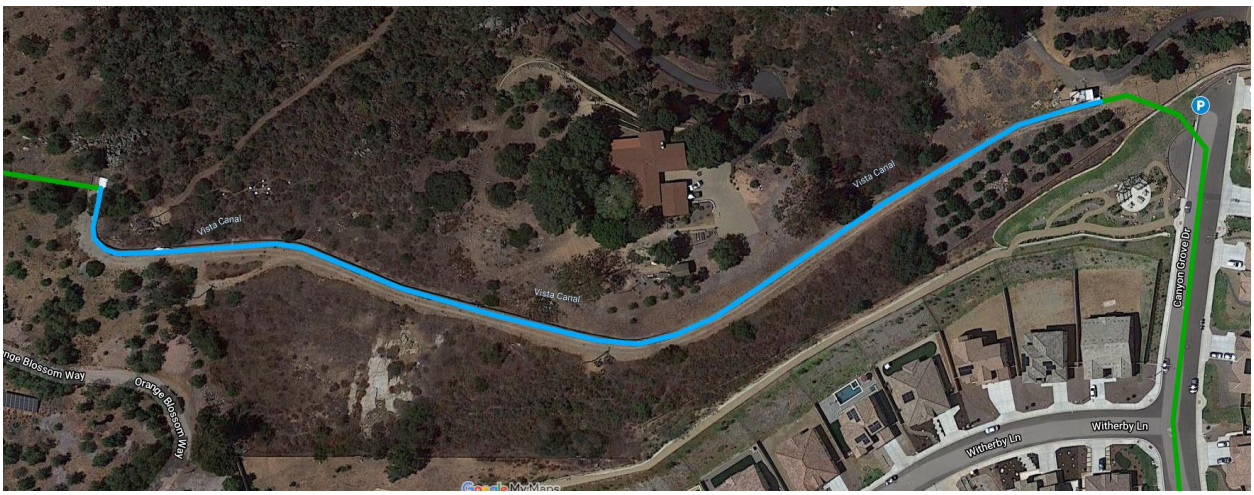

Figure 4-10. Kornhauser Bench Alignment

4.4.1 Condition Assessment Results

There were a total of 15 videos recorded for the Kornhauser Bench, two (2) of the videos are higher altitude broad perspective videos. The videos are labeled DJI_0426.MP4 – DJI_0440.MP4. The Kornhauser Bench is in poor condition based on the drone inspection. Significant defects include cracks, fractures, missing gunite, reinforcement projecting/corroded, and a suspected hole.

Missing gunite, staining, and the suspected hole are shown in Figure 4-11 below:

Figure 4-11. Missing Gunite, Staining, Suspected Hole, DJI_0428.MP4 4:12, ~STA 286+80

Fractures are shown in Figure 4-12 below:

Figure 4-12. Fractures, DJI_0430.MP4 1:12, ~STA 281+90

4.4.2 Repair Recommendations

The missing gunite, staining, and suspected hole at ~Station 286+80 should be repaired within one (1) year by applying patch material. Existing reinforcement should be assessed and renewed if required. In addition, overgrown or fallen vegetation should be removed seasonally. Cracks and fractures throughout this bench should be monitored and patched as necessary on an annual basis until this bench section has been replaced.

4.5 Finkbinder Bench

The Finkbinder Bench, shown in Figure 4-13, is located approximately 0.25 miles east of the I-15 in North Escondido, and traverses mostly open space and a couple of private residences. The Finkbinder Bench section is approximately 3,888 linear feet in length.

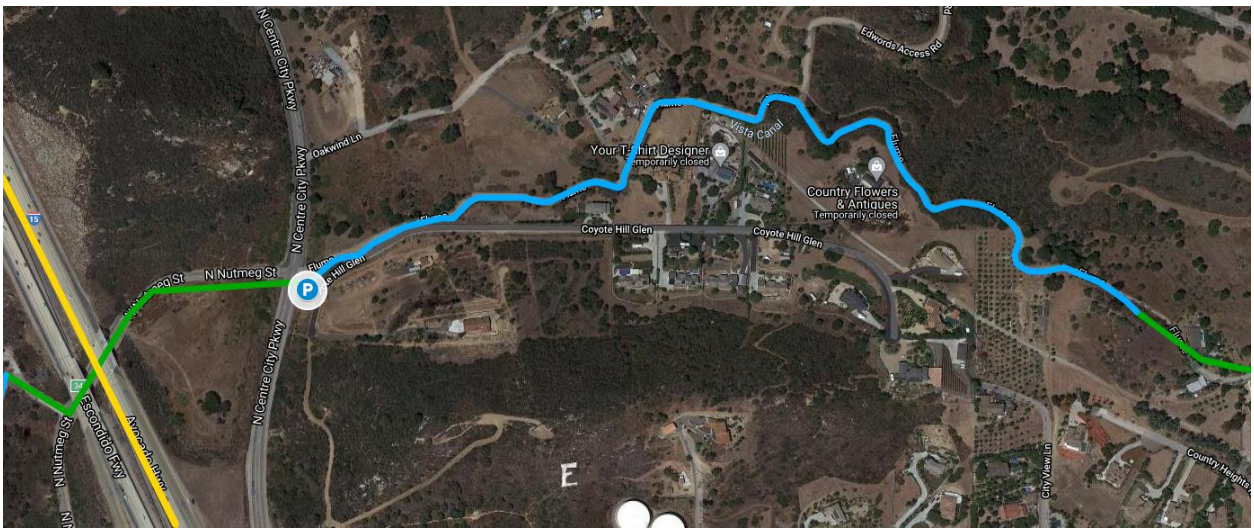

Figure 4-13. Finkbinder Bench Alignment

4.5.1 Condition Assessment Results

There were a total of 35 videos recorded for the Finkbinder Bench, six (6) of the videos are higher altitude broad perspective videos. The videos are labeled DJI_0441.MP4 – DJI_0475.MP4. The Finkbinder Bench is in very poor condition based on the drone inspection. Significant defects include cracks, fractures, missing gunite, reinforcement visible, suspected exfiltration, hole, and failed repairs.

A fracture with suspected exfiltration is shown in Figure 4-14 below:

Figure 4-14. Fracture with Suspected Exfiltration, DJI_0447.MP4 1:43, ~STA 401+20

Reinforcement Visible is shown in Figure 4-15 below:

Figure 4-15. Reinforcement Visible, DJI_0448.MP4 0:31, ~STA 402+10

Failed Repair is shown in Figure 4-16 below:

Figure 4-16. Failed Repair, DJI_0452.MP4 1:06, ~STA 416+51

Hole is shown in Figure 4-17 below:

Figure 4-17. Hole, DJI_0464.MP4 4:11, ~STA 428+80

4.5.2 Repair Recommendations

The fracture with suspected exfiltration at ~Station 401+20 should be repaired within one (1) year by stopping the exfiltration and applying patch material. Hole at ~Station 428+80 should be repaired within one (1) year by applying patch material. In addition, overgrown or fallen vegetation should be removed seasonally. Cracks and fractures throughout this bench should be monitored and patched as necessary on an annual basis until this bench section has been replaced.

4.6 MD Bench

The MD Bench, shown in Figure 4-18, is located approximately 200 feet west of the I-15 in North Escondido, and traverses a hillside and up into residential housing. The MD Bench section is approximately 3,290 linear feet in length.

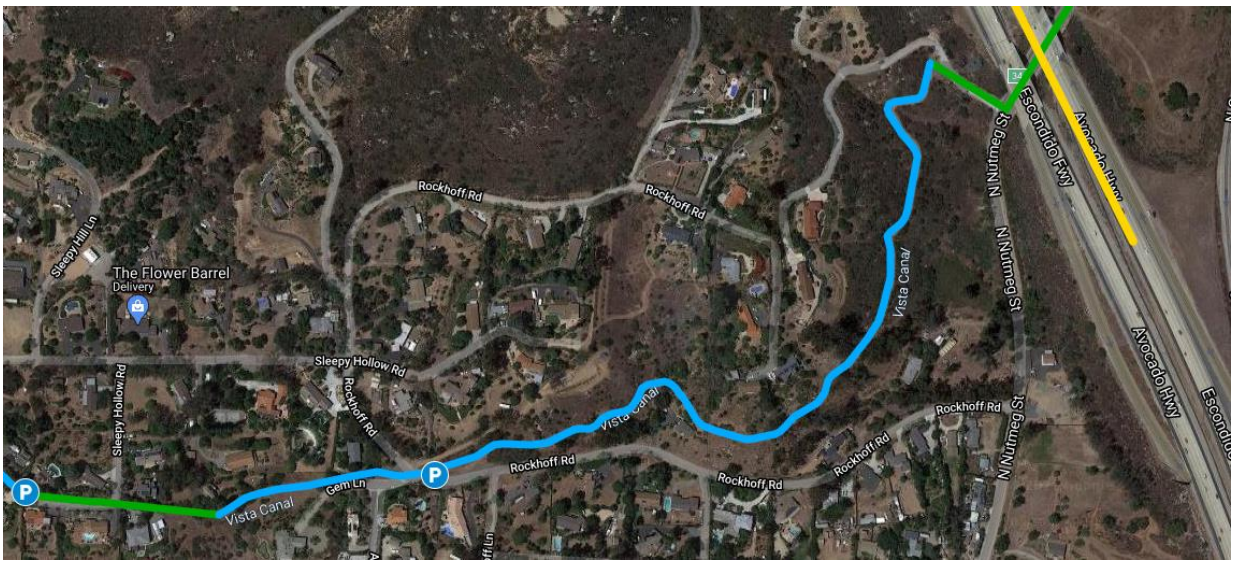

Figure 4-18. MD Bench Alignment

4.6.1 Condition Assessment Results

There were a total of 25 videos recorded for the MD Bench, four (4) of the videos are higher altitude broad perspective videos. The videos are labeled DJI_0401.MP4 – DJI_0425.MP4. The MD Bench is in fair condition based on the drone inspection. Significant defects include cracks, fractures, patches, and staining on the walls.

Fractures are shown in Figure 4-19 below:

Figure 4-19. Fractures, DJI_0419.MP4 4:00, ~STA 466+36

Cracks are shown in Figure 4-20 below:

Figure 4-20. Cracks, DJI_0424.MP4 2:48, ~STA 482+20

4.6.2 Repair Recommendations

Remove overgrown or fallen vegetation seasonally. Cracks and fractures throughout this bench should be monitored and patched as necessary on an annual basis until this bench section has been replaced.

4.7 Pearson Bench

The Pearson Bench, shown in Figure 4-21, is located approximately 600 feet west of the downstream end of the MD Bench, alongside private property at 21009 Sleep Hollow Road. The Pearson Bench section is approximately 371 linear feet in length.

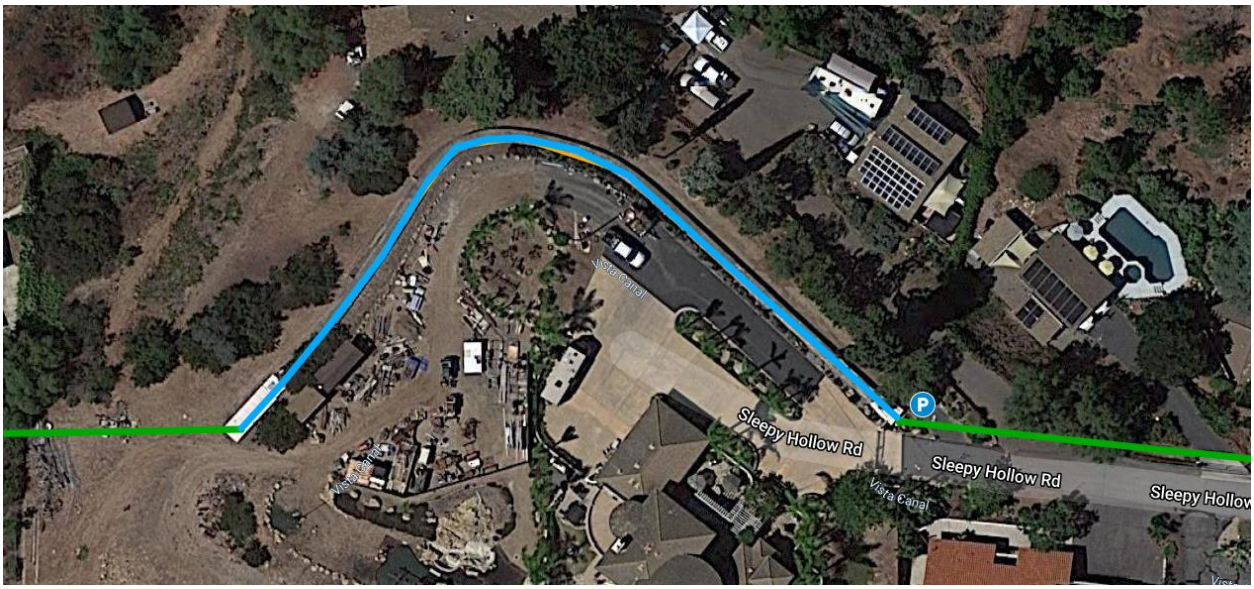

Figure 4-21. Pearson Bench Alignment

4.7.1 Condition Assessment Results

There were a total of 8 videos recorded for the Pearson Bench, two (2) of the videos are higher altitude broad perspective videos. The videos are labeled DJI_0344.MP4 – DJI_0351.MP4. The Pearson Bench is in fair condition based on the drone inspection. Defects include stains, patched cracks, and vegetation overgrowth.

Vegetation overgrowth is shown in Figure 4-22 below:

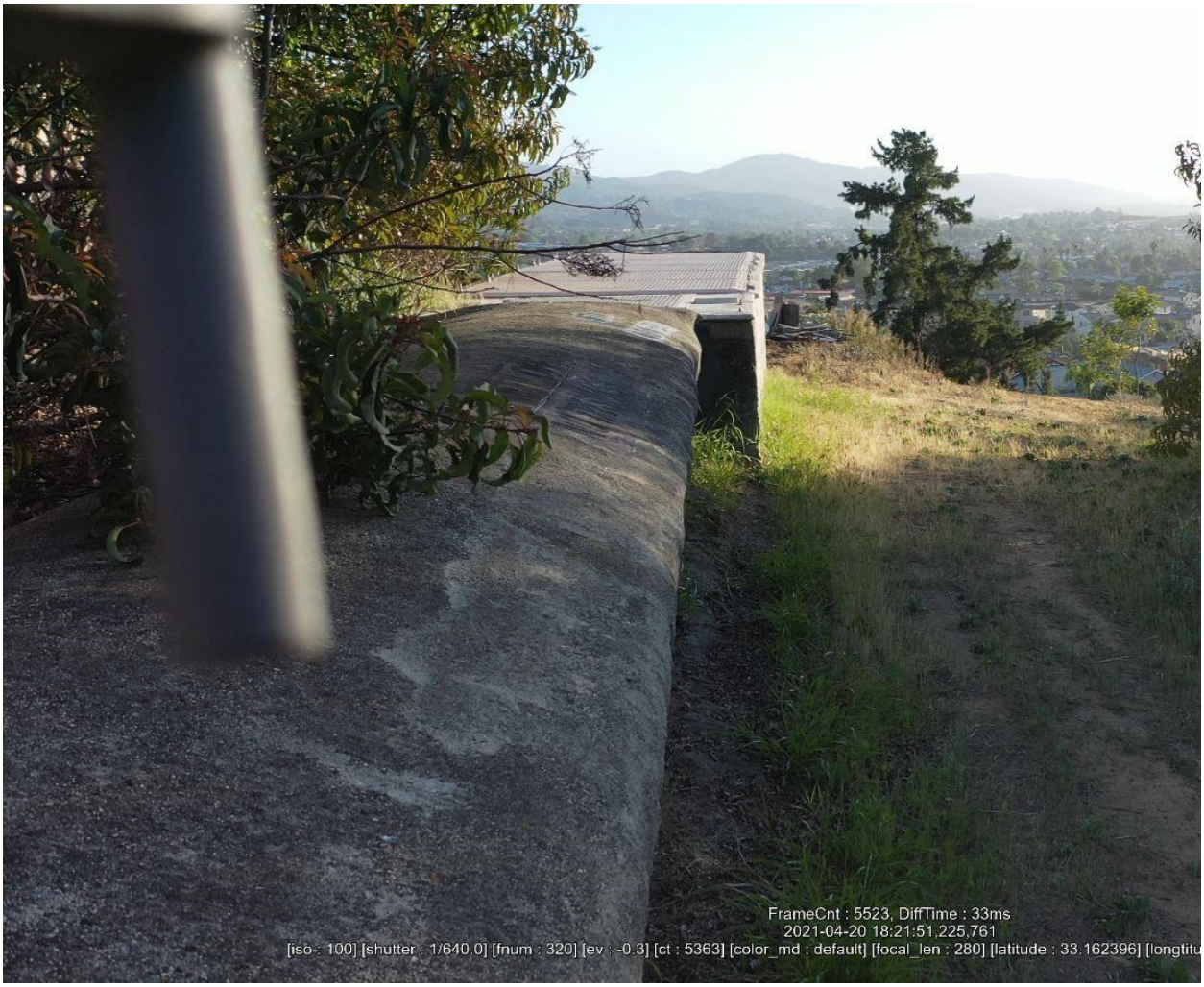

Figure 4-22. Vegetation Overgrowth, DJI_0346.MP4 3:03, ~STA 494+75

4.7.2 Repair Recommendations

Remove overgrown or fallen vegetation seasonally. Cracks and fractures throughout this bench should be monitored and patched as necessary on an annual basis until this bench section has been replaced.

4.8 Beehive Bench

The Beehive Bench, shown in Figure 4-23, is located at the northwest end of the old Escondido Country Club and near the Escondido Highlands residential neighborhood in Escondido. The Beehive Bench section is approximately 477 linear feet in length.

Figure 4-23. Beehive Bench Alignment

4.8.1 Condition Assessment Results

There were a total of 6 videos recorded for the Beehive Bench, two (2) of the videos are higher altitude broad perspective videos. The videos are labeled DJI_0338.MP4 – DJI_0343.MP4. The Beehive Bench is in poor condition based on the drone inspection. Significant defects include staining, cracks, and missing gunite with reinforcement projecting/corroded and suspected hole.

Missing gunite with reinforcement projecting/corroded and suspected hole is shown in Figure 4-24 below:

Figure 4-24. Missing Gunite with Reinforcement Projecting/Corroded and Suspected Hole, DJI_0338.MP4 2:57, ~STA 520+95

A failed patch is shown in Figure 4-25 below:

Figure 4-25. Failed Patch, DJI_0339.MP4 0:56, ~STA 521+44

4.8.2 Repair Recommendations

The missing gunite with reinforcement projecting/corroded and suspected hole at ~Station 520+95 should be repaired within one (1) year by applying patch material. Existing reinforcement should be assessed and renewed if required. In addition, overgrown or fallen vegetation should be removed seasonally. Cracks and fractures throughout this bench should be monitored and patched as necessary on an annual basis until this bench section has been replaced.

4.9 Borden Bench

The Borden Bench, shown in Figure 4-26, is located south of the Escondido Highlands neighborhood and traverses open space adjacent to residential properties. The Borden Bench section is approximately 6,256 linear feet in length.

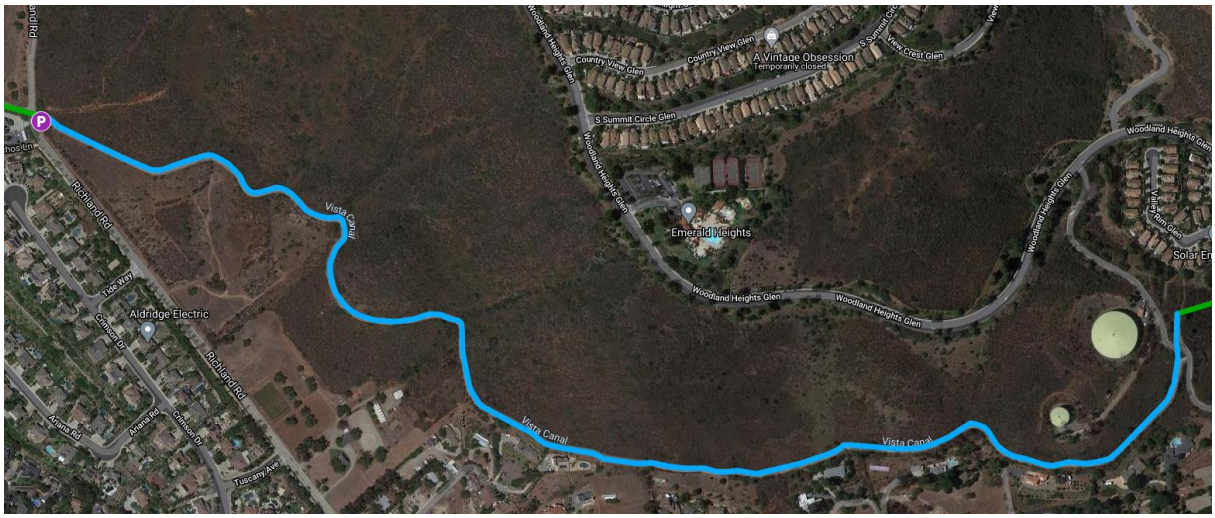

Figure 4-26. Borden Bench Alignment

4.9.1 Condition Assessment Results

There were a total of 48 videos recorded for the Borden Bench, eight (8) of the videos are higher altitude broad perspective videos. The videos are labeled DJI_0352.MP4 – DJI_0399.MP4. The Borden Bench is in fair to poor condition based on the drone inspection. Significant defects include corrosion staining, fractures, missing gunite with reinforcement projecting/corroded, and suspected hole.

Missing gunite with reinforcement projecting/corroded is shown in Figure 4-27 below:

Figure 4-27. Missing Gunite with Reinforcement Projecting/Corroded, DJI_0360.MP4 2:02, ~531+78

Missing gunite with reinforcement projecting/corroded is shown in Figure 4-28 below:

Figure 4-28. Missing Gunite with Reinforcement Projecting/Corroded, DJI_0373.MP4 4:17, ~STA 561+20

A fracture is shown in Figure 4-29 below:

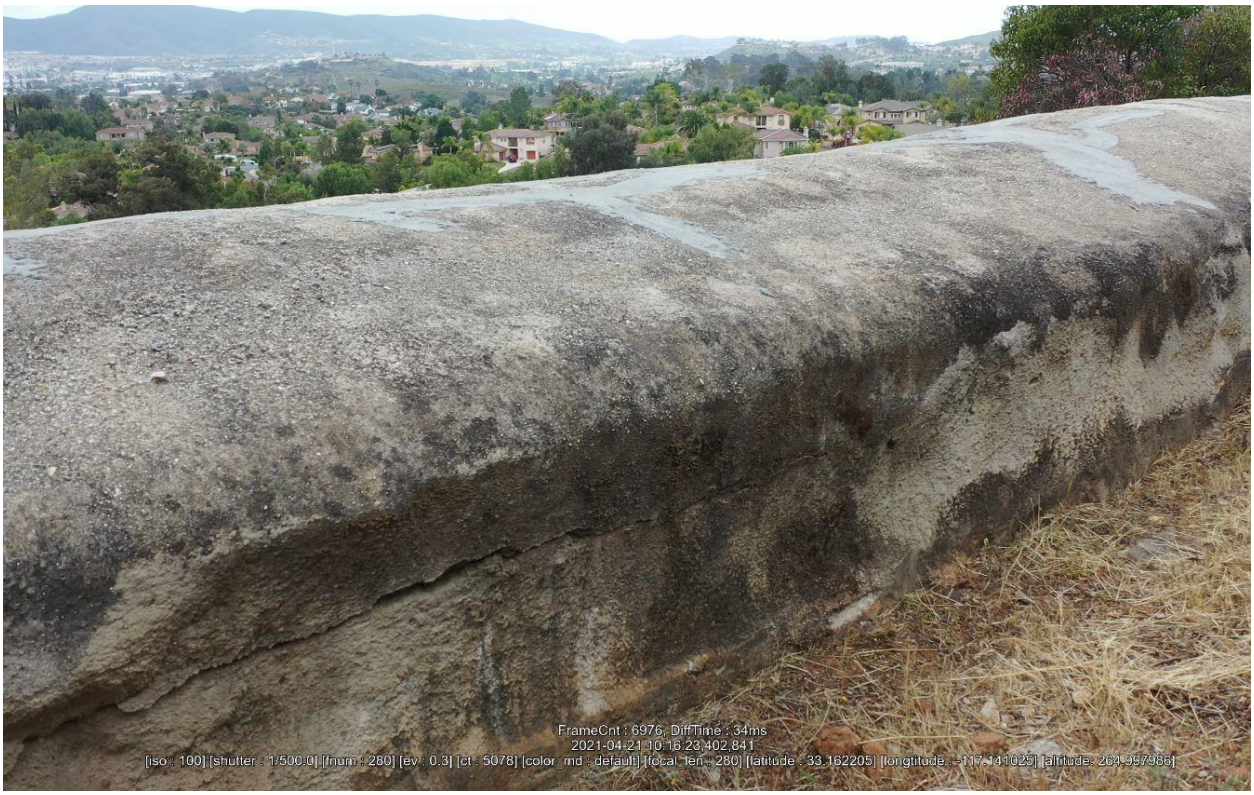

Figure 4-29. Fracture, DJI_0378.MP4 3:51, ~574+00

Missing gunite with reinforcement projecting/corroded and suspected hole is shown in Figure 4-30 below:

Figure 4-30. Missing Gunite with Reinforcement Projecting/Corroded and Suspected Hole, DJI_0399.MP4 3:46, ~STA 531+85

4.9.2 Repair Recommendations

The missing gunite with reinforcement projecting/corroded at ~Station 531+78 and 561+20 should be repaired within two (2) years. The fracture at Station 574+00 should be repaired within two (2) years. The missing gunite with reinforcement projecting/corroded and suspected hole at Station 531+85 should be repaired within one (1) year. Existing reinforcement should be assessed and renewed if required. In addition, overgrown or fallen vegetation should be removed seasonally. Cracks and fractures throughout this bench should be monitored and patched as necessary on an annual basis until this bench section has been replaced.

4.10 Twin Oaks Bench

The Twin Oaks Bench, shown in Figure 4-31, is located west of the Twin Oaks Golf Course on the west side of North Twin Oaks Valley Road. The Twin Oaks Bench section is approximately 5,135 linear feet in length.

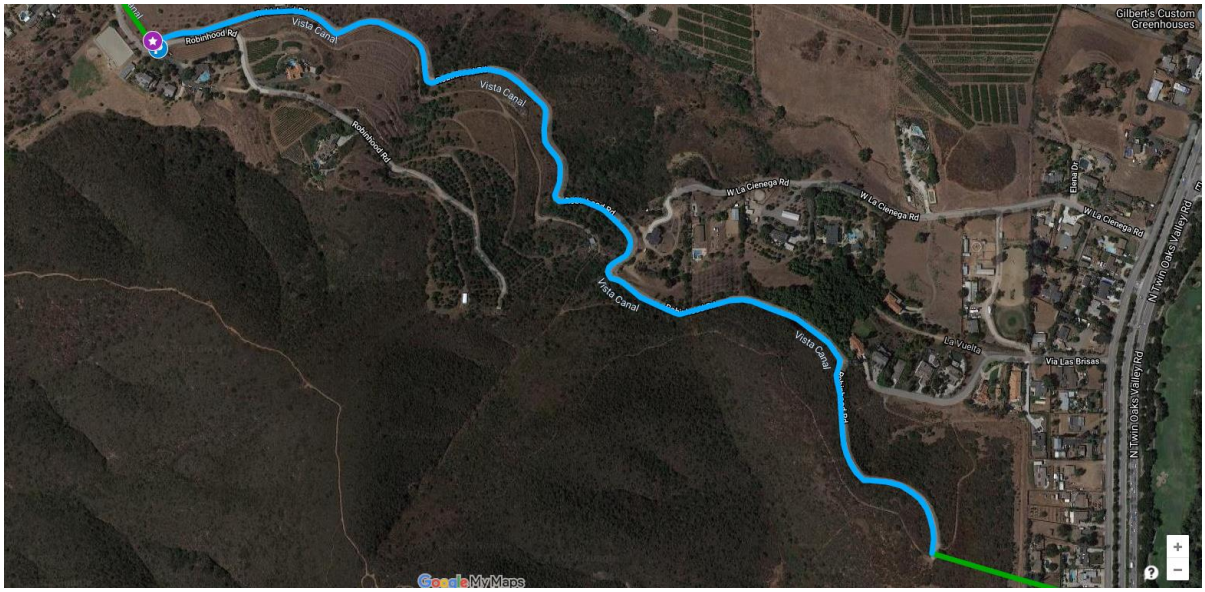

Figure 4-31. Twin Oaks Bench Alignment

4.10.1 Condition Assessment Results

There were a total of 36 videos recorded for the Twin Oaks Bench, zero (0) of the videos are higher altitude broad perspective videos. The videos are labeled DJI_0302.MP4 – DJI_0337.MP4. The Twin Oaks Bench is in fair to poor condition based on the drone inspection. Significant defects include staining, cracks, fractures, and missing gunite with reinforcement projecting/corroded.

Missing gunite with reinforcement projecting/corroded is shown in Figure 4-32 below:

Figure 4-32. Missing Gunite and Reinforcement Projecting/Corroded, DJI_0322.MP4 1:47, ~STA 687+15

Fractures are shown in Figure 4-33 below:

Figure 4-33. Fractures, DJI_0316.MP4 0:11, ~STA 703+15

4.10.2 Repair Recommendations

The missing gunite with reinforcement projecting/corroded at ~Station 687+15 should be repaired within two (2) years by applying patch material. Existing reinforcement should be assessed and renewed if required. The fractures at ~Station 703+15 should be repaired within two (2) years. In addition, overgrown or fallen vegetation should be removed seasonally. Cracks and fractures throughout this bench should be monitored and patched as necessary on an annual basis until this bench section has been replaced.

4.11 MW Bench

The MW Bench, shown in Figure 4-34, is located south of the Pechstein Reservoir on the south side of Buena Creek Road and Robinhood Road intersection. The MW Bench section is approximately 2,137 linear feet in length.

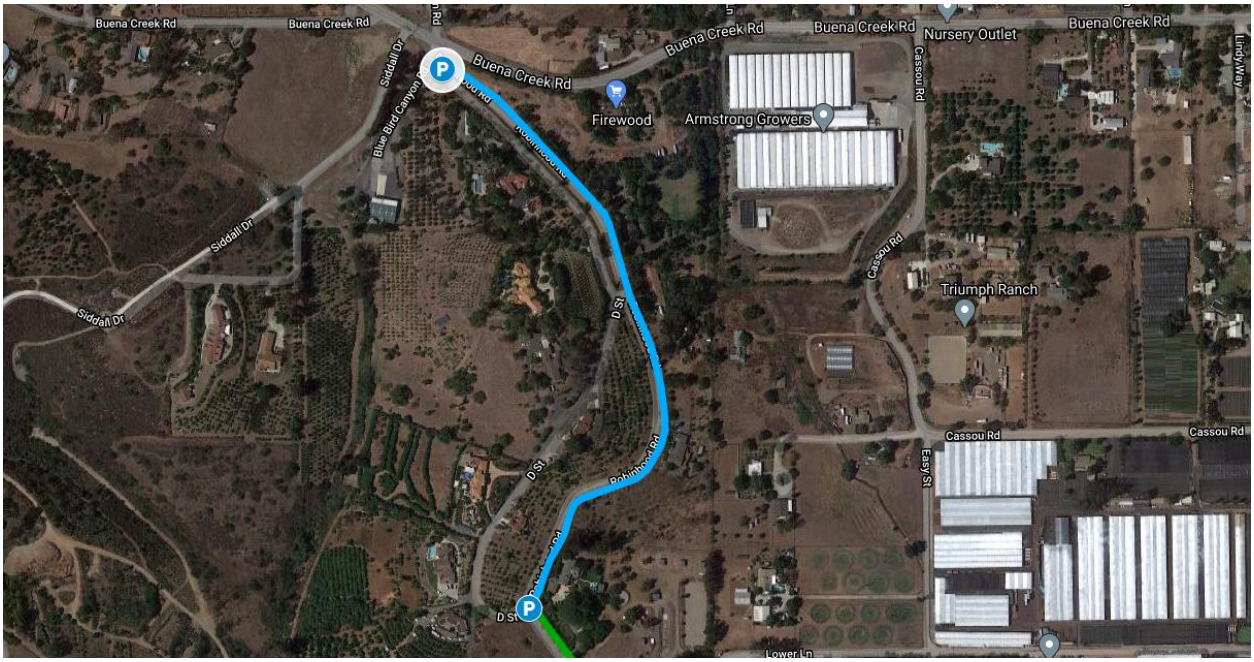

Figure 4-34. MW Bench Alignment

4.11.1 Condition Assessment Results

There were a total of 31 videos recorded for the MW Bench, 12 of the videos are higher altitude broad perspective videos. The videos are labeled DJI_0271.MP4 – DJI_0301.MP4. The MW Bench is in fair to poor condition based on the drone inspection. Significant defects include staining, cracks, and cracked patches.

Restraining lag bolts are shown in Figure 4-35 below, observation with no repair recommended:

Figure 4-35. Restraining Lag Bolts, DJI_0277.MP4 2:56, ~STA 722+43

Fractures and missing gunite shown in Figure 4-36 below:

Figure 4-36. Fractures and Missing Gunite, DJI_0281 3:03, ~STA 717+22

4.11.2 Repair Recommendations

Remove overgrown or fallen vegetation seasonally. Cracks and fractures throughout this bench should be monitored and patched as necessary on an annual basis until this bench section has been replaced.

4.12 Repair Recommendations Summary

A summary of the repair recommendation is included in Table 4-1 below:

Table 4-1 Repair Recommendations Summary

Flume Bench Section	Approximate Length (LF)	Inspection Date	Video Files	Repair Timeframe* (yrs)	Repair Recommendations
Jack Creek Bench	394	4/23/21	DJI_0507.MP4 – DJI_0514.MP4	1	The failed patch at ~Station 128+88 (DJI_0509.MP4, 0:29) should be repaired within one (1) year by removing any detached patch material and applying new patch material. The reinforcement, if visible, should be assessed for corrosion and renewed if required. In addition, overgrown or fallen vegetation should be removed seasonally. Cracks and fractures throughout this bench should be monitored and patched as necessary on an annual basis until this bench section has been replaced.
Tunnel Bench	3,750	4/23/21	DJI_0515.MP4 – DJI_0547.MP4	1	The hole at ~Station 177+55 (DJI_0517.MP4, 1:19) should be repaired within one (1) year by dowling in new reinforcement and applying patch material. Existing reinforcement should be assessed for corrosion and renewed if required. In addition, overgrown or fallen vegetation should be removed seasonally. Cracks and fractures throughout this bench should be monitored and patched as necessary on an annual basis until this bench section has been replaced.
Daley Bench	3,241	4/23/21	DJI_0476.MP4 – DJI_0506.MP4	1	The missing gunite and projecting/corroded reinforcement at ~Station 234+68 (DJI_0486.MP4 , 0:32) should be repaired within one (1) year by applying patch material. Existing reinforcement should be assessed and renewed if required. Fractures and suspected exfiltration at ~Station 214+90 (DJI_0492.MP4, 4:56) should be further investigated and repaired within one (1) year. In addition, overgrown or fallen vegetation should be removed seasonally. Cracks and fractures throughout this bench should be monitored and patched as necessary on an annual basis until this bench section has been replaced.
Kornhauser Bench	1,321	4/22/21	DJI_0426.MP4 – DJI_0440.MP4	1	The missing gunite, staining, and suspected hole at ~Station 286+80 (DJI_0430.MP4, 1:12) should be repaired within one (1) year by applying patch material. Existing reinforcement should be assessed and renewed if required. In addition, overgrown or fallen vegetation should be removed seasonally. Cracks and fractures throughout this bench should be monitored and patched as necessary on an annual basis until this bench section has been replaced.

Table 4-1 Repair Recommendations Summary

Flume Bench Section	Approximate Length (LF)	Inspection Date	Video Files	Repair Timeframe* (yrs)	Repair Recommendations
Finkbinder Bench	3,888	4/22/21	DJI_0441.MP4 – DJI_0475.MP4	1	The fracture with suspected exfiltration at ~Station 401+20 (DJI_0447.MP4, 1:36) should be repaired within one (1) year by stopping the exfiltration and applying patch material. Hole in soil next to flume at ~Station 428+80 (DJI_0454.MP4, 4:35) should be investigated. In addition, overgrown or fallen vegetation should be removed seasonally. Cracks and fractures throughout this bench should be monitored and patched as necessary on an annual basis until this bench section has been replaced.
MD Bench	3,290	4/21/21	DJI_0401.MP4 – DJI_0425.MP4	Annually	Remove overgrown or fallen vegetation seasonally. Cracks and fractures throughout this bench should be monitored and patched as necessary on an annual basis until this bench section has been replaced.
Pearson Bench	371	4/20/21	DJI_0344.MP4 – DJI_0351.MP4	Annually	Remove overgrown or fallen vegetation seasonally. Cracks and fractures throughout this bench should be monitored and patched as necessary on an annual basis until this bench section has been replaced.
Beehive Bench	477	4/20/21	DJI_0338.MP4 – DJI_0343.MP4	1	The missing gunite with reinforcement projecting/corroded and suspected hole at ~Station 520+95 (DJI_0338.MP4, 2:57) should be repaired within one (1) year by applying patch material. Existing reinforcement should be assessed and renewed if required. In addition, overgrown or fallen vegetation should be removed seasonally. Cracks and fractures throughout this bench should be monitored and patched as necessary on an annual basis until this bench section has been replaced.
Borden Bench	6,265	4/21/21	DJI_0352.MP4 – DJI_0399.MP4	1-2	The missing gunite with reinforcement projecting/corroded at ~Station 531+78 (DJI_0360.MP4, 2:00) and 561+20 (DJI_0373.MP4, 4:17) should be repaired within two (2) years. The fracture at Station 574+00 (DJI_0373.MP4, 4:17) should be repaired within two (2) years. The missing gunite with reinforcement projecting/corroded and suspected hole at Station 531+85 (DJI_0360.MP4, 3:20) should be repaired within one (1) year. Existing reinforcement should be assessed and renewed if required. In addition, overgrown or fallen vegetation should be removed seasonally. Cracks and fractures throughout this bench should be monitored and patched as necessary on an annual basis until this bench section has been replaced.
Twin Oaks Bench	5,135	4/20/21	DJI_0302.MP4 – DJI_0337.MP4	2	The missing gunite with reinforcement projecting/corroded at ~Station 687+15 (DJI_0322.MP4, 1:47) should be repaired within two (2) years by applying patch material. Existing reinforcement should be assessed and renewed if required. The fractures at ~Station 703+15 (DJI_0316.MP4, 0:11) should be repaired within two (2) years. In addition, overgrown or fallen vegetation should be removed seasonally. Cracks and fractures throughout this bench should be monitored and patched as necessary on an annual basis until this bench section has been replaced.

Table 4-1 Repair Recommendations Summary

Flume Bench Section	Approximate Length (LF)	Inspection Date	Video Files	Repair Timeframe* (yrs)	Repair Recommendations
MW Bench	2,173	4/20/21	DJI_0271.MP4 – DJI_0301.MP4	Annually	Remove overgrown or fallen vegetation seasonally. Cracks and fractures throughout this bench should be monitored and patched as necessary on an annual basis until this bench section has been replaced.

Total Approximate Length (LF) 30,305
Defect locations are identified with Stationing numbers stenciled on flume as well as video name and time in the video where defect is observed
**Repair timeframe is based on external visual inspection results only. Interior condition and any repairs needed are unknown.*

Section 5

Prioritization and Replacement

Prioritization and replacement of the bench sections were developed from visual inspection and defect identification of the exterior surfaces of the bench sections in conjunction with District input regarding historic repairs and issues. Prioritization and replacement recommendations do not account for defects that might be identified from an internal inspection. The recommended prioritization of the bench sections should be re-evaluated if additional internal inspections or testing are performed.

5.1 Remaining Useful Service Life

The service life of an asset is defined by the length of time that an asset is operating with minimal maintenance, no issues, minimal structural defects, and no leaks. The bench sections evaluated along the Vista Flume have numerous repaired sections, holes, staining, suspected leaks (exfiltration), require increased maintenance, and are no longer functioning as they were when newly constructed. The asset will continue to deliver water, but will be more costly to operate, less efficient, and has a higher risk of failure. The risk of failure will continue to increase as the asset degrades until replacement is performed. The typical design life for this type of asset is 50-75 years, while the actual age of this asset is 90+ years. Therefore, it has been determined that this asset is beyond its anticipated useful service life.

5.2 Bench Section Historical Condition and Maintenance

The District indicated that several bench sections have had and continue to have significant repairs to patch cracks, fractures, and holes. Reinforcement within the cover has corroded and caused multiple cracks that continue to degrade. Some areas of the flume have sedimentation buildup on the back of the flume due to stormwater deposition and clogged storm drains.

The worst condition bench is the Beehive bench due to the degrading reinforcement over the PVC arch within the cover section. The Borden and Twin Oaks benches are also in very poor condition due to recurring ongoing repairs to address the degrading reinforcement within the cover. With the reinforcement corroding away, the cover is separating from the walls and the convex arch is not being properly supported. This is causing multiple cracks and fractures, leading to the susceptibility of cover collapse. These repairs are no longer isolated point repairs and have become a frequent, widespread issue in these sections. The Borden bench has also experienced slope failure in the past, and on occasion has standing water behind the flume due to clogged storm drains adding additional risk of failure.

The Daley, Finkbinder, and MD benches are in poor condition due to reoccurring ongoing repairs for cracks and fractures, and failing gunite. The Daley bench has also experienced standing water behind the flume due to a clogged storm drain. The MD bench has had repairs to its Hypalon lining.

The Jack Creek, Tunnel, Kornhauser, and Pearson benches are in fair to poor condition with less frequent repairs for cracks and fractures.

The MW bench is in fair condition due to installation of an HDPE pipe inside the bench section as part of a flume replacement pilot project in 2010. The internal pipeline is expected to be in good

condition with only the exterior gunite covering requiring minimal maintenance at this stage. Over time the exterior gunite is expected to deteriorate and require increased maintenance and repairs.

5.3 Bench Section Replacement Prioritization

The replacement prioritization levels assigned in this section are based on the external inspections performed as part of this investigation and the District's knowledge of historical repairs and maintenance, and assumes the repairs recommended in this report will be performed in the timeframe recommended in Section 4. The following is the process used for establishing the replacement prioritizations:

1. A recordable issue/defect/observation was identified from the video and entered into the Observation Table.
2. An Observation Type was assigned to categorize the recorded entry.
3. The observation was then coded to define the details/severity of the recorded defect in accordance with PACP standards.
4. Results were presented to District's O&M staff and input was solicited and received.
5. Final prioritization was developed using condition assessment results and the District's input.

The prioritization levels assigned include: 1 (very poor), 2 (poor), 3 (fair to poor), and 4 (fair) conditions. Prioritization level 1 bench sections should be the first to be replaced, followed by prioritization level 2, 3, and lastly prioritization level 4.

The bench section replacement prioritization levels are summarized in Table 5-1 and shown on Figure 5-1 below:

Table 5-1 Replacement Prioritization

Flume Bench Section	Approximate Length (LF)	Prioritization Level*
Jack Creek Bench	394	3
Tunnel Bench	3,750	3
Daley Bench	3,241	2
Kornhauser Bench	1,321	3
Finkbinder Bench	3,888	2
MD Bench	3,290	2
Pearson Bench	371	3
Beehive Bench	477	1
Borden Bench	6,265	1
Twin Oaks Bench	5,135	1
MW Bench	2,173	4

**Prioritization Level*
1 = Very Poor
2 = Poor
3 = Fair to Poor
4 = Fair

Due to this inspection being limited to aerial drone footage with no internal inspection data or structural analysis of the existing bench sections, the prioritization levels are subject to change as additional inspection data is acquired during future inspection efforts.

Further inspections, such as an internal condition assessment, may change the prioritization of bench sections or identify other issues that require the replacement timeframe to be accelerated. Evaluation of the Flume's replacement for criticality, construction sequencing and phasing, bypass considerations, public disruption, and capital budgeting for this project may also change the

order/sequence of bench section replacement. These aspects will be considered further during the Coarse and Fine Screening phases of the Flume Replacement Alignment Study.

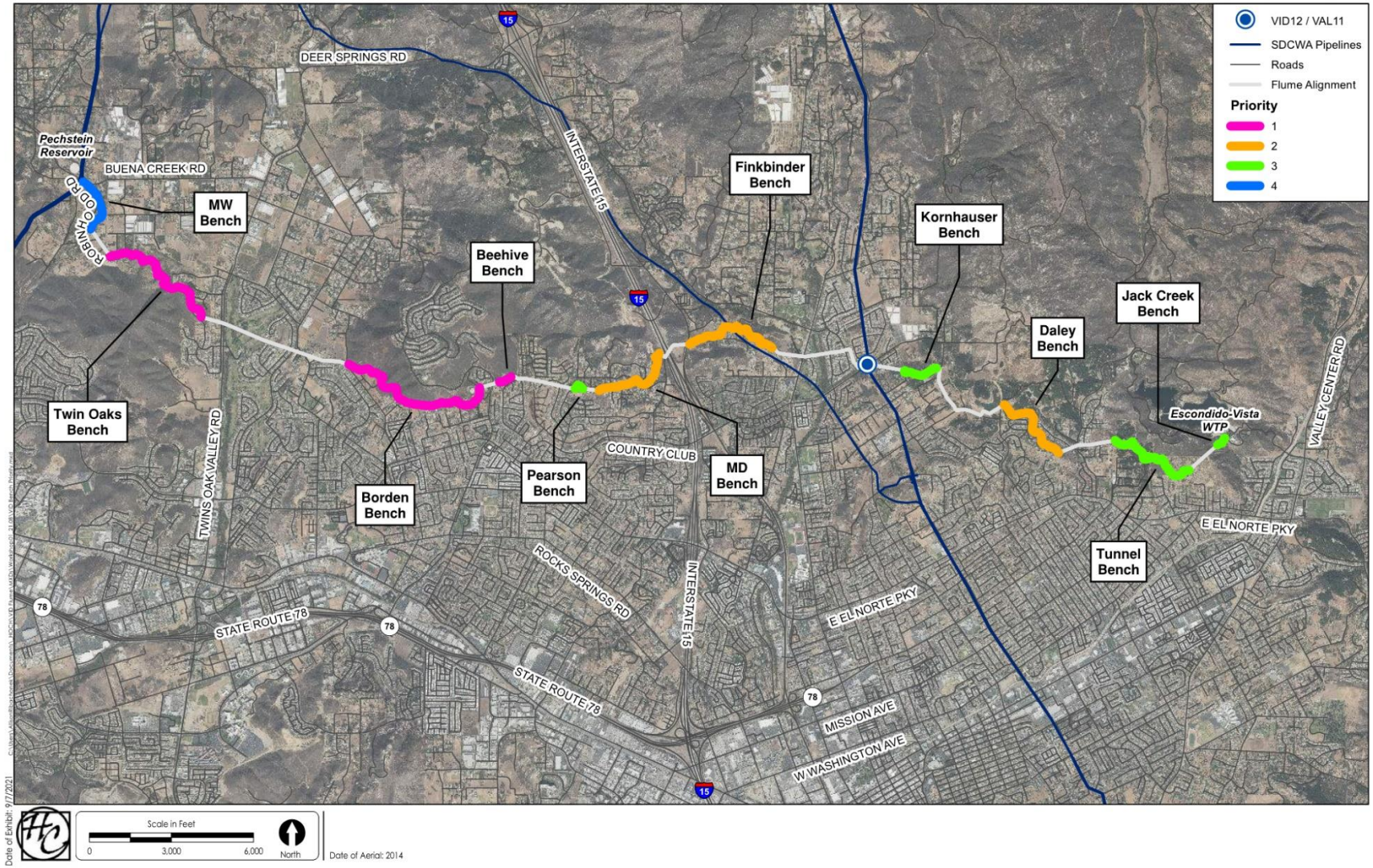

Figure 5-1: Bench Section Replacement Prioritization

Section 6

Limitations

This document was prepared solely for Vista Irrigation District in accordance with professional standards at the time the services were performed and in accordance with the contract between Vista Irrigation District and Brown and Caldwell dated February 17, 2021. This document is governed by the specific scope of work authorized by Vista Irrigation District; it is not intended to be relied upon by any other party except for regulatory authorities contemplated by the scope of work. We have relied on information or instructions provided by Vista Irrigation District and other parties and, unless otherwise expressly indicated, have made no independent investigation as to the validity, completeness, or accuracy of such information.

Appendix A: Defect Coding Summary

LEGEND

Code/Abbreviation	Definition
A	Access
AOC	Access Other Structure
CM	Cracks Multiple
D (Direction)	Downstream
D (Observation Type)	Defect
Dir	Direction *(refers to drone's flight path)*
FL	Fracture Longitudinal
FM	Fractures Multiple
HVV	Hole Void Visible
L	Left *(side of flume facing downstream)*
MGO	Miscellaneous General Observation
O	Observation
Obs Type	Observation Type *(refers to either structural defect, operational defect, or general observation)*
R	Right *(side of flume facing downstream)*
RPRD	Repair Defective
SRP	Surface Damage Reinforcement Projecting
SRV	Surface Damage Reinforcement Visible
SSS	Surface Spalling
U	Upstream
OBI	Object Intruding through wall
IS	Infiltration Stain
STA	Stationing

Appendix A - Drone Inspection Raw Data

Flume Replacement Alignment Study

Vista Irrigation District

Notes:

1) The relative side is based on a standardized inspection orientation, which is facing downstream along the flume.

2) Refers to direction of drone's flight path, which is independent of the inspection orientation.

3) Relative to standardized inspection orientation facing downstream. "Clock 1" refers to orientation at start of defect. "Clock 2" refers to orientation at end of defect.

	Video	Date	Bench	Side(1)	Dir(2)	Time	Sta	Obs Type	Code	Component	Clock 1(3)	Clock 2(3)	Note	Defect summary
1	DJI_0271.MP4	4/20/21	MW	L	U	0:00	738+74	A	AOC				Access point	
						3:21		D	CC	Cap	12	3	Patched, Continuing	
						5:00		O	MGO				End of video	Cracks, patches and stains
2	DJI_0272.MP4	4/20/21	MW	L	U	0:00		O	MGO				Continuation video	
						0:00		D	CC	Cap	12	3	Patched, Continuing	
						3:43		D	CM	Cap	12	3	Cracks without patches	
						4:37	734+48	O	MGO	Cap			STA stencil	
						4:58	734+48	A	AOC				Access point	
						5:00		O	MGO				End of video	Cracks, patches and stains
3	DJI_0273.MP4	4/20/21	MW	L	U	0:00	734+48	A	AOC				Access point	
						0:00		O	MGO				Continuation video	
						0:00		D	CC	Cap	12	3	Patched, Continuing	
						1:54		D	CL	Wall	4			
						2:46		D	CM	Cap	12	3		
						3:56		D	CM	Cap	12	3		
						4:43	731+23	O	MGO				STA stencil	
						4:55	731+23	A	AOC				Access point	
						5:00		O	MGO				End of video	Multiple cracks in cap and stains on wall
4	DJI_0274.MP4	4/20/21	MW	L	U	0:00	731+26	O	MGO				Continuation video	
						0:00		D	CC	Cap	12	3	Continuing	
						2:27		D	CC	Cap	12	3		
						4:13	728+45	O	MGO				STA stencil	
						5:00		O	MGO				End of video	Cracks, patches and stains
5	DJI_0275.MP4	4/20/21	MW	L	U	0:00		O	MGO				Continuation video	
						0:00		D	CC	Cap	12	3	Continuing	
						0:06		D	CL	Cap	2		Continuing	
						0:23		D	CL	Cap	2		End	
						0:56		O	MGO				727+? Patch covering stencil	
						1:07		O	MGO				End of video	Cracks, patches and stains
6	DJI_0276.MP4	4/20/21	MW	L	U	0:00	727+?	O	MGO				Continuation video	
						0:00		D	CC	Cap	12	3	Continuing	
						2:00	727+00	A	AOC				Access Hatch	
						2:31	727+00	O	MGO				STA stencil	
						2:59		A	AOC				Access Hatch	
						4:21		O	MGO				Walking bridge crossing line	
						5:00		O	MGO				End of video	No significant defects
7	DJI_0277.MP4	4/20/21	MW	L	U	0:00		O	MGO				Continuation video	
						0:00		D	SRI	All	12	4	Continuing	
						0:11		O	MGO				Vegetation overgrowth	
						1:55	723+55	O	MGO				STA stencil	
						2:22		D	IS	Wall	3	4	Stains	
						2:56	722+43	O	MGO	Wall	5		Restraining lag bolts	
						4:37		D	CC	Cap	1	3		
						5:01		O	MGO				End of video	Lag bolts, vegetation overgrowth, cracks and stains
8	DJI_0278.MP4	4/20/21	MW	L	U	0:00		O	MGO				Continuation video	
						0:29	721+42	O	MGO				STA stencil	
						0:29	721+42	A	AOC				Access point	
						1:21		D	CC	Cap	12	3	Patched, Continuing	
						1:44		O	MGO				Vegetation overgrowth	
						3:31		D	SS	Wall	3	4	Missing Gunite	
						5:00		O	MGO				End of video	Vegetation, spalling, cracks and stains
9	DJI_0279.MP4	4/20/21	MW	L	U	0:00		O	MGO				Continuation video	
						1:06		D	IS	Wall	4		Stains - continuing	
						1:28		D	IS	Wall	4		End	
						2:16	716+98	O	MGO				STA stencil	
						2:37	716+98	A	AOC				Air vac valve	
						2:53	716+98	O	AEP				End of Section	
						4:58		O	MGO				End of US inspection	Stains on wall
10	DJI_0280.MP4	4/20/21	MW	R	D	0:00	716+98	O	MGO				Start of DS inspection	
						0:32		D	CM	Wall	3	4		
						5:00		O	MGO				End of video	Multiple cracks in cap and stains on wall
11	DJI_0281.MP4	4/20/21	MW	R	D	0:00		O	MGO				Continuation video	
						2:08		D	CL	Wall	4			
						2:35		D	CM	Cap	1	3		

Brown AND Caldwell

Appendix A - Drone Inspection Raw Data

Flume Replacement Alignment Study

Vista Irrigation District

Notes:

1) The relative side is based on a standardized inspection orientation, which is facing downstream along the flume.

2) Refers to direction of drone's flight path, which is independent of the inspection orientation.

3) Relative to standardized inspection orientation facing downstream. "Clock 1" refers to orientation at start of defect. "Clock 2" refers to orientation at end of defect.

	Video	Date	Bench	Side(1)	Dir(2)	Time	Sta	Obs Type	Code	Component	Clock 1(3)	Clock 2(3)	Note	Defect summary
						3:03	717+22	D	FL	Wall	4		Fractures and missing Gunite	
						4:42		A	AOC				Access point	
						5:00		O	MGO				End of video	Fracture, cracks and stains
12	DJI_0282.MP4	4/20/21	MW	R	D	0:00		O	MGO				Continuation video	
						1:07		D	CM	Cap	9	10		
						1:07		D	CL	Wall	9			
						1:28		D	SS	Wall	8		Missing Gunite	
						2:52		D	SS	Wall	8		Missing Gunite	
						3:16		D	CM	Wall	7	9		
						4:50		O	MGO				Vegetation overgrowth	
						4:50		O	MGO				Pedestrian bridge	
						5:00		O	MGO				End of video	Vegetation overgrowth, cracks and stains
13	DJI_0283.MP4	4/20/21	MW	R	D	0:00		O	MGO				Continuation video	
						1:20		D	SS	Wall	8		Missing Gunite	
						2:01		D	SS	Wall	8		Missing Gunite	
						2:13		A	AOC				Access structure	
						3:24		A	AOC				Access structure	
						3:55		D	CC	Cap	9	12		
						5:00		O	MGO				End of video	Missing Gunite on wall and cracks in cap
14	DJI_0284.MP4	4/20/21	MW	R	D	0:00		O	MGO				Continuation video	
						0:15		D	CL	Wall	8			
						2:09		O	MGO				End of video	Cracks and stains
15	DJI_0285.MP4	4/20/21	MW	R	D	0:00		O	MGO				Continuation video	
						2:16		D	CC	Wall	8	9		
						5:01		O	MGO				End of video	Cracks and stains
16	DJI_0286.MP4	4/20/21	MW	R	D	0:00		O	MGO				Continuation video	
						2:44		A	AOC				Access cover	
						2:52		D	CM	Wall				
						5:00		O	MGO				End of video	Cracks and stains
17	DJI_0287.MP4	4/20/21	MW	R	D	0:00		O	MGO				Continuation video	
						4:05		A	AOC				Access cover	
						5:00		O	MGO				End of video	No significant defects
18	DJI_0288.MP4	4/20/21	MW	R	D	0:00		O	MGO				Continuation video	
						3:42		D	CC	Cap	11	12	Continuing	
						4:09		D	CC	Cap	11	12	End	
						5:00		O	MGO				End of video	cracks in the cap and stains on the wall
19	DJI_0289.MP4	4/20/21	MW	R	D	0:00		O	MGO				Continuation video	
						0:42		A	AOC				Access Valve	
						0:53		O	MGO				End of DS inspection	No significant defects
20	DJI_0290.MP4	4/20/21	MW	O									Overview	
21	DJI_0291.MP4	4/20/21	MW	O									Overview	
22	DJI_0292.MP4	4/20/21	MW	O									Overview	
23	DJI_0293.MP4	4/20/21	MW	O									Overview	
24	DJI_0294.MP4	4/20/21	MW	O									Overview	
25	DJI_0295.MP4	4/20/21	MW	O									Overview	
26	DJI_0296.MP4	4/20/21	MW	O									Overview	
27	DJI_0297.MP4	4/20/21	MW	O									Overview	
28	DJI_0298.MP4	4/20/21	MW	O									Overview	
29	DJI_0299.MP4	4/20/21	MW	O									Overview	
30	DJI_0300.MP4	4/20/21	MW	O									Overview	
31	DJI_0301.MP4	4/20/21	MW	O									Overview	
32	DJI_0302.MP4	4/20/21	Twin Oaks	R	D	0:00	651+50	O	MGO				Start of downstream inspection	
						0:00	651+50	A	AOC				Hatched access structure	
						1:06		A	AOC				Access structure	
						3:08		D	CC	Cap	12	3	Patched	
						5:01		O	MGO				End of video	Cracks in the cap and stains on the wall
33	DJI_0303.MP4	4/20/21	Twin Oaks	R	D	0:00		O	MGO				Continuation video	
						2:35		D	CM	Cap	1	2	Patched	
						3:43		A	AOC				Hatched access structure	
						3:47	656+25	O	MGO	Cap			STA stencil	
						4:10	656+65	O	MGO	Cap			STA stencil	
						5:00		O	MGO				End of video	Cracks in the cap and stains on the wall
34	DJI_0304.MP4	4/20/21	Twin Oaks	R	D	0:00		O	MGO				Continuation video	
						0:31		D	CM	Cap	12	3	Patched-Continuing	

Appendix A - Drone Inspection Raw Data

Flume Replacement Alignment Study

Vista Irrigation District

Notes:

1) The relative side is based on a standardized inspection orientation, which is facing downstream along the flume.

2) Refers to direction of drone's flight path, which is independent of the inspection orientation.

3) Relative to standardized inspection orientation facing downstream. "Clock 1" refers to orientation at start of defect. "Clock 2" refers to orientation at end of defect.

	Video	Date	Bench	Side(1)	Dir(2)	Time	Sta	Obs Type	Code	Component	Clock 1(3)	Clock 2(3)	Note	Defect summary
						4:08		D	CM	Cap	12	3	End	
						4:11	661+75	A	AOC				Access lid	
						4:11	661+75	O	MGO				STA stencil	
						5:00		O	MGO				End of video	Cracks in the cap and stains on the wall
35	DJI_0305.MP4	4/20/21	Twin Oaks	R	D	0:00		O	MGO				Continuation video	
						0:14		D	IS	Wall	4	5		
						1:53		D	CL	Wall	4		Continuing	
						3:05	664+90	O	MGO				STA stencil	
						4:32	666+12	A	AOC				Access lid	
						4:32	666+12	O	MGO				STA stencil	
						5:00		O	MGO				End of video	No significant defects
36	DJI_0306.MP4	4/20/21	Twin Oaks	R	D	0:00		O	MGO				Continuation video	
						0:17		D	CM	Wall	3	5		
						1:53		D	SS	Wall	5			
						2:33		O	MGO				End of video	Missing Gunite on wall and cracks in cap
37	DJI_0307.MP4	4/20/21	Twin Oaks	R	D	0:00		O	MGO				Continuation video	
						1:33	669+77	O	MGO				STA stencil	
						1:35		D	CL	Wall	5			
						2:34	670+65	A	AOC				Access lid	
						2:34	670+65	O	MGO				STA stencil	
						3:10		O	MGO				PVC Pipe	
						5:00		O	MGO				End of video	Cracks in cap and stains on wall
38	DJI_0308.MP4	4/20/21	Twin Oaks	R	D	0:00		O	MGO				Continuation video	
						1:02		D	IS	Wall	4	5		
						1:08	673+45	O	MGO				STA stencil	
						1:08	673+45	D	CL	Wall	4			
						3:47		D	FM	Wall	5		Excess Gunite	
						3:47		A	AOC				Hatched lid	
						3:54	675+70	O	MGO				STA stencil	
						5:00		O	MGO				End of video	Fracture in Gunite on wall, patches, stains
39	DJI_0309.MP4	4/20/21	Twin Oaks	R	D	0:00		O	MGO				Continuation video	
						0:38		D		Cap	12	3	Corrosion stains-Continuing	
						1:46		D	SRP	Cap/Wall	3		Reinforcement projecting/Corroded	
						3:59	679+25	O	MGO				STA stencil	
						3:59	679+25	A	AOC				Access lid	
						5:00		O					End of video	Stains on wall throughout. Cracks in cap. Reinforcement projecting and corroded. Patched cracks
40	DJI_0310.MP4	4/20/21	Twin Oaks	R	D	0:00		O	MGO				Continuation video	
						3:41	683+84	O	MGO				STA stencil	
						3:41	683+84	A	AOC				Access cover	
						5:00		O					End of video	Exfiltration stains on wall throughout. Cracks in cap. Patched cracks and spot repairs
41	DJI_0311.MP4	4/20/21	Twin Oaks	R	D	0:00		O	MGO				Continuation video	
						1:49		O					End of video	Exfiltration stains on wall. Some Cracks in cap. Patched cracks
42	DJI_0312.MP4	4/20/21	Twin Oaks	R	D	0:00		O	MGO				Continuation video	
						1:49	688+35	O	MGO				STA stencil	
						1:49	688+35	A	AOC				Access Hatch	
						2:51	689+25	O	MGO				STA stencil	
						2:58		D	RFB				Weeds growing on cap	
						5:00		O					End of video	Exfiltration stains on wall. Some Cracks in cap. Small cracks, weed growing on cap
43	DJI_0313.MP4	4/20/21	Twin Oaks	R	D	0:00		O	MGO				Continuation video	
						4:32	693+80	O	MGO				STA stencil	
						4:32	693+80	A	AOC				Access lid	
						5:00		O					End of video	Exfiltration stains on wall throughout. Cracks in cap. Patched cracks
44	DJI_0314.MP4	4/20/21	Twin Oaks	R	D	0:00		O	MGO				Continuation video	
						2:42		O	MGO				Crossing	
						3:10	697+50	A	AOC				Access lid	
						3:10	697+50	O	MGO				STA stencil	
						5:00		O					End of video	Exfiltration stains on wall throughout. Cracks in cap. Patched cracks and spot repairs
45	DJI_0315.MP4	4/20/21	Twin Oaks	R	D	0:00		O	MGO				Continuation video	
						1:32		D	RPPD	Wall				
						3:34	703+15	O	MGO				STA stencil	

Brown AND Caldwell

Appendix A - Drone Inspection Raw Data

Flume Replacement Alignment Study

Vista Irrigation District

Notes:

1) The relative side is based on a standardized inspection orientation, which is facing downstream along the flume.

2) Refers to direction of drone's flight path, which is independent of the inspection orientation.

3) Relative to standardized inspection orientation facing downstream. "Clock 1" refers to orientation at start of defect. "Clock 2" refers to orientation at end of defect.

	Video	Date	Bench	Side(1)	Dir(2)	Time	Sta	Obs Type	Code	Component	Clock 1(3)	Clock 2(3)	Note	Defect summary
						3:44	703+15	A	AOC				Access hatch	
						5:00	703+15	O	MGO				End of video end of segment	Broken repair, stains on wall, Patches and cracks
46	DJI_0316.MP4	4/20/21	Twin Oaks	L	U	0:00	703+15	O	MGO				Start of left side upstream	
						0:11	703+15	D	FL	Wall	4		Fractures	
						0:55	703+15	O	MGO				End of video	
47	DJI_0317.MP4	4/20/21	Twin Oaks	L	U	0:00	703+15	O	MGO				Start of left side upstream	
						3:03		D	FL	Cap	3			
						5:00		O					End of video	Fracture in the cap and exfiltration stains on wall throughout.
48	DJI_0318.MP4	4/20/21	Twin Oaks	L	U	0:00		O	MGO				Continuation video	
						5:00		O	MGO				End of video	Cracks in cap and stains on wall
49	DJI_0319.MP4	4/20/21	Twin Oaks	L	U	0:00		O	MGO				Continuation video	
						1:21	697+50	A	AOC				Access lid	
						5:00		O					End of video	Cracks in cap and stains on wall
50	DJI_0320.MP4	4/20/21	Twin Oaks	L	U	0:00		O	MGO				Continuation video	
						3:10		A	AOC				Access lid	
						5:00		O	MGO				End of video	Cracks in cap and stains on wall
51	DJI_0321.MP4	4/20/21	Twin Oaks	L	U	0:00		O	MGO				Continuation video	
						3:01		O	MGO				End of video	Cracks in cap and stains on wall
52	DJI_0322.MP4	4/20/21	Twin Oaks	L	U	0:00	689+00	O	MGO				Continuation video	
						1:47	687+15	D	SRP	Wall			Missing Gunite and reinforcement projecting/Corroded	
						5:00		O					End of video	Missing Gunite with projecting corroded reinforcement
53	DJI_0323.MP4	4/20/21	Twin Oaks	L	U	0:00		O	MGO				Continuation video	
						5:00		O	MGO				End of video	Stains on wall
54	DJI_0324.MP4	4/20/21	Twin Oaks	L	U	0:00		O	MGO				Continuation video	
						5:00		O	MGO				End of video	Stains on wall
55	DJI_0325.MP4	4/20/21	Twin Oaks	L	U	0:00		O	MGO				Continuation video	
						0:56		A	AOC				Access lid	
						5:00		O	MGO				End of video	Stains on wall
56	DJI_0326.MP4	4/20/21	Twin Oaks	L	U	0:00		O	MGO				Continuation video	
						2:28		O	MGO				End of video	Stains on wall
57	DJI_0327.MP4	4/20/21	Twin Oaks	L	U	0:00	679+25	O	MGO				Continuation video	
						1:00		A	AOC				Access lid	
						1:49		D	RPPD				With weeds growing at edges of patch	
						5:00		O	MGO				End of video	Stains on wall and defective repair patch
58	DJI_0328.MP4	4/20/21	Twin Oaks	L	U	0:00		O	MGO				Continuation video	
						2:20		A	AOC				Hatch	
						5:00		O	MGO				End of video	Stains on wall and repair patches on cap
59	DJI_0329.MP4	4/20/21	Twin Oaks	L	U	0:00		O	MGO				Continuation video	
						0:13		O	MGO				Vegetation overgrowth	
						5:00		D	SSS	Cap	12		with cracks	
						5:00		O	MGO				End of video	Vegetation, spalling, cracks and stains
60	DJI_0330.MP4	4/20/21	Twin Oaks	L	U	0:00		O	MGO				Continuation video	
						2:52		D	SRC	Wall	3	4	Missing Gunite reinforcement projecting/corroded	
						5:00		O	MGO				End of video	Missing Gunite with reinforcement projecting/corroded. Cracks in cap and stains on wall
61	DJI_0331.MP4	4/20/21	Twin Oaks	L	U	0:00		O	MGO				Continuation video	
						2:59		O	MGO				End of video	Stains on wall
62	DJI_0332.MP4	4/20/21	Twin Oaks	L	U	0:00		O	MGO				Continuation video	
						0:27		A	AOC				Access lid	
						5:00		O	MGO				End of video	Cracks in cap and stains on wall
63	DJI_0333.MP4	4/20/21	Twin Oaks	L	U	0:00		O	MGO				Continuation video	
						0:31		A	AOC				Access lid	
						1:24		D	CM	Cap	10	11		
						5:00		O	MGO				End of video	Cracks in cap and stains on wall
64	DJI_0334.MP4	4/20/21	Twin Oaks	L	U	0:00		O	MGO				Continuation video	
						2:51		O	MGO				End of video	No significant defects
65	DJI_0335.MP4	4/20/21	Twin Oaks	L	U	0:00		O	MGO				Continuation video	
						1:09		A	AOC				Hatch	
						5:00		O	MGO				End of video	Cracks in cap and stains on wall
66	DJI_0336.MP4	4/20/21	Twin Oaks	L	U	0:00		O	MGO				Continuation video	
						2:38		A	AOC				Hatch	
						3:45		A	AOC				Upstream structure	
						4:10		O	MGO				End of video	Cracks in cap and stains on wall
67	DJI_0337.MP4	4/20/21	Twin Oaks	L	U	0:00		O	MGO				Continuation video	

Appendix A - Drone Inspection Raw Data

Flume Replacement Alignment Study

Vista Irrigation District

Notes:

1) The relative side is based on a standardized inspection orientation, which is facing downstream along the flume.

2) Refers to direction of drone's flight path, which is independent of the inspection orientation.

3) Relative to standardized inspection orientation facing downstream. "Clock 1" refers to orientation at start of defect. "Clock 2" refers to orientation at end of defect.

	Video	Date	Bench	Side(1)	Dir(2)	Time	Sta	Obs Type	Code	Component	Clock 1(3)	Clock 2(3)	Note	Defect summary
						1:07		O	MGO				End of video	Upstream structure
68	DJI_0338.MP4	4/20/21	Beehive	L	U	0:00	519+02	O	MGO				Start of Beehive Bench	
						0:00	519+02	A	AOC				Downstream structure	
						2:57	520+95	D	SRP	Wall	8	9	Missing Gunite with reinforcement projecting /corroded and possible hole	
						3:30		D	SRP	Wall	8		Missing Gunite reinforcement projecting/corroded	
						4:48		A	AOC				Access lid	
						5:00		O	MGO				End of video	Missing Gunite, reinforcement projecting/corroded, possible hole, patches, cracks and stains
69	DJI_0339.MP4	4/20/21	Beehive	L	U	0:00		O	MGO				Continuation video	
						0:56	521+44	D	SSS	Wall	7	8	Failed patch	
						1:28		D	SSS	Wall	8		Missing Gunite	
						2:33	523+50	A	AOC				Upstream structure	
						3:43		O	MGO				Start of DS inspection	
						5:00		O	MGO				End of video	Missing Gunite with reinforcement projecting/corroded, cracks and stains
70	DJI_0340.MP4	4/20/21	Beehive	R	D	0:00		O	MGO				Continuation video	
						1:24		D	CL	Cap	10			
						2:52	521+00	A	AOC				Access lid	
						5:00		O	MGO				End of video	Cracks and patches
71	DJI_0341.MP4	4/20/21	Beehive	R	D	0:00		O	MGO				Continuation video	
						0:40		D	CL	Wall	9			
						1:18	519+02	O	MGO				STA stencil	
						2:19	519+02	A	AOC				Downstream structure	
						3:25		O	MGO				End of video	Cracks in cap and wall
72	DJI_0342.MP4												Perspective	
73	DJI_0343.MP4												Perspective	
74	DJI_0344.MP4	4/20/21	Pearson	L	D								Drone is on ground no movement	
75	DJI_0345.MP4	4/20/21	Pearson	L	D	0:00	491+35	O	MGO				Start of downstream inspection	
						0:36	491+35	A	AOC				Upstream structure	
						5:00		O	MGO				End of video	Surface roughness, 1 patch
76	DJI_0346.MP4	4/20/21	Pearson	L	D	0:00		O	MGO				Continuation video	
						3:03	494+75	D					Vegetation overgrowth	
						3:18	494+90	O	MGO				STA stencil	
						3:25	494+90	A	AOC				Downstream structure	
						5:00		O	MGO				End of video	Vegetation overgrowth and patches
77	DJI_0347.MP4	4/20/21	Pearson	L	D								11 second video to end downstream inspection	
78	DJI_0348.MP4	4/20/21	Pearson	R	U	0:00	494+90	O	MGO				Start of upstream inspection	
						2:35		O	MGO				Structural support	
						3:33		O	MGO				Structural support	
						5:00		O	MGO				End of video	Stains, patches and discolored areas
79	DJI_0349.MP4	4/20/21	Pearson	R	U	0:00		O	MGO				Continuation video	
						2:45	491+35	O	MGO				STA stencil	
						3:18	491+35	A	AOC				Upstream structure	
						3:54	491+35	O	MGO				End of upstream inspection	No significant defects
80	DJI_0350.MP4	4/20/21	Pearson										Perspective	
81	DJI_0351.MP4	4/20/21	Pearson										Perspective	
82	DJI_0352.MP4	4/21/21	Borden										Overview	
83	DJI_0353.MP4	4/21/21	Borden										Overview	
84	DJI_0354.MP4	4/21/21	Borden										Overview	
85	DJI_0355.MP4	4/21/21	Borden										Overview	
86	DJI_0356.MP4	4/21/21	Borden										Overview	
87	DJI_0357.MP4	4/21/21	Borden										Overview	
88	DJI_0358.MP4	4/21/21	Borden										Overview	
89	DJI_0359.MP4	4/21/21	Borden										Overview	
90	DJI_0360.MP4	4/21/21	Borden	R	D	0:00	531+50	A	AOC				Start of downstream inspection	
						1:43		D	SRP	Cap			Missing Gunite with reinforcement projecting/corroded	
						2:02	531+78	D	SRP	Cap			Missing Gunite with reinforcement projecting/corroded	
						3:20		D	SRP	Cap			Missing Gunite with reinforcement projecting/corroded	
						4:16		O	MGO				Road overcrossing	
						5:00		O	MGO				End of video	Multiple locations with missing Gunite and reinforcement projecting/corroded
91	DJI_0361.MP4	4/21/21	Borden	R	D	0:00		O	MGO				Continuation video	
						5:00		O	MGO				End of video	Patches on cap and stains on wall
92	DJI_0362.MP4	4/21/21	Borden	R	D	0:00		O	MGO				Continuation video	

Appendix A - Drone Inspection Raw Data

Flume Replacement Alignment Study

Vista Irrigation District

Notes:

1) The relative side is based on a standardized inspection orientation, which is facing downstream along the flume.

2) Refers to direction of drone's flight path, which is independent of the inspection orientation.

3) Relative to standardized inspection orientation facing downstream. "Clock 1" refers to orientation at start of defect. "Clock 2" refers to orientation at end of defect.

	Video	Date	Bench	Side(1)	Dir(2)	Time	Sta	Obs Type	Code	Component	Clock 1(3)	Clock 2(3)	Note	Defect summary
						0:56		A	AOC				Access lid	
						5:00		O	MGO				End of video	Patches on cap and stains on wall
93	DJI_0363.MP4	4/21/21	Borden	R	D	0:00		O	MGO				Continuation video	
						1:46		A	AOC				Access lid	
						5:00		O	MGO				End of video	Patches on cap and stains on wall
94	DJI_0364.MP4	4/21/21	Borden	R	D	0:00		O	MGO				Continuation video	
						0:39		O	MGO				End of video	Short video stains on wall
95	DJI_0365.MP4	4/21/21	Borden	R	D	0:00		O	MGO				Continuation video	
						2:41		O	MGO				End of video	Drone does not move picture out of focus
96	DJI_0367.MP4	4/21/21	Borden	R	D	0:00		O	MGO				Continuation video	
						3:41		A	AOC				Access lid	
						5:00		O	MGO				End of video	Spalling on wall and corrosion stains
97	DJI_0368.MP4	4/21/21	Borden	R	D	0:00		O	MGO				Continuation video	
						5:00		O	MGO				End of video	Patches on cap and stains on wall
98	DJI_0369.MP4	4/21/21	Borden	R	D	0:00		O	MGO				Continuation video	
						0:27		A	AOC				Access lid	
						3:21		O	MGO				Soil erosion	
						5:00		O	MGO				End of video	Spalling on wall and corrosion stains. Erosion of surrounding soil
99	DJI_0370.MP4	4/21/21	Borden	R	D	0:00		O	MGO				Continuation video	
						3:54		A	AOC				Hatched access	
						5:00		O	MGO				End of video	Patches on cap and stains on wall
100	DJI_0371.MP4	4/21/21	Borden	R	D	0:00		O	MGO				Continuation video	10 second video
101	DJI_0372.MP4	4/21/21	Borden	R	D	0:00		O	MGO				Continuation video	
						2:34		A	AOC				Access lid	
						5:00		O	MGO				End of video	Patches on cap and stains on wall
102	DJI_0373.MP4	4/21/21	Borden	R	D	0:00		O	MGO				Continuation video	
						4:17	561+20	D	SRV	Cap	1	3	Missing Gunite reinforcement projecting/corroded	
						5:00		O	MGO				End of video	Missing Gunite with reinforcement projecting/corroded
103	DJI_0374.MP4	4/21/21	Borden	R	D	0:00		O	MGO				Continuation video	
						5:00		O	MGO				End of video	Patches on cap and stains on wall
104	DJI_0375.MP4	4/21/21	Borden	R	D	0:00		O	MGO				Continuation video	
						2:47		A	AOC				Square hatch	
						5:00		O	MGO				End of video	Patches on cap and stains on wall
105	DJI_0375.MP4	4/21/21	Borden	R	D	0:00		O	MGO				Continuation video	
						5:00		O	MGO				End of video	Patches on cap and stains on wall
106	DJI_0376.MP4	4/21/21	Borden	R	D	0:00		O	MGO				Continuation video	10 second video
107	DJI_0377.MP4	4/21/21	Borden	R	D	0:00		O	MGO				Continuation video	
						2:54		A	AOC				Access lid	
						5:00		O	MGO				End of video	Patches on cap and stains on wall
108	DJI_0378.MP4	4/21/21	Borden	R	D	0:00		O	MGO				Continuation video	
						0:02		D	SSS				Patch is broken and some patch material missing	
						2:21		O	MGO				Wooden support	
						3:51		d	FL	Wall	4		Fracture	
						5:00		O	MGO				End of video	Fracture between cap and wall, broken patch
109	DJI_0379.MP4	4/21/21	Borden	R	D	0:00		O	MGO				Continuation video	
						0:29		A	AOC				Access lid	
						0:35		O	MGO				Soil erosion	
						1:35		O	MGO				End of video	Patches on cap and stains on wall
110	DJI_0380.MP4	4/21/21	Borden	R	D	0:00		O	MGO				Continuation video	
						5:00		O	MGO				End of video	Patches on cap and stains on wall
111	DJI_0381.MP4	4/21/21	Borden	R	D	0:00		O	MGO				Continuation video	
						0:23		A	AOC				Access lid	
						3:59		O	MGO				End of video	Patches on cap and stains on wall
112	DJI_0382.MP4	4/21/21	Borden	R	D	0:00		O	MGO				Continuation video	
						3:57		A	AOC				Square access hatch	
						5:00		O	MGO				End of video	Patches on cap and stains on wall
113	DJI_0383.MP4	4/21/21	Borden	R	D	0:00		O	MGO				Continuation video	
						3:32		O	MGO				Fallen tree	
						5:00		O	MGO				End of video	Patches on cap and stains on wall
114	DJI_0384.MP4	4/21/21	Borden	R	D	0:00		O	MGO				Continuation video	
						0:23		A	AOC				Access lid	
						4:37		A	AOC				Access lid	
						5:00		O	MGO				End of video	Patches on cap and stains on wall
115	DJI_0385.MP4	4/21/21	Borden	R	D	0:00		O	MGO				Continuation video	

Appendix A - Drone Inspection Raw Data

Flume Replacement Alignment Study

Vista Irrigation District

Notes:

1) The relative side is based on a standardized inspection orientation, which is facing downstream along the flume.

2) Refers to direction of drone's flight path, which is independent of the inspection orientation.

3) Relative to standardized inspection orientation facing downstream. "Clock 1" refers to orientation at start of defect. "Clock 2" refers to orientation at end of defect.

	Video	Date	Bench	Side(1)	Dir(2)	Time	Sta	Obs Type	Code	Component	Clock 1(3)	Clock 2(3)	Note	Defect summary
						4:50		A	AOC				Square Hatch	
						5:00		O	MGO				End of video	Patches on cap and stains on wall
116	DJI_0386.MP4	4/21/21	Borden	R	D	0:00		O	MGO				Continuation video	
						0:15		A	AOC				Upstream structure	
						0:27		O	MGO				End of video	Corrosion stains from frame
117	DJI_0387.MP4	4/21/21	Borden	L	U	0:00	594+12	O	MGO				Start of left side upstream	
						1:56	594+12	A	AOC				Square access hatch	
						2:25	594+12	O	MGO				STA stencil	
						4:43	591+13	A	AOC				Access lid	
						4:43	591+13	O	MGO				STA stencil	
						5:00		O	MGO				End of video	Patches on cap and wall
118	DJI_0388.MP4	4/21/21	Borden	L	U	0:00		O	MGO				Continuation video	
						2:46	587+90	A	AOC				Access lid	
						2:46	587+90	O	MGO				STA stencil	
						5:00		O	MGO				End of video	Patches on cap and stains on wall
119	DJI_0389.MP4	4/21/21	Borden	L	U	0:00		O	MGO				Continuation video	
						0:47	583+95	A	AOC				Square access hatch	
						0:54	583+95	O	MGO				STA stencil	
						1:57	583+00	O	MGO				STA stencil	
						4:33	579+50	A	AOC				Access lid	
						4:35	579+50	O	MGO				STA stencil	
						5:00		O	MGO				End of video	Patches on cap and wall
120	DJI_0390.MP4	4/21/21	Borden	L	U	0:00		O	MGO				Continuation video	
						2:35		A	AOC				Access lid	
						2:35		O	MGO				STA stencil	
						5:00		O	MGO				End of video	Patches on cap and wall
121	DJI_0391.MP4	4/21/21	Borden	L	U	0:00		O	MGO				Continuation video	
						0:59		O	MGO				STA stencil	
						1:24	570+00	A	AOC				Access lid	
						1:25	570+00	O	MGO				STA stencil	
						1:36		O	MGO				End of video	Patches on cap and wall
122	DJI_0392.MP4	4/21/21	Borden	L	U	0:00		O	MGO				Continuation video	
						2:44	564+74	A	AOC				Square access hatch	
						2:49	566+74	O	MGO				STA stencil	
						4:35	566+02	O	MGO				STA stencil	
						5:00		O	MGO				End of video	Patches on cap and wall
123	DJI_0393.MP4	4/21/21	Borden	L	U	0:00		O	MGO				Continuation video	
						2:54	561+50	A	AOC				Access lid	
						2:54	561+50	O	MGO				STA stencil	
						3:41	560+55	O	MGO				STA stencil	
						5:01		O	MGO				End of video	Patches on cap and wall
124	DJI_0394.MP4	4/21/21	Borden	L	U	0:00		O	MGO				Continuation video	
						1:37	554+45	A	AOC				Access lid	
						1:37	554+45	O	MGO				STA stencil	
						3:38	554+45	A	AOC				Square access hatch	
						3:38	554+45	O	MGO				STA stencil	
						5:00		O	MGO				End of video	Patches on cap and wall
125	DJI_0395.MP4	4/21/21	Borden	L	U	0:00		O	MGO				Continuation video	
						0:40	552+05	O	MGO				STA stencil	
						1:29	550+86	O	MGO				STA stencil	
						3:11	594+00	A	AOC				Access lid	
						3:11	594+00	O	MGO				STA stencil	
						5:00		O	MGO				End of video	Patches on cap and wall
126	DJI_0396.MP4	4/21/21	Borden	L	U	0:00		O	MGO				Continuation video	
						1:18	544+47	A	AOC				Access lid	
						1:18	544+47	O	MGO				STA stencil	
						1:40		O	MGO				End of video	Patches on cap and wall
127	DJI_0397.MP4	4/21/21	Borden	L	U	0:00		O	MGO				Continuation video	
						4:15		A	AOC				Access lid	
						5:01		O	MGO				End of video	Patches on cap and wall
128	DJI_0398.MP4	4/21/21	Borden	L	U	0:00		O	MGO				Continuation video	
						2:29	535+58	A	AOC				Access lid	
						2:29	535+58	O	MGO				STA stencil	
						5:00		O	MGO				End of video	Patches on cap and wall

Appendix A - Drone Inspection Raw Data

Flume Replacement Alignment Study

Vista Irrigation District

Notes:

1) The relative side is based on a standardized inspection orientation, which is facing downstream along the flume.

2) Refers to direction of drone's flight path, which is independent of the inspection orientation.

3) Relative to standardized inspection orientation facing downstream. "Clock 1" refers to orientation at start of defect. "Clock 2" refers to orientation at end of defect.

	Video	Date	Bench	Side(1)	Dir(2)	Time	Sta	Obs Type	Code	Component	Clock 1(3)	Clock 2(3)	Note	Defect summary
129	DJI_0399.MP4	4/21/21	Borden	L	U	0:00		O	MGO				Continuation video	
						1:13		O	MGO				Road overcrossing	
						3:46	531+85	D	FL	Wall	9		Missing Gunite with Reinforcement Projecting/Corroded and Possible Hole	
						4:06	531+50	O	MGO				STA stencil	
						4:06	531+50	A	AOC				Square access hatch	
						5:01	531+50	O	MGO				End of upstream inspection	Patches on cap and wall
130	DJI_0400.MP4												8 second video	
131	DJI_0401.MP4	4/21/21	MD		D								Overview	
132	DJI_0402.MP4	4/21/21	MD		D								Overview	
133	DJI_0403.MP4	4/21/21	MD		D								Overview	
134	DJI_0404.MP4	4/21/21	MD		D								Overview	
135	DJI_0405.MP4	4/21/21	MD	R	U	0:00	485+15	O	MGO				Start of upstream inspection	
						1:13	485+15	A	AOC				Downstream structure	
						5:01		O	MGO				End of video	No significant defects
136	DJI_0406.MP4	4/21/21	MD	R	U	0:00		O	MGO				Continuation video	
						0:01	481+40	O	MGO				STA stencil	
						0:01	481+40	A	AOC				Access lid	
						2:14		O	MGO				Vegetation overgrowth	
						2:43		A	AOC				Square access hatch	
						4:24		O	MGO				Road overcrossing	
						5:00		O	MGO				End of video	Vegetation next to flume limits view of wall
137	DJI_0407.MP4	4/21/21	MD	R	U	0:00		O	MGO				Continuation video	
						1:58		A	AOC				Square access hatch	
						5:01		O	MGO				End of video	Stains on wall
138	DJI_0408.MP4	4/21/21	MD	R	U	0:00		O	MGO				Continuation video	
						0:42		A	AOC				Access lid	
						4:28		A	AOC				Access lid	
						5:01		O	MGO				End of video	Stains on wall
139	DJI_0409.MP4	4/21/21	MD	R	U	0:00		O	MGO				Continuation video	
						1:30		O	MGO				End of video	Stains on wall
140	DJI_0410.MP4	4/21/21	MD	R	U	0:00		O	MGO				Continuation video	
						4:52		O	MGO				End of video	Stains on wall
141	DJI_0411.MP4	4/21/21	MD	R	U	0:00		O	MGO				Continuation video	
						2:00		A	AOC				Square access hatch	
						5:00		O	MGO				End of video	Vegetation next to flume limits view of wall
142	DJI_0412.MP4	4/21/21	MD	R	U	0:00		O	MGO				Continuation video	
						1:10		A	AOC				Access lid	
						5:00		O	MGO				End of video	Stains on wall
143	DJI_0413.MP4	4/21/21	MD	R	U	0:00		O	MGO				Continuation video	
						3:06		A	AOC				Access lid	
						5:00		O	MGO				End of video	Stains on wall
144	DJI_0414.MP4	4/21/21	MD	R	U	0:00		O	MGO				Continuation video	
						2:00		O	MGO				End of video	Stains on wall
145	DJI_0415.MP4	4/21/21	MD	R	U	0:00		O	MGO				Continuation video	
						2:37		A	AOC				Access lid	
						2:37		O	MGO				Weeds growing around frame of lid	
						5:00		O	MGO				End of video	Stains on wall
146	DJI_0416.MP4	4/21/21	MD	R	U	0:00		O	MGO				Continuation video	
						2:55		A	AOC				Hinged lid	
						3:26		a	AOC				Square access hatch	
						3:43		A	AOC				Upstream structure	
						4:48		O	MGO				Completed upstream inspection	Stains on wall
147	DJI_0417.MP4	4/21/21	MD	L	D	0:00		O	MGO				Start of downstream inspection	
						1:01	451+95	A	AOC				Rectangular Hatch (Aluminum)	
						1:19	451+95	O	MGO				STA stencil	
						3:07	454+83	O	MGO				STA stencil	
						3:48	455+20	A	AOC				Access lid	
						3:48	455+20	O	MGO				STA stencil	
						5:00		O	MGO				End of video	Patches on cap and stains on wall
148	DJI_0418.MP4	4/21/21	MD	L	D	0:00		O	MGO				Continuation video	
						2:05	460+00	A	AOC				Access lid	
						2:05	460+00	O	MGO				STA stencil	
						5:01		O	MGO				End of video	Patches on cap and stains on wall
149	DJI_0419.MP4	4/21/21	MD	L	D	0:00		O	MGO				Continuation video	

Appendix A - Drone Inspection Raw Data

Flume Replacement Alignment Study

Vista Irrigation District

Notes:

1) The relative side is based on a standardized inspection orientation, which is facing downstream along the flume.

2) Refers to direction of drone's flight path, which is independent of the inspection orientation.

3) Relative to standardized inspection orientation facing downstream. "Clock 1" refers to orientation at start of defect. "Clock 2" refers to orientation at end of defect.

	Video	Date	Bench	Side(1)	Dir(2)	Time	Sta	Obs Type	Code	Component	Clock 1(3)	Clock 2(3)	Note	Defect summary
						1:38	463+?	A	AOC				Access lid	
						1:38	463+?	O	MGO				STA marking faded can't read	
						4:00	466+36	D	FL	Cap	10		Fractures	
						4:43	467+00	A	AOC				Rectangular Hatch	
						4:53	467+00	O	MGO				STA stencil	
						5:01	467+00	O	MGO				End of video	Multiple fractures on cap
150	DJI_0420.MP4	4/21/21	MD	L	D	0:00	467+00	O	MGO				Continuation video	
						0:04	467+00	O	MGO				Corrosion stain	
						5:00		O	MGO				End of video	
151	DJI_0421.MP4	4/21/21	MD	L	D	0:00	467+00	O	MGO				Continuation video	
						0:38	472+10	A	AOC				Access lid	
						0:38	472+10	O	MGO				STA stencil	
						1:00		O	MGO				End of video	Stains on wall
152	DJI_0422.MP4	4/21/21	MD	L	D	0:00	472+10	O	MGO				Continuation video	
						2:39	475+50	A	AOC				Access lid	
						2:39	475+50	O	MGO				STA stencil	
						3:27	476+09	O	MGO				STA stencil	
						5:01		O	MGO				End of video	Patches on cap and stains on wall
153	DJI_0423.MP4	4/21/21	MD	L	D	0:00	472+10	O	MGO				Continuation video	
						0:53	477+00	A	AOC				Side connection with access	
						1:02	477+00	O	MGO				anything	
						1:15	477+00	A	AOC				Rectangular Hatch	
						2:42		O	MGO				Road overcrossing	
						4:06	485+15	0	MGO				STA stencil	
						4:11	485+15	A	AOC				2 Square access hatches	
						5:00		O	MGO				End of video	Stains on wall
154	DJI_0424.MP4	4/21/21	MD	L	D	0:00		O	MGO				Continuation video	
						1:29		A	AOC				Access lid	
						2:48	482+20	D	CM	Cap	9	12	Cracks	
						5:01		O	MGO				End of video	Cracks in cap and stains on wall
155	DJI_0425.MP4	4/21/21	MD	L	D	0:00		O	MGO				Continuation video	
						3:02		A	AOC				Rectangular Hatch	
						3:02		A	AOC				Downstream structure	
						3:43		O	MGO				MD bench inspection completed	
156	DJI_0426.MP4	4/22/21	Kornhauser										Overview	
157	DJI_0427.MP4	4/23/21	Kornhauser										Overview	
158	DJI_0428.MP4	4/23/21	Kornhauser	L	U	0:00	287+90	O	MGO				Start of Kornhauer Bench inspection	
						0:29	287+90	A	AOC				Downstream structure	
						2:11	287+90	A	AOC				Rectangular Hatch	
						4:12	286+80	D	SRV				Missing Gunite, staining, possible hole	
						4:25	286+80	O	MGO				STA stencil	
						4:25	286+80	A	AOC				Square access hatch	
						5:01		O	MGO				End of video	Broken Gunite with stains and possible hole
159	DJI_0429.MP4	4/22/21	Kornhauser	L	U	0:00		O	MGO				Continuation video	
						5:01		O	MGO				End of video	Patches on cap and stains on wall
160	DJI_0430.MP4	4/22/21	Kornhauser	L	U	0:00		O	MGO				Continuation video	
						0:40	282+25	O	MGO				STA stencil	
						1:12	281+90	D	FL				Fractures	
						2:25		O	MGO				End of video	Fractures and cracks in cap and stains on wall
161	DJI_0431.MP4	4/22/21	Kornhauser	L	U	0:00		O	MGO				Continuation video	
						1:39	280+20	A	AOC				Access lid	
						1:39	280+20	O	MGO				STA stencil	
						5:01		O	MGO				End of video	Multiple cracks in cap and stains on wall
162	DJI_0432.MP4	4/22/21	Kornhauser	L	U	0:00		O	MGO				Continuation video	
						3:23		D	SSS	Cap	9	12	Missing Gunite	
						3:50		A	AOC				Rectangular hatch	
						3:55	274+90	A	AOC				Upstream structure	
						5:01	274+90	O	MGO				End of video	Patches on cap and stains on wall
163	DJI_0433.MP4	4/22/21	Kornhauser	L	U	0:00		O	MGO				Continuation video	
						0:59	274+90	O	MGO				Upstream inspection completed	No significant defects
164	DJI_0434.MP4	4/22/21	Kornhauser	R	D	0:00	274+90	O	MGO				Start of downstream inspection	
						2:22		D	FM	Wall	4	5	2 Longitudinal fractures	
						5:01		O	MGO				End of video	Cracks and patches in cap. Fractures and stains on wall
165	DJI_0435.MP4	4/22/21	Kornhauser	R	D	0:00		O	MGO				Start of downstream inspection	

Brown AND Caldwell

Appendix A - Drone Inspection Raw Data

Flume Replacement Alignment Study

Vista Irrigation District

Notes:

1) The relative side is based on a standardized inspection orientation, which is facing downstream along the flume.

2) Refers to direction of drone's flight path, which is independent of the inspection orientation.

3) Relative to standardized inspection orientation facing downstream. "Clock 1" refers to orientation at start of defect. "Clock 2" refers to orientation at end of defect.

	Video	Date	Bench	Side(1)	Dir(2)	Time	Sta	Obs Type	Code	Component	Clock 1(3)	Clock 2(3)	Note	Defect summary
						5:01		O	MGO				End of video	Stains on wall
166	DJI_0436.MP4	4/22/21	Kornhauser	R	D	0:00		O	MGO				Continuation video	
						2:02		A	AOC				Access lid	
						5:01		O	MGO				End of video	Stains on wall
167	DJI_0437.MP4	4/22/21	Kornhauser	R	D	0:00		O	MGO				Continuation video	
						5:01		O	MGO				End of video	Stains on wall
168	DJI_0438.MP4	4/22/21	Kornhauser	R	D	0:00		O	MGO				Continuation video	
						2:26		O	MGO				End of video	Stains on wall
169	DJI_0439.MP4	4/22/21	Kornhauser	R	D	0:00		O	MGO				Continuation video	
						2:08		O	MGO				Vegetation overgrowth	
						2:54		A	AOC				Rectangular Hatch	
						5:01		O	MGO				End of video	Stains on wall
170	DJI_0440.MP4	4/22/21	Kornhauser	R	D	0:00		O	MGO				Continuation video	
						0:53	287+90	A	AOC				Square access hatch	
						1:30	287+90	A	AOC				Downstream structure	
						1:35	287+90	O	MGO				Kornhauser bench inspection complete	
171	DJI_0441.MP4	4/22/21	Finkbinder										Overview	
172	DJI_0442.MP4	4/22/21	Finkbinder										Overview	
173	DJI_0443.MP4	4/22/21	Finkbinder										Overview	
174	DJI_0444.MP4	4/22/21	Finkbinder										Overview	
175	DJI_0445.MP4	4/22/21	Finkbinder										Overview	
176	DJI_0446.MP4	4/22/21	Finkbinder										Overview	
177	DJI_0447.MP4	4/22/21	Finkbinder	R	D	0:00	401+20	O	MGO				Start of Finkbinder bench inspection	
						1:01	401+20	A	AOC				Upstream structure	
						1:36	401+20	D	FL	Wall			Fracture with possible exfiltration	
						4:24	401+20	A	AOC				Rectangular hatch	
						5:01		O	MGO				End of video	Fracture with possible exfiltration
178	DJI_0448.MP4	4/22/21	Finkbinder	R	D	0:00		O	MGO				Continuation video	
						0:31	402+10	D	SRV	Cap	12	1	Reinforcement visible	
						3:23	404+50	O	MGO				STA stencil	
						3:23	404+50	A	AOC				Access lid	
						4:26	405+88	O	MGO				STA stencil	
						5:01		O	MGO				End of video	Spalling with missing Gunite, reinforcement projecting/corroded on cap and stains on wall
179	DJI_0449.MP4	4/22/21	Finkbinder	R	D	0:00		O	MGO				Continuation video	
						3:41	409+50	O	MGO				STA stencil	
						3:41	409+50	A	AOC					
						5:01		O	MGO				End of video	Patches on cap and stains on wall
180	DJI_0450.MP4	4/22/21	Finkbinder	R	D	0:00		O	MGO				Continuation video	
						4:02	414+46	A	AOC				Rectangular hatch	
						4:06	414+46	O	MGO				STA Stencil	
						5:01		O	MGO				End of video	Patches on cap and stains on wall
181	DJI_0451.MP4	4/22/21	Finkbinder	R	D	0:00		O	MGO				Continuation video	
						0:28	415+60	O	MGO				STA Stencil	
						2:20		O	MGO				End of video	Stains on wall
182	DJI_0452.MP4	4/22/21	Finkbinder	R	D	0:00		O	MGO				Continuation video	
						1:06	416+51	D	RPRD				Failed Repair	
						2:58	418+80	O	MGO				STA Stencil	
						3:02	418+80	A	AOC				Round access lid	
						4:25		O	MSC				Transition to circular DIP pipe	
						5:01		O	MGO				End of video	Defective repair, cracks on cap and stains on wall
183	DJI_0453.MP4	4/22/21	Finkbinder	R	D	0:00		O	MGO				Continuation video	
						0:06		O	MSC				Transition to Capped channel	
						2:37		O	MGO				STA Stencil	
						2:39		A	AOC				Round access lid	
						3:58		O	MGO				Weeds growing in cracks	
						5:01		O	MGO				End of video	Weeds growing in cracks, patches and stains
184	DJI_0454.MP4	4/22/21	Finkbinder	R	D	0:00		O	MGO				Continuation video	
						1:44	426+50	O	MGO				STA Stencil	
						1:53	426+50	A	AOC				Round access lid	
						4:35		O	MGO				hole in soil next to flume	
						5:01		O	MGO				End of video	Patches, cracks on cap and stains on wall
185	DJI_0455.MP4	4/22/21	Finkbinder	R	D	0:00		O	MGO				Continuation video	
						1:29	430+00	O	MGO				STA Stencil	

Appendix A - Drone Inspection Raw Data

Flume Replacement Alignment Study

Vista Irrigation District

Notes:

1) The relative side is based on a standardized inspection orientation, which is facing downstream along the flume.

2) Refers to direction of drone's flight path, which is independent of the inspection orientation.

3) Relative to standardized inspection orientation facing downstream. "Clock 1" refers to orientation at start of defect. "Clock 2" refers to orientation at end of defect.

	Video	Date	Bench	Side(1)	Dir(2)	Time	Sta	Obs Type	Code	Component	Clock 1(3)	Clock 2(3)	Note	Defect summary
						1:39	430+00	A	AOC				Square access lid	
						3:55	432+00	O	MGO				STA Stencil	
						4:21	432+50	O	MGO				STA Stencil	
						5:01		O	MGO				End of video	Patches, cracks on cap and stains on wall
186	DJI_0456.MP4	4/22/21	Finkbinder	R	D	0:00		O	MGO				Continuation video	
						1:12		O	MGO				End of video	Patches on cap and stains on wall
187	DJI_0457.MP4	4/22/21	Finkbinder	R	D	0:00		O	MGO				Continuation video	
						0:53	435+00	O	MGO				STA Stencil	
						0:58	435+00	A	AOC				Round access lid	
						4:50	439+15	O	MGO				STA Stencil	
						4:57	439+15	A	AOC				Rectangular hatch	
						5:01		O	MGO				End of video	Patches on cap and stains on wall
188	DJI_0458.MP4	4/22/21	Finkbinder	R	D	0:00		O	MGO				Continuation video	
						0:38		A	AOC				Downstream structure	
						1:59		O	MGO				Downstream inspection complete	Section is in fair condition
189	DJI_0459.MP4	4/22/21	Finkbinder	L	U	0:00	439+15	O	MGO				Upstream inspection start	
						0:18	439+15	O	MGO				End of video	18 seconds no observed defects
190	DJI_0461.MP4	4/22/21	Finkbinder	L	U	0:00	439+15	O	MGO				Continuation video	
						3:05		D	HVV	Wall	7		No visible exfiltration	
						3:15		D	HVV	Wall	7		No visible exfiltration	
						3:53		D	FL	Cap	10		Gunite is spalling and fractured	
						4:01		D	FL	Cap	10		Gunite is spalling and fractured	
						5:01		O	MGO				End of video	Voids in Gunite on wall and fractures in cap
191	DJI_0462.MP4	4/22/21	Finkbinder	L	U	0:00		O	MGO				Continuation video	
						1:16		A	AOC				Round access lid	
						2:12		D	FL	Cap	10		Cap is fractured	
						5:01		O	MGO				End of video	Fractures in cap and stains on wall
192	DJI_0463.MP4	4/22/21	Finkbinder	L	U	0:00		O	MGO				Continuation video	
						3:23		O	MGO				End of video	Section is in fair condition
193	DJI_0464.MP4	4/22/21	Finkbinder	L	U	0:00		O	MGO				Continuation video	
						1:01		A	AOC				Square access lid	
						1:22		D	SRV	Wall	8		Missing Gunite reinforcement projecting/corroded	
						4:11	428+80	D	HVV	Cap	2		Hole	
						5:01		O	MGO				End of video	Missing Gunite, reinforcement projecting/corroded, small hole in cap
194	DJI_0465.MP4	4/22/21	Finkbinder	L	U	0:00		O	MGO				Continuation video	
						2:33		A	AOC				Round access lid	
						5:01		O	MGO				End of video	Patches on cap and stains on wall
195	DJI_0466.MP4	4/22/21	Finkbinder	L	U	0:00		O	MGO				Continuation video	
						2:46		A	AOC				Round access lid	
						5:01		O	MGO				End of video	Patches on cap and stains on wall
196	DJI_0467.MP4	4/22/21	Finkbinder	L	U	0:00		O	MGO				Continuation video	
						0:41		O	MSC				Transition to Circular pipe	
						1:19		O	MSC				Transition to Capped channel	
						3:11		A	AOC				Round access lid	
						5:01		O	MGO				End of video	Patches on cap and stains on wall
197	DJI_0468.MP4	4/22/21	Finkbinder	L	U	0:00		O	MGO				Continuation video	
						1:44		O	MGO				Spot repair	
						2:51		O	MGO				End of video	Patches, spot repair on cap and stains on wall
198	DJI_0469.MP4	4/22/21	Finkbinder	L	U	0:00		O	MGO				Continuation video	
						5:01		O	MGO				End of video	Section is in fair condition
199	DJI_0470.MP4	4/22/21	Finkbinder	L	U	0:00		O	MGO				Continuation video	
						0:11		A	AOC				Rectangular hatch	
						0:11		D	SRV	Wall	8		Below access hatch	Reinforcement projecting/corroded, patches on cap and stains on wall
200	DJI_0471.MP4	4/22/21	Finkbinder	L	U	0:00		O	MGO				Continuation video	
						2:05		D	SRV	Wall	8		Fracture in Gunite with visible reinforcement	
						3:33		A	AOC				Round access lid	
						5:01		O	MGO				End of video	Fracture in wall with corroded reinforcement visible
201	DJI_0472.MP4	4/22/21	Finkbinder	L	U	0:00		O	MGO				Continuation video	
						5:01		O	MGO				End of video	Some patches in cap and stains on wall
202	DJI_0473.MP4	4/22/21	Finkbinder	L	U	0:00		O	MGO				Continuation video	
						0:52		O	MGO				End of video	Some patches in cap and stains on wall
203	DJI_0474.MP4	4/22/21	Finkbinder	L	U	0:00		O	MGO				Continuation video	
						0:38		A	AOC				Round access lid	

Appendix A - Drone Inspection Raw Data

Flume Replacement Alignment Study

Vista Irrigation District

Notes:

1) The relative side is based on a standardized inspection orientation, which is facing downstream along the flume.

2) Refers to direction of drone's flight path, which is independent of the inspection orientation.

3) Relative to standardized inspection orientation facing downstream. "Clock 1" refers to orientation at start of defect. "Clock 2" refers to orientation at end of defect.

	Video	Date	Bench	Side(1)	Dir(2)	Time	Sta	Obs Type	Code	Component	Clock 1(3)	Clock 2(3)	Note	Defect summary
						3:56		D	SRV	Cap	10		Missing Gunite reinforcement projecting/corroded	
						4:52		A	AOC				Rectangular hatch	
						5:01		O	MGO				End of video	Patches in cap, reinforcement projecting/corroded, stains on wall
204	DJI_0475.MP4	4/22/21	Finkbinder	L	U	0:00		O	MGO				Continuation video	
						1:28		A	AOC				Upstream structure	
						2:33		O	MGO				End of upstream inspection	
205	DJI_0476.MP4	4/23/21	Daley	R	D	0:00	203+00	O	MGO				Start of downstream inspection	
						0:00	203+00	A	AOC				Upstream structure	
						1:43	203+00	A	AOC				Access Hatch	
						5:00		O	MGO				End of video	Stains on wall
206	DJI_0477.MP4	4/23/21	Daley	R	D	0:00		O	MGO				Continuation video	
						1:49		a	AOC				Access Hatch	
						2:01		O	MGO				Plastic tarp covering flume	
						5:00		O	MGO				End of video	Stains on wall
207	DJI_0478.MP4	4/23/21	Daley	R	D	0:00		O	MGO				Continuation video	
						1:24	211+22	O	MGO				STA Stencil	
						2:16		A	AOC				Round access lid	
						4:00	213+85	O	MGO				STA Stencil	
						4:57		A	AOC				Access Hatch	
						5:00		O	MGO				End of video	Stains on wall
208	DJI_0479.MP4	4/23/21	Daley	R	D	0:00		O	MGO				Continuation video	
						0:46	214+90	O	MGO				STA Stencil	
						0:46	214+90	A	AOC				Access Hatch	
						0:51	214+90	D	FM				Fractures and possible exfiltration	
						5:00		O	MGO				End of video	Stains, fractures and possible exfiltration
209	DJI_0480.MP4	4/23/21	Daley	R	D	0:00		O	MGO				Continuation video	
						2:01	220+45	A	AOC				Round access lid	
						2:16	220+45	O	MGO				End of video	Patches, cracks, and stains
210	DJI_0481.MP4	4/23/21	Daley	R	D	0:00	220+45	O	MGO				Continuation video	
						5:00		O	MGO				End of video	Stains on wall
211	DJI_0482.MP4	4/23/21	Daley	R	D	0:00		O	MGO				Continuation video	
						1:48	224+75	O	MGO				STA Stencil	
						1:48	224+75	A	AOC				Round access lid	
						2:42	225+43	O	MGO				STA Stencil	
						5:00		O	MGO				End of video	Stains on wall
212	DJI_0483.MP4	4/23/21	Daley	R	D	0:00		O	MGO				Continuation video	
						2:28		A	AOC				Round access lid	
						2:35	229+65	O	MGO				STA Stencil	
						4:02	231+44	O	MGO				STA Stencil	
						4:32		D	SSS	Wall	4	5	Missing Gunite, wall intact	
						5:00		O	MGO				End of video	Cracks, patches, spalling and stains
213	DJI_0484.MP4	4/23/21	Daley	R	D	0:00		O	MGO				Continuation video	
						2:51		A	AOC				Access Hatch	
						3:37		A	AOC				Downstream structure	
						4:30		O	MGO				End of DS inspection	
214	DJI_0486.MP4	4/23/21	Daley	L	U	0:00		O	MGO				Start of upstream inspection	
						0:32	234+68	D	SRP				Missing Gunite with reinforcement projecting/corroded	
						5:00		O	MGO				End of video	Missing Gunite and reinforcement projecting/corroded
215	DJI_0487.MP4	4/23/21	Daley	L	U	0:00		O	MGO				Continuation video	
						4:17		A	AOC				Round access lid	
						5:00		O	MGO				End of video	Stains on wall
216	DJI_0488.MP4	4/23/21	Daley	L	U	0:00		O	MGO				Continuation video	
						4:05		O	MGO				Vegetation overgrowth	
						5:00		O	MGO				End of video	Stains on wall
217	DJI_0489.MP4	4/23/21	Daley	L	U	0:00		O	MGO				Continuation video	
						1:50		A	AOC				Round access lid	
						3:20		D	OBI				Wooden stake	
						5:00		O	MGO				End of video	Stains on wall and wooden stake through cap
218	DJI_0490.MP4	4/23/21	Daley	L	U	0:00		O	MGO				Continuation video	
						0:00		D	OBI				Wooden stake	
						0:30		O	MGO				End of video	Stains on wall and wooden stake through cap
219	DJI_0491.MP4	4/23/21	Daley	L	U	0:00		O	MGO				Continuation video	
						4:11		D	SSS	Wall	5		Missing Gunite	
						4:21		O	MGO				Vegetation overgrowth	

Appendix A - Drone Inspection Raw Data

Flume Replacement Alignment Study

Vista Irrigation District

Notes:

1) The relative side is based on a standardized inspection orientation, which is facing downstream along the flume.

2) Refers to direction of drone's flight path, which is independent of the inspection orientation.

3) Relative to standardized inspection orientation facing downstream. "Clock 1" refers to orientation at start of defect. "Clock 2" refers to orientation at end of defect.

	Video	Date	Bench	Side(1)	Dir(2)	Time	Sta	Obs Type	Code	Component	Clock 1(3)	Clock 2(3)	Note	Defect summary
						5:00		O	MGO				End of video	Spalling, stains and vegetation
220	DJI_0492.MP4	4/23/21	Daley	L	U	0:00		O	MGO				Continuation video	
						0:53		A	AOC				Round access lid	
						1:43		O	MGO				Vegetation overgrowth	
						4:56		D	FL	Cap	3		Fracture at cap connection to wall	
						5:00		O	MGO				End of video	Fracture, stains and vegetation
221	DJI_0493.MP4	4/23/21	Daley	L	U	0:00		O	MGO				Continuation video	
						1:45		O	MGO				Vegetation overgrowth	
						5:01		O	MGO				End of video	Vegetation and stains
222	DJI_0494.MP4	4/23/21	Daley	L	U	0:00		O	MGO				Continuation video	
						0:21		A	AOC				Access Hatch	
						2:21		O	MGO				Vegetation overgrowth	
						3:13		A	AOC				Bolted cover	
						5:00		O	MGO				End of video	Vegetation and stains
223	DJI_0495.MP4	4/23/21	Daley	L	U	0:00		O	MGO				Continuation video	6 second video
224	DJI_0496.MP4	4/23/21	Daley	L	U	0:00		O	MGO				Continuation video	Video is 0 seconds
225	DJI_0497.MP4	4/23/21	Daley	L	U	0:00		O	MGO				Continuation video	
						2:43		A	AOC				Round access lid	
						2:55		O	MGO				Vegetation overgrowth	
						5:00		O	MGO				End of video	Vegetation and stains
226	DJI_0498.MP4	4/23/21	Daley	L	U	0:00		O	MGO				Continuation video	
						0:50		O	MGO				Vegetation overgrowth	
						5:00		O	MGO				End of video	Vegetation and stains
227	DJI_0499.MP4	4/23/21	Daley	L	U	0:00		O	MGO				Continuation video	
						0:49		O	MGO				Tarp Covering half of flume	
						1:38		A	AOC				Access Hatch	
						2:12		O	MGO				End of video	Vegetation and stains
228	DJI_0500.MP4	4/23/21	Daley	L	U	0:00		O	MGO				Continuation video	
						5:00		O	MGO				End of video	Vegetation and stains
229	DJI_0501.MP4	4/23/21	Daley	L	U	0:00		O	MGO				Continuation video	
						4:00		A	AOC				Access Hatch	
						5:00		O	MGO				End of video	Stains on wall
230	DJI_0502.MP4	4/23/21	Daley	L	U	0:00		O	MGO				Continuation video	
						0:14		A	AOC				Upstream structure	
						1:17		O	MGO				End of Daley inspection	No significant defects
231	DJI_0503.MP4	4/23/21	Daley										Overview	
232	DJI_0504.MP4	4/23/21	Daley										Overview	
233	DJI_0505.MP4	4/23/21	Daley										Overview	
234	DJI_0506.MP4	4/23/21	Daley										Overview	
235	DJI_0507.MP4	4/23/21	Jack Creek	L	U	0:00		O	MGO				Start of upstream inspection	
						4:34	129+60	A	AOC				Rectangular cover	
						5:00	129+60	O	MGO				End of video	Cracks, patches and stains
236	DJI_0508.MP4	4/23/21	Jack Creek	L	U	0:00		O	MGO				Continuation video	
						0:06	129+60	O	MGO				STA Stencil	
						5:01		O	MGO				End of video	Cracks, patches and stains
237	DJI_0509.MP4	4/23/21	Jack Creek	L	U	0:00		O	MGO				Continuation video	
						0:29		D	FL	Cap	2		Broken Gunite	
						0:41		A	AOC				Rectangular access	
						1:13		A	AOC				Upstream structure	
						1:22		A	AOC				Manhole lid access	
						2:41		O	MGO				End of upstream inspection	Fracture, cracks and stains
238	DJI_0510.MP4	4/23/21	Jack Creek	R	D	0:00		O	MGO				Start of downstream inspection	
						1:22		O	MGO				Vegetation overgrowth	
						5:01		O	MGO				End of video	Vegetation limits view of wall
239	DJI_0511.MP4	4/23/21	Jack Creek	R	D	0:00		O	MGO				Continuation video	
						2:35	128+88	D	RFPD	Cap	1		Failed patch	
						5:01		O	MGO				End of video	Defective patch, stains
240	DJI_0512.MP4	4/23/21	Jack Creek	R	D	0:00		O	MGO				Continuation video	
						0:23		A	AOC				Rectangular lid	
						0:35		O	MGO				Chlorination pump?	
						2:12		O	MGO				End of Downstream inspection	No significant defects
241	DJI_0513.MP4	4/23/21	Jack Creek										Overview	
242	DJI_0514.MP4	4/23/21	Jack Creek										Overview	
243	DJI_0515.MP4	4/23/21	Tunnel	L	U	0:00		O	MGO				Start of inspection	

Appendix A - Drone Inspection Raw Data

Flume Replacement Alignment Study

Vista Irrigation District

Notes:

1) The relative side is based on a standardized inspection orientation, which is facing downstream along the flume.

2) Refers to direction of drone's flight path, which is independent of the inspection orientation.

3) Relative to standardized inspection orientation facing downstream. "Clock 1" refers to orientation at start of defect. "Clock 2" refers to orientation at end of defect.

	Video	Date	Bench	Side(1)	Dir(2)	Time	Sta	Obs Type	Code	Component	Clock 1(3)	Clock 2(3)	Note	Defect summary
						3:47		A	AOC				Rectangular Hatch (Aluminum)	
						4:13	181+53	O	MGO				STA Stencil	
						4:13		A	AOC				Square Hatch (Aluminum)	
						5:01		O	MGO				End of video	Patched cracks at a few locations
244	DJI_0516.MP4	4/23/21	Tunnel_Bench1	L	U	0:00		O	MGO				Continuation video	
						0:58		D	IS	Wall	4		Damp areas on wall, caused by rainfall	
						1:08		D	IS	Wall	4		Damp areas on wall, caused by rainfall	
						5:01		O	MGO				End of video	Damp at base of wall for entire video inspection 0:00:00 - 0:05:01
245	DJI_0517.MP4	4/23/21	Tunnel_Bench2	L	U	0:00		O	MGO				Continuation video	
						1:19	177+55	D	H	Cap	2		Hole with missing Gunite and reinforcement projecting/corroded	Hole in cap
						2:12	177+14	O	MGO				STA stencil	
						2:35	176+85	A	AOC				Hatched lid	
						2:43	176+85	O	MGO				STA stencil	
						5:01		O	MGO				End of video	Hole with missing Gunite and reinforcement projecting/corroded
246	DJI_0518.MP4	4/23/21	Tunnel_Bench3	L	U	0:00		O	MGO				Continuation video	
						1:14	172+98	O	MGO				STA Stencil	
						1:27		D	IS	Wall	4		Damp areas on wall, caused by rainfall	
						2:40	171+58	A	AOC				Hatched lid	
						2:40	171+58	O	MGO				STA Stencil	
						5:01		O	MGO				End of video	Minor patched cracks
247	DJI_0519.MP4	4/23/21	Tunnel_Bench4	L	U	0:00		O	MGO				Continuation video	
						2:04		O	MGO				End of video	
248	DJI_0520.MP4	4/23/21	Tunnel_Bench5	L	U	0:00		O	MGO				Continuation video	
						1:37		A	AOC				Hatched lid	
						1:45	167+50	O	MGO				STA Stencil	
						3:11		D	MGO	Cap	1		Weeds growing out of cap	Patched cracks
						4:31		O	MGO				Under bridge with metal cover	
						5:01		O	MGO				End of video	No significant defects
249	DJI_0521.MP4	4/23/21	Tunnel_Bench6	L	U	0:00		O	MGO				Continuation video	
						3:23	163+34	O	MGO				STA Stencil	
						4:22	162+60	A	AOC				Square hatch (aluminum)	
						4:22	162+60	O	MGO				STA Stencil	
						5:01		O	MGO				End of video	Multiple patched areas on cap, water staining
250	DJI_0522.MP4	4/23/21	Tunnel_Bench7	L	U	0:00		O	MGO				Continuation video	
						1:51	161+20	O	MGO				STA Stencil	
						4:20		A	AOC				Hatched lid	
						4:25	159+00	O	MGO				STA Stencil	
						5:01		O	MGO				End of video	Multiple patched cracks, minor water staining
251	DJI_0523.MP4	4/23/21	Tunnel_Bench8	L	U	0:00		O	MGO				Continuation video	
						0:29	157+91	O	MGO				STA Stencil	
						0:43		O	MGO				Restraint anchor	
						1:02	157+25	D	FM	Cap			Fractures	
						2:31	156+32	O	MGO				STA Stencil	
						5:01		O	MGO				End of video	Multiple patched cracks, water staining
252	DJI_0524.MP4	4/23/21	Tunnel_Bench9	L	U	0:00		O	MGO				Continuation video	
						1:21	152+60	O	MGO				STA Stencil	
						1:22	152+60	A	AOC				Hatched lid	
						1:33		O	MGO				End of video	Multiple patched cracks
253	DJI_0525.MP4	4/23/21	Tunnel_Bench10	L	U	0:00		O	MGO				Continuation video	
						0:17	152+60	O	MGO				STA Stencil	
						0:17	152+60	A	AOC				Hatched lid	
						4:50	148+50	O	MGO				STA Stencil	
						4:50	148+50	A	AOC				Hatched lid	
						5:01		O	MGO				End of video	Multiple patched cracks throughout, minor water staining
254	DJI_0526.MP4	4/23/21	Tunnel_Bench11	L	U	0:00		O	MGO				Continuation video	
						2:23	145+18	O	MGO				STA Stencil	
						4:02		A	AOC				Hatched lid	
						5:00		O	MGO				End of upstream inspection	Patched cracks on cap and stains on wall
255	DJI_0527.MP4	4/23/21	Tunnel Bench										4 second video	
256	DJI_0528.MP4	4/23/21	Tunnel Bench	R	D	0:00		O	MGO				Start of downstream inspection	
						1:19		A	AOC				Square access hatch	
						5:01		O	MGO				End of video	Some patches on cap and stains on wall
257	DJI_0529.MP4	4/23/21	Tunnel Bench	R	D	0:00		O	MGO				Continuation video	
						1:12		D	FL	Wall	4		Between cap and wall	

Brown AND Caldwell

Appendix A - Drone Inspection Raw Data

Flume Replacement Alignment Study

Vista Irrigation District

Notes:

1) The relative side is based on a standardized inspection orientation, which is facing downstream along the flume.

2) Refers to direction of drone's flight path, which is independent of the inspection orientation.

3) Relative to standardized inspection orientation facing downstream. "Clock 1" refers to orientation at start of defect. "Clock 2" refers to orientation at end of defect.

	Video	Date	Bench	Side(1)	Dir(2)	Time	Sta	Obs Type	Code	Component	Clock 1(3)	Clock 2(3)	Note	Defect summary
						2:57		A	AOC				Round access lid	
						5:01		O	MGO				End of video	Some patches on cap, stains on wall and a fracture between cap and wall
258	DJI_0530.MP4	4/23/21	Tunnel Bench	R	D	0:00		O	MGO				Continuation video	
						2:59		O	MGO				End of video	Some patches on cap and stains on wall
259	DJI_0531.MP4	4/23/21	Tunnel Bench	R	D	0:00		O	MGO				Continuation video	
						2:12		A	AOC				Round access lid	
						5:01		O	MGO				End of video	Some patches on cap and stains on wall. Vegetation overgrowth
260	DJI_0532.MP4	4/23/21	Tunnel Bench	R	D	0:00		O	MGO				Continuation video	
						5:01		O	MGO				End of video	Some patches on cap and stains on wall. Vegetation overgrowth
261	DJI_0533.MP4	4/23/21	Tunnel Bench	R	D	0:00		O	MGO				Continuation video	
						1:12		A	AOC				Round access lid	
						3:10		D	FL	Wall	4			
						5:01		O	MGO				End of video	Fracture in Gunite on wall, patches, stains and dead vegetation
262	DJI_0534.MP4	4/23/21	Tunnel Bench	R	D	0:00		O	MGO				Continuation video	
						1:16		A	AOC				Square access hatch	
						5:01		O	MGO				End of video	Some patches on cap and stains on wall
263	DJI_0535.MP4	4/23/21	Tunnel Bench	R	D	0:00		O	MGO				Continuation video	
						0:52		O	MGO				Bridge	
						0:52		O	MGO				End of video	Section in fair condition
264	DJI_0536.MP4	4/23/21	Tunnel Bench	R	D	0:00		O	MGO				Continuation video	
						1:21		D	RPPD				Cracks and missing patch	
						4:31		A	AOC				Round access lid	
						5:01		O	MGO				End of video	Broken patch, stains on wall
265	DJI_0537.MP4	4/23/21	Tunnel Bench	R	D	0:00		O	MGO				Continuation video	
						4:40		A	AOC				Round access lid	
						5:01		O	MGO				End of video	Some patches on cap and stains on wall. Dead leaves obscured view of some sections
266	DJI_0538.MP4	4/23/21	Tunnel Bench	R	D	0:00		O	MGO				Continuation video	
						5:01		O	MGO				End of video	Section is in fair condition
267	DJI_0539.MP4	4/23/21	Tunnel Bench	R	D	0:00		O	MGO				Continuation video	
						1:01		A	AOC				Round access lid	
						5:01		O	MGO				End of video	Some patches on cap and stains on wall. Dead leaves obscured view of some sections
268	DJI_0540.MP4	4/23/21	Tunnel Bench	R	D	0:00		O	MGO				Continuation video	
						1:30		O	MGO				End of video	Section is in fair condition
269	**DJI_0541.MP4**	**4/23/21**	**Tunnel Bench**	**R**	**D**	**0:00**		**O**	**MGO**				**Continuation video**	
						2:06	131+53	A	AOC				Square access hatch	
						2:20	131+53	A	AOC				Access hatch	
						2:34		O	MGO				Downstream structure	
						2:55		O	MGO				Downstream inspection complete	Section is in fair condition
270	DJI_0542.MP4	4/23/21	Tunnel Bench										Overview	
271	DJI_0543.MP4	4/23/21	Tunnel Bench										Overview	
272	DJI_0544.MP4	4/23/21	Tunnel Bench										Overview	
273	DJI_0545.MP4	4/23/21	Tunnel Bench										Overview	
274	DJI_0546.MP4	4/23/21	Tunnel Bench										Overview	
275	DJI_0547.MP4	4/23/21	Tunnel Bench										Overview	

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