AGENCY LATERAL FG

TO:	Shoshone-Paiute Tribes of the Duck Valley Reservation
FROM:	Jeff Olsson, PE DOWL (Nevada TSP #TSP-12-8709)
DATE:	11/17/2017
PROJECT:	Agency Lateral FG Pipeline Design Report

Project: Agency Lateral FG Pipeline

Location: Agency Canal Mile Post 4.3L

Pipe Inlet Coordinates:
Lat: 41.97344 N
Long: 116.11794 W

Sho-Pai Tracts Served:
1138, 1101, 1102, 1103, and 1104

Conservation Practice Standards:
430 – Irrigation Pipeline
587 – Structure for Water Control

To the best of my professional knowledge, judgement, and belief, this design meets practice standard criteria and complies with applicable laws and regulations.

11/17/2017

PROFESSIONAL ENGINEER - STATE OF NEVADA
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Exp: 12/31/2017
CIVIL
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SUMMARY

Design documents for this project include:

1. Design Report
2. Construction Drawings
3. DVIP Standard Specifications for Construction of Irrigation Pipelines and Minor Structures (Revision 10/06/2017)
4. DVIP Standard Detail Drawings (Revision 11/17/2017)

Agency Lateral FG is a lateral diversion off of the Agency Canal of the DVIP which supplies irrigation water to several irrigation deliveries for flood irrigation. The purposes of this project are primarily to reduce maintenance and improve water delivery service, with the secondary benefit of reducing conveyance losses.

In general, the DVIP Water Board desires to keep the number of 40-acre tracts included on a single pipeline to five (200 irrigated acres), with the intent to keep water rotations to acceptable levels. The service area of the proposed Agency Lateral FG pipeline includes five deliveries, most of which are full 40-acre tracts.

No environmental permits are anticipated to be needed for the construction of this project. An encroachment permit may be required at the locations where the pipeline parallels or crosses existing roadways if they are BIA roads with formal right-of-way (ROW). DOWL is currently coordinating ROW issues and the potential need for encroachment permits with the BIA.

Survey of the topography and existing features was performed for the project area. Survey data are in reference to the North American Datum of 1983 (NAD83), Nevada State Plane, East Zone, U.S. survey feet. Elevations are in reference to the North American Vertical Datum of 1988 (NAVD88).

PIPELINE DESIGN

Capacity:

The Sho-Pai previously contracted with the Irrigation Training and Research Center (ITRC) to develop a Modernization Plan for system improvements (ITRC 2017). The Modernization Plan included the recommendation for a delivery flow rate of 5 cfs for each tract, with each pipeline sized to deliver flow to only one tract at a time. The design flow for the pipeline is therefore 5 cfs.

Pipeline Hydraulics:

The starting point for pipeline hydraulics is the elevation that water must be delivered to. This is taken to be the top of the berm adjacent a flood ditch that must be overtopped to deliver water to the field or, in the case of deliveries to existing on-farm pipelines, the hydraulic grade line at the inlet to the existing pipe. Pipeline hydraulic computations consider the friction losses in the pipeline as well as minor losses for pipeline appurtenances and fittings.

Pipeline friction losses are estimated using the Hazen-Williams formula, with a design friction coefficient of 120. The Hazen-Williams friction coefficient for PVC pipe is generally expected to be within the range of 150 to 120 (Lindeburg 2006, pg. A-25). A higher friction coefficient corresponds to a smoother wall pipe, less energy loss, and a less conservative design. A conservatively low design value of 120 is used in the current pipeline design, as it allows for aging of the pipe and the minor reduction in conveyance efficiency that is commonly expected to occur over the life of a pipeline. A spreadsheet of pipeline hydraulic computations is included as Attachment 1 to this report.

Minor losses occur at the pipeline inlet and trash rack, as well as at pipeline bends, fittings, valves, and points of delivery. Minor losses are also tabulated in Attachment 1 and used in determining appropriate pipe size.

Trench and Backfill Requirements:

Pipeline trench and backfill requirements are depicted in DVIP Standard Detail 31-1, Typical PVC Pipe Trench Details. Supporting specifications are provided in DVIP Standard Specification 31 00 01, Earthwork. Trench and backfill requirements that utilize existing materials are specified where possible to provide a savings in cost. In general, “Select Native Material” (see also Std. Spec. 31 00 01) consisting of a 1-inch minus material produced from trench excavations is used as bedding and initial backfill material over the majority of the pipeline length. “Imported Bedding” consisting of a sandy gravel, fine gravel, or screened pit run material (see also Std. Spec. 31 00 01) is used as bedding material to provide additional pipe support at farm access road crossings and at fittings, and over the entire trench backfill section at public road crossings. Minimum cover is 36 inches except for farm access roads, where minimum cover of 30 inches is acceptable. Cover in the vicinity of farm access crossings and canal operation and maintenance roads is often limited; improved bedding and more stringent compaction requirements are specified in these areas to offset the allowable reduction in cover. Pipeline loading and floatation computations based on the requirements of the National Engineering Handbook, Part 636, Chapter 52 (NRCS 2005) are included in Attachment 2.

Revegetation:

Revegetation requirements are included in Standard Specification 32 90 01, and were adopted from the Northeastern Nevada Revegetation Guide (McAdoo and Davis 2014); alternate seed mix to that specified in 32 90 01 may be used at the discretion of the Water Board. In particular, alternate seed mix may be more appropriate in areas of actively irrigated pasture or to restore irrigated pasture to pre-disturbance conditions.

Materials

Materials are summarized below, with a complete list provided in Attachment 3.

- Mainline Pipe: 24-inch nominal diameter PIP PVC SDR51
- Mainline Pipe Fittings: 24-inch nominal diameter PIP PVC SDR41
- Lateral Delivery Pipe and Fittings: 18-inch nominal diameter PIP PVC SDR41

APPURTENANT STRUCTURES

Submerged Orifice Inlet

A submerged orifice inlet structure is included in the design to allow ease of operation and flow measurement. Dimensions, details, and structural connections are provided in DVIP Standard Detail 03-1, Precast Submerged Orifice Pipe Inlet. The submerged orifice is sized such that there will be a 6-inch head differential across the orifice when the diverted flow is equal to 5.0 cfs. The coefficient of discharge for a rectangular orifice is 0.61 (USBR 1997, pg. 9-7). The submerged orifice is 26 inches in width and 8 inches in height. Two rating tables for this orifice, one measured in tenths of feet and the other in inches, are provided in Table 1.

Table 1: Submerged Orifice Rating Tables for Head Measurement in Feet (left) and Inches (right)

Measured Head (ft)	Discharge (cfs)
0.05	1.58
0.10	2.24
0.15	2.74
0.20	3.16
0.25	3.54
0.30	3.87
0.35	4.18
0.40	4.47
0.45	4.74
0.50	5.00
0.55	5.24
0.60	5.48
0.65	5.70
0.70	5.92
0.75	6.12

Measured Head (in)	Discharge (cfs)
0.5	1.44
1.0	2.04
1.5	2.50
2.0	2.89
2.5	3.23
3.0	3.54
3.5	3.82
4.0	4.08
4.5	4.33
5.0	4.56
5.5	4.79
6.0	5.00
6.5	5.20
7.0	5.40
7.5	5.59

Orifice hydraulic calculations are included in Attachment 1. Note that the rating tables in Table 1 are provided for general reference only, as the submerged orifice and pipeline is intended to be operated at constant discharge of 5 cfs at all times. The ditch rider will measure the height from the top of the concrete inlet box to the canal water surface outside of the box and compare it to the height measured on the inside of the box, and then adjust the gate until the difference between these two measurements is 0.5 feet. When the differential is 0.5 feet, the pipeline flow will be 5.0 cfs.

Inlet Trash Rack

Although it is likely that debris will be swept past the submerged orifice, some debris may enter the orifice or fall in from above when the access hatch is open. A trash rack/safety rack is included within the inlet box. The purpose of this rack is to prevent debris from entering the pipeline, and to improve safety for operators when the access cover of the inlet structure is opened. The trash rack includes a 3-inch opening bar grating. The trash rack is removable. Trash rack head loss computations documenting selection of a trash rack head loss coefficient are included in Attachment 1. A 2-inch opening bar grate may be substituted for the 3-inch opening grate included in the design at the discretion of the Tribe. The head loss through a 2-inch opening bar grate will be roughly 2.3 times greater than a 3-inch opening bar grate, but will still be less than a tenth of a foot. A 1-inch opening bar grate is not recommended unless significant excess head is available; head loss through a 1-inch grate is estimated to be roughly 9 times that of a 3-inch opening grate.

Farm Deliveries “Turnouts”

The design includes two alternate delivery turnout configurations. The Turnout Type 1 (see Standard Detail 33-1) is intended when delivery is made to an existing on-farm flood ditch, whereas the Turnout Type 2 (Standard Detail 33-2) is appropriate when connection to an existing on-farm pipeline is required. Additionally, in expectation that irrigators may in the future want to convert from flood ditches to on-farm pipelines, Standard Detail 33-3 is provided in the design to standardize the requirements for converting from a Type 1 Turnout to a Type 2 Turnout.

The Type 1 Turnout includes an 18-inch Waterman Alfalfa Valve with a Type 4 frame. Alternate manufacturer’s products were considered; however, the Waterman valve is recommended as it is the only product to our knowledge that provides a mounting ring on the gate frame. This mounting ring is intended by the manufacturer to allow installation of a universal hydrant “bonnet” for connection to gated pipe. The mounting ring is important for the proposed design configuration, not necessarily for the ability to convert to gated pipe (available head may not be sufficient), but rather to allow the DVIP to fabricate and install a locking mechanism on the valve. All PVC pipe joints between the mainline pipe and the alfalfa valve are solvent-welded (as opposed to the gasketed joints used on the main line pipe) to provide joint restraint.

The Type 2 Turnout includes an 18-inch diameter double-flanged or lug-style butterfly valve (wafer-style valve is not allowed). Double-flanged and lug-style valves allow the system to remain in operation even if the on-farm pipeline downstream of the valve is taken out of service and/or removed completely for replacement or maintenance. This is a key concept of the design, as it allows the pipeline to remain functional regardless of maintenance or damage to on-farm pipelines which are outside of the control or responsibility of the DVIP. Type 2 turnout valves are restrained by means of the flanged or lug-style valve. Fittings downstream of the valve include gasketed joints to allow flexibility during assembly and connection to the existing pipeline.

Head loss through the delivery units is estimated and included in the minor loss hydraulic computations, see Attachment 1.

Corrosion Potential At Locations of Buried Valves

Field resistivity tests were conducted in the vicinity of buried valves to assess corrosion potential. The results of these tests are included in Table 2; based on the results of these tests, an 8-mil polyethylene wrap is specified in the Construction Drawings to supplement the valve coatings specified in Standard Detail 40-1.

Table 2: Field Resistivity Test Results

Location	Measured Resistivity	Anticipated Corrosion Potential to Buried Metal
NE1/4 Tract 1138	1,963 ohm-cm	Severe

CONSTRUCTION INSPECTION PLAN

The design packet will be reviewed with the Sho-Pai Tribes Water Resources Department, their Irrigation Project Manager, and the designated construction superintendent prior to the beginning of construction. DOWL will be responsible for project certification by conducting inspections during construction. Items to be checked include:

- Elevations of the inlet structure;
- Pipe and appurtenant materials size, class, and specifications (pipe, valves, gates, etc.);
- Trench depth, width, pipe placement in the trench, as well as backfill materials and methods;
- Minimum depth of cover.

Pipeline elevations may vary from those shown on the plans as long as the pipe is not laid at an adverse grade and minimum depth of cover is maintained. As-built documentation will include hand-written notes documenting the pipe elevation at regular intervals (such as every 100 feet); as-built survey of inlet box elevations; and documentation of deviations from the design drawings. No as-built survey is planned for the pipeline.

Bibliography

ITRC. *Duck Valley Irrigation Project Modernization Recommendations.* Shoshone-Paiute Tribes, 2017.

Lindeburg, Michael R. *Civil Engineering Reference Manual for the PE Exam, Tenth Ed.* Belmont, CA: Professional Publications, Inc., 2006.

McAdoo, J. Kent, and Rod Davis. *Northeastern Nevada Revegetation Guide: Planting Desirable Vegetation to Compete with Invasive Weeds in Upland Habitats.* Reno, NV: University of Nevada Cooperative Extension, 2014.

NRCS. *Part 636 Structural Engineering National Engineering Handbook Chapter 52 Structural Design of Flexible Conduits.* U.S. Department of Agriculture, 2005.

USBR. *Water Meanurement Manual A Water Resources Technical Publication, Third Ed.* Denver, CO: U.S. Government Printing Office, 1997.

OPERATION AND MAINTENANCE

1) Filling Requirements

   a) Inspect all air vents, delivery turnouts and other visible pipe appurtenances for damage prior to initial filling. Exercise valves to verify they open and close.

   b) Fill the pipeline slowly. Recommended filling rate is 1 to 2 cfs (orifice differential of 0.5 to 1 inch.

   c) When the pipeline is full, leave the slide gate at the inlet box open to prevent draining of the pipeline upon opening of a delivery valve.

2) Water Delivery Procedures

   a) Deliver water to 1 delivery at a time.

   b) Set check boards in the canal immediately downstream of the submerged orifice headgate to provide the design water level indicated on the drawings.

   c) After verifying that the slide gate at the inlet box is in an open condition, open a delivery turnout valve.

   d) Adjust the slide gate at the inlet box until the water surface outside of the box is 0.5 feet higher than the water surface inside of the box (given this differential, flow will be 5.0 cfs). Measurements of the water level outside of the box and inside of the box should be made to a common reference point along the orifice headwall.

   e) Once delivery to an individual tract is initiated, the water level in the canal should be kept as constant as possible. This will reduce the need to adjust the slide gate at the inlet box and will provide a more constant flow rate to the irrigator.

   f) The ditch rider should check the submerged orifice at least daily to:

      i) Remove any grass or debris accumulated at the orifice,

      ii) Check the trash rack for debris and remove as needed, and

      iii) Remeasure the head differential across the orifice to ensure that the head (and thus the delivery flow) has not changed.

   g) Do not adjust the check board level in the canal or the slide gate in the inlet when an irrigator has completed his irrigation; simply shut (or have the irrigator shut his valve when complete). The pipeline will remain full, with the canal water level and slide gate opening at the right setting for the next irrigator.

   h) The delivery valve for the next irrigator can then be opened to begin irrigation. After the next irrigator’s valve is open, confirm that the water level in the inlet box is at the required head differential for the desired delivery flow rate. If the canal water level and the slide gate remain in the same position as was set for the last irrigator the flow rate (and head differential) will be the same.

   i) If, for whatever reason, the pipeline is drained (such as through the slide gate being closed or lack of water within the canal), refill the pipeline slowly following the filling procedures described herein.

3) Periodic Pipeline Inspection During Operation and Troubleshooting

   a) Inspect the pipeline at regular intervals during operation (recommended minimum interval is once per week during the peak of the season, perhaps once per month outside of the peak).

      i) Check air vent pipes for signs of blockage or debris (all vents should have a debris screen to prevent blockage; confirm the screen is present). Remove any blockage and repair the screen as needed.

      ii) Check the air valves for leakage or other signs of improper operation. Leakage may be a minor leak from the air valve or from the fittings below.

         (1) Removing air valves with minor leaks for maintenance during the irrigation season may be possible during pipeline operation after shutting the ball valve on the air valve assembly.

         (2) Leaks from fittings below will require removing the pipeline from service, draining, and excavation of the fittings. To protect the more significant fittings below, the designed weak spot in the air valve riser is where the bottom end of the PVC fitting is threaded onto the brass nipple connected to the weld-neck flange. A lateral force applied at the top of the air valve riser will likely result in cracking of the Sch. 40 FPT adapter. This should be a simple fix after the pipe is drained. (see also Standard Detail 40-3).

      iii) Check the drain line to ensure that no flow is exiting the drain pipe unless the drain valve is intentionally open. If water is observed exiting the drain, confirm the drain valve is closed. There should be minimal chance of obstruction of the valve if the trash rack is maintained in place.

      iv) Check for delivery valves that are not shut or do not seal completely. Shut or repair as needed.

      v) Inspect the pipeline for evidence of leakage or damage (water boiling to the ground surface, sinkholes, or excessive vegetation growth, etc.). Leaks from cracked pipe or fittings will likely be significant and possibly catastrophic and will require immediate repair.

   b) If the desired head differential of 0.5 feet cannot be achieved to provide the desired flow rate of 5 cfs:

      i) Confirm that the canal water level is at the design operating level, the slide gate is completely open, the delivery valve is open and unobstructed, and the submerged orifice and trash rack are not obstructed.

      ii) Check for excessive water level differential across the trash rack. The trash rack as designed with an opening width of 3 inches between bars should result in less than

1-inch of water differential across the rack, and the differential is more likely to be nearly immeasurable. The trash rack is removable, but should be done so with caution, as it is a safety feature.

iii) Check the delivery conditions downstream of the delivery valve; raising the bank of an on-farm ditch, for instance, will increase the water level required to provide the design flow rate. If flood irrigation is used by means of overtopping the on-farm ditch banks is used, try using siphon tubes to identify whether the downstream delivery elevation is the limiting factor. Use of siphon tubes in the on-farm ditch will allow the water level to be delivered to a lower elevation and result in a lower required upstream elevation.

iv) Open the drain valve to sluice potential sediment that may have accumulated in the pipeline.

v) Inspect air valves and vents for damage, obstruction, or other evidence of loss of functionality.

4) Draining Requirements

a) Confirm that the air vent at the inlet of the pipe is unobstructed.

b) Inspect the water level in the channel to receive the drain water; if the water level is significantly above the elevation of the drain pipe it may be beneficial to wait for the water level to drop to allow the pipeline to be drained completely. This may not be possible during the middle of the irrigation season; and if necessary, the pipe can be at least partially drained (perhaps almost entirely) even with water above the discharge elevation.

c) If the canal is dry, leave the slide gate in an open condition to allow additional venting during draining. If the canal is not dry, close the slide gate and begin the draining procedures.

d) Open the drain valve slowly to the full open position to drain the pipeline and flush any sediment that may have accumulated in the pipeline.

i) If desired, the last delivery, or a delivery at a convenient point near the end of the pipeline can be opened to drain a portion of the pipeline through the delivery and into the farm field. Doing so will reduce the time required to drain the line, but will also limit the flow available to flush sediment through the drain.

ii) Other deliveries can be opened to improve venting during draining; however, this is not required.

e) Check the color of the drain water for evidence of sediment flushing. Not all pipelines will intercept and/or accumulate sediment at the same rate; some canals will carry more sediment, some inlets may be more prone to sediment interception than others, and larger diameter pipelines will have lower scouring velocity at the design flow and may be more prone to sediment settling in the pipeline. If significant sediment-laden water is observed draining from a pipeline it may be beneficial to flush the pipeline mid-way through the following irrigation season to prevent excessive sediment build-up.

5) Other Considerations

   a) If a delivery rate less than 5 cfs is requested by the irrigator, reference the submerged orifice rating table to determine the required head differential across the orifice. Note that the orifice is sized to provide reasonable water level measurement (and flow measurement accuracy) at the design flow rate of 5.0 cfs. Accuracy of flow measurement will be reduced at low flows; if delivery rates of roughly 3.5 cfs or less (head measurement less than 3 inches) an alternate orifice may be needed. If future operations require different flow rates, or variable flow rates for different deliveries on a given pipeline, consideration should be made to installing an adjustable orifice gate.

   b) Not all deliveries on a given pipeline will require the canal to be checked to the same water level in the canal. Two modes of canal operation are acceptable:

      i) Maintain the canal at the design water level all the time: this will result in minimum adjustments to the canal water level, and only the slide gate will need to be adjusted to provide the required head differential. This method is preferred, and is the method described in these water delivery procedures.

      ii) Alternatively, the water level in the canal could be reduced to a lower level to improve freeboard. Significant fluctuations in water level are not recommended and could lead to canal blowouts if rodents burrow into the embankment above the water prior to the water level being raised. This risk must be weighed against the risk of operating the canal at minimum freeboard, however.

   c) Spare parts:

      i) Maintaining a supply of spare parts and miscellaneous fittings is recommended. Lead times on large, fabricated PVC fittings are often several weeks. A supply of fittings can allow immediate response and repair of failures. Lead times on butterfly valves may be a month or more; standardizing butterfly valves and maintaining a stock of extra valves is desired.

      ii) It may not be cost effective to have a stock of all potential fittings that may be needed. At a minimum, a supply of repair couplings of various sizes for the 18- to 24-inch diameter PVC pipe and a few extra sticks of pipe should be kept on hand.

      iii) Maintain at least one blind flange and set of bolts/nuts for each size and bolt pattern of flanged fittings in operation on the project.

      iv) Keep spare parts covered and out of direct exposure to sunlight.

Attachment 1
Hydraulic Computations

Agency Lateral FG Pipeline

Project: Duck Valley Irrigation Project
Client: Shoshone-Paiute Tribes of the Duck Valley Reservation
Canal: Agency Canal
Mile Post: 4.3L

Design Paramaters

Design Flow (cfs)	5.0
Pipe Size (in)	23.710
Pipe Velocity (ft/s)	1.63
Headloss Coeff.	120
Delivery Loss Coeff.	4.8
Inlet Station (ft)	0+10
Orifice WS Differential	0.5
Max Check Elev. (ft)	5,360.00
Top of Bank Elev. (ft)	5,360.25
Design WS Elev. (ft)	5,359.25
Design Freeboard (ft)	1.0
Pipe Friction Loss (ft/ft)	0.000480

Minor Losses

No.	Station	Type	Coeff.
1	0+10	Inlet	0.78
2	0+10	Trash Rack	0.48
3	0+26	45 deg. Bend	0.236
4	0+30	45 deg. Bend	0.236
5	10+85	90 deg. Bend	0.5
6	23+55	90 deg. Bend	0.5
7	63+31	Tee, Branch Fl.	0.75
8	63+62	45 deg. Bend	0.236
9			
10			

Design Computations

Calc. No.	Tract Served	Elevation (ft)	Delivery Elevation (ft)	Delivery Station (ft)	Delivery Direction	Delivery Type	Pipe Length (ft)	Friction Loss (ft)	Sum Minor Loss Coeff.	Minor Losses (ft)	Required Upstream Canal WS Elev. (ft)	Design WS > Required WS	Notes
1	1138	5,352.40	5,352.90	63+30	Lt.	Farm Ditch	6,321	3.034	7.48	0.309	5,356.75	Yes	Top of farm ditch plus 0.5 ft.
2	1104	5,351.70	5,352.20	63+65	Rt.	Farm Ditch	6,356	3.051	8.47	0.350	5,356.11	Yes	Top of farm ditch plus 0.5 ft.
3	1103	5,354.03	5,354.53	62+50	Rt.	Farm Ditch	6,241	2.996	7.48	0.309	**5,358.34**	Yes	Top of farm ditch plus 0.5 ft.
4	1102	5,354.34	5,354.84	36+88	Rt.	Farm Ditch	3,679	1.766	7.48	0.309	5,357.42	Yes	Top of farm ditch plus 0.5 ft.
5	1101	5,354.71	5,355.21	36+30	Rt.	Farm Ditch	3,621	1.738	7.48	0.309	5,357.76	Yes	Top of farm ditch plus 0.5 ft.
6	1101	5,355.50	5,356.00	23+65	Rt.	Farm Ditch	2,356	1.131	7.48	0.309	5,357.94	Yes	Top of farm ditch plus 0.5 ft.

Pipeline Elevations and Pressures

Station (ft)	Invert Elev. (ft)	Static Pressure (psi)	Operating HGL Elev. (ft)	Operating Pressure (psi)
0+10	5,356.25	0.9	5,358.50	0.5
10+00	5,352.81	2.4	5,358.01	1.8
25+00	5,348.44	4.3	5,357.25	3.4
36+00	5,347.16	4.8	5,356.72	3.7
50+00	5,346.53	5.1	5,356.05	3.7
63+30	5,344.62	5.9	5,355.41	4.2

Air Valve Elevations

Station (ft)	Operating HGL Elev. (ft)	Max. Air Valve Elev. for Press. = 2 PSI
36+72	5,356.68	5,352.0
49+95	5,356.05	5,351.4
63+23	5,355.41	5,350.7

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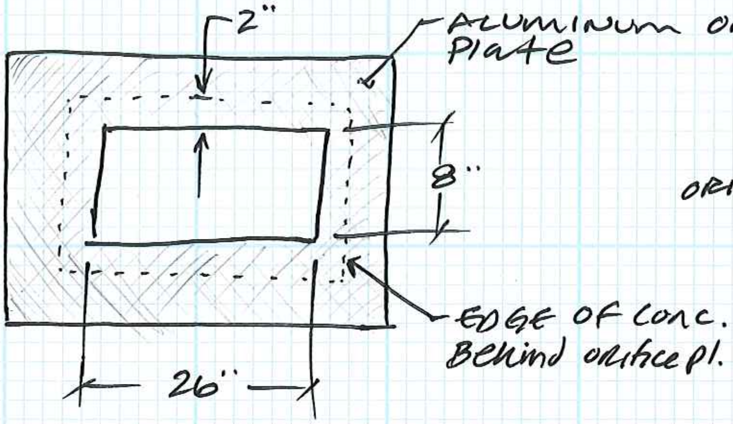
COMPUTATIONS	Project #:
Client Name:	Sheet ____ of ____

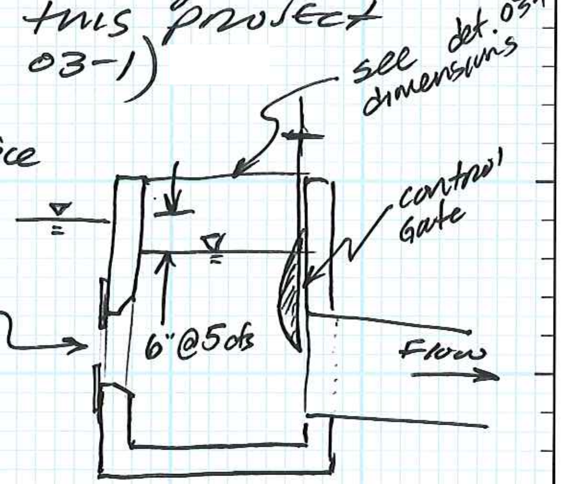
Project Name: DVIP – Orifice Hyd.	Prepared by:	Date	Checked by:	Date

SUBMERGED ORIFICE INLET CALCS

THIS detail documents hydraulic design of the pipe inlet specified for this project (see dimensions in Std. det. 03-1)



standard orifice dimensions



operation: control gate is raised/lowered as needed to provide desired head diff. across orifice

Hyd. calcs:

orifice equation $Q = CA\sqrt{2gh}$

Q = flow (cfs)

C = Coeff. of discharge = 0.61 per USBR Water Meas. Manual

A = orifice area (sf)

g = Grav. accel. constant (32.2 ft/s²)

h = head diff. across orifice (ft)

$$Q = 0.61\left(\frac{26''}{12} \times \frac{8''}{12}\right)\sqrt{2(32.2)(0.5)}$$

$\boxed{Q = 5.0 \text{ cfs for } 26'' \times 8'' \text{ orifice}}$

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COMPUTATIONS		Project #:	
Client Name:		Sheet ____ of ____	
Prepared by:	Date	Checked by:	Date

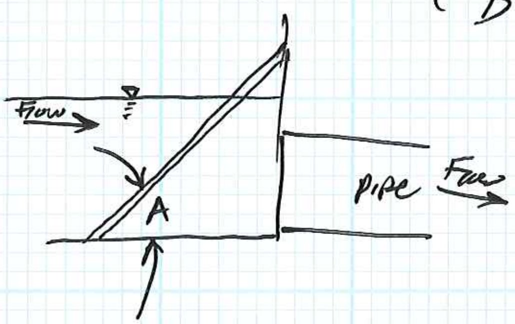
Project Name: DVIP – h_L TRASH RACK

Computation of Head Loss Through INLET TRASH RACK

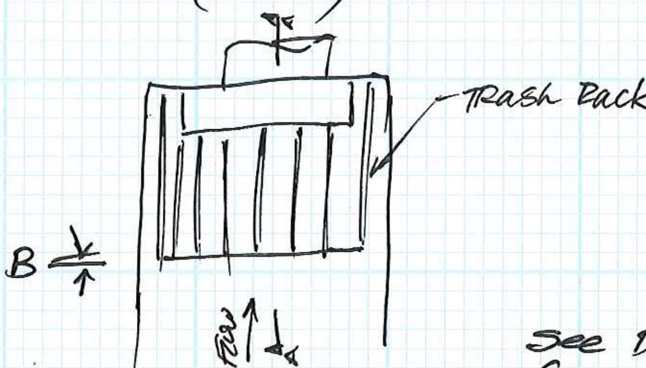
THIS SHEET documents how the head loss coefficient for the inlet trash rack was developed.

head loss eqn. (EQN 1)

$$H = 1.32\left(\frac{TV}{D}\right)^2 \sin(A)\left(\frac{1}{\cos B}\right)^{1.875}$$



section A



plan

See Det. Dwg 05-1 for dimensions

T = Bar thickness (in)
D = Bar Spacing (in)
V = Velocity below TR. Rack. (ft/s)
A = TRASH Rack angle of inclination (deg.)
B = Angle of approach (deg.) (Range 0° to 60°)

T = 0.25"
D = 3"
A = 55°
B = 0°

EQN 2: $K\frac{V^2}{2g} = H$ = head loss; solve for K in EQN 2

for
18" ⌀ ⟹ V = 2.82 fps ⟹ H = 0.060 ft ⟹ K = 0.48
21" ⌀ ⟹ V = 2.08 fps ⟹ H = 0.032 ft ⟹ K = 0.48
24" ⌀ ⟹ V = 1.59 fps ⟹ H = 0.020 ft ⟹ K = 0.48
if $V = \frac{5}{1.444}$ ⟹ H = 0.090 ⟹ K = 0.48
orif. area

$\therefore$ TRASH Rack head loss assumed to be $H = K\frac{V^2}{2g}$ where K = 0.48 for all pipe sizes

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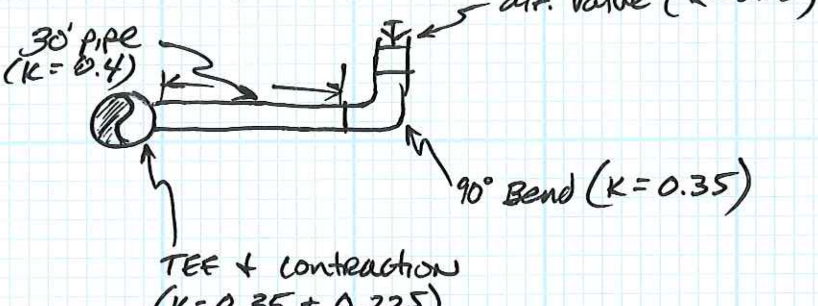
COMPUTATIONS	Project #:
Client Name:	Sheet 1 of 3
Prepared by: Date	Checked by: Date

Project Name: DVIP – h_L Delivery

Delivery Head loss + Back calculated Head loss coefficient

Type 1 Delivery: (see Std. Det. 33-1)

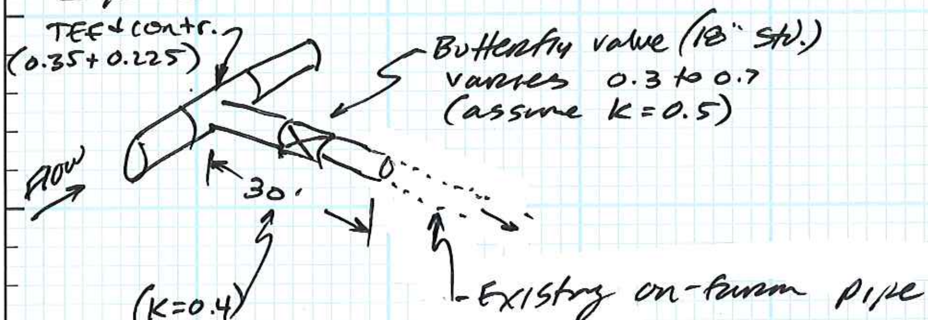


"Effective K" for 30' PVC 18" @ 5cfs (V=2.83 fps)
$h_L = 0.05'$
$\Rightarrow K = 0.4$

$\Sigma_K = 0.35 + 0.225 + 0.4 + 0.35 + 0.15$

$\Sigma_K = 1.475$

Type 2 Delivery: (See Std. Det. 33-2)



$\Sigma_K = 0.35 + 0.225 + 0.5 + 0.4$

$\Sigma_K = 1.475$

$\Rightarrow$ Assume Outlet $K = 1.5$ for Del. Ty 1 + Ty 2 for 18" ø pipe @ 5cfs for 18" ø Delivery pipe

$K = 1.5$ $\Rightarrow h_L = K\dfrac{V^2}{2g} = 1.5\dfrac{(2.83)^2}{64.4} = 0.1865$

$V = 2.83$ fps

to Treat outlet as a point loss w effective Coeff. of K_e Need to Relate actual head loss (constant 0.1865 for 5 cfs all mainline dia.) to mainline Dia. which varies.

$\Rightarrow$ Back calculate K_e given h_L + V

$K_{e(21")} \Rightarrow 0.187 = K_{e21}\dfrac{2.08^2}{64.4}$

$\Rightarrow K_{e21} = 2.78$

$K_{e(24")} \Rightarrow 0.187 = K_{e24}\dfrac{1.59^2}{64.4}$

$\Rightarrow K_{e24} = 4.75$

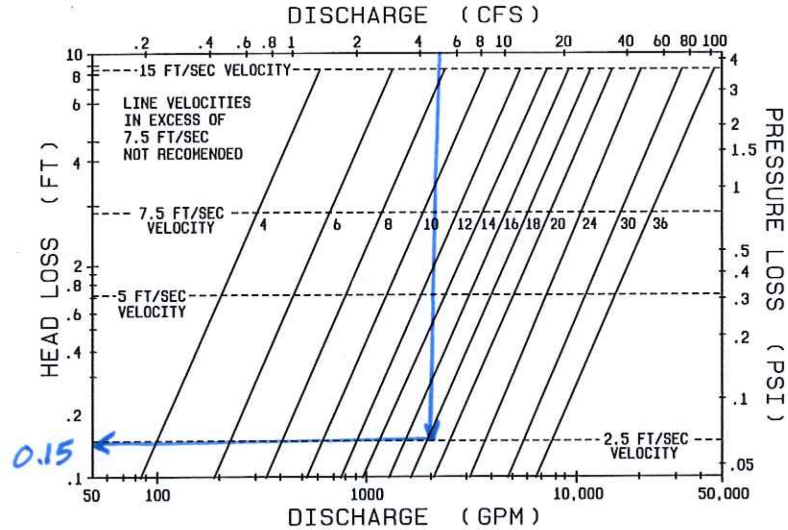
∴ outlet Loss coeff

18" ø	1.5
21" ø	2.78
24" ø	4.75

3/3

PERFORMANCE CHART & PARTS GUIDE

Flow through various size overflow valves, with corresponding pressure loss at rate of discharge



SUNSHINE OVERFLOW VALVE PARTS GUIDE *								
SIZE	COVER		SCREW		YAKIMA FRAME (CONCRETE)		TYPE-4 FRAME (IPS-PIP)	CIP FRAME (IPS-PIP)
3½"	W656	3½SS	½"W506B	5S	W102	3½Y	W1196	-
4"	W1655	4SS	½"W506B	5S	W117	4Y	W1296	W1751-CIP
5"	W1035SS	5SS	½"W598B	5SL	W118	5Y	W1155	-
5" X 6"	W1035SS	5SS	½"W596B	5SL	W118	5Y	W1195	W1792-CIP
6"	W925	6SS	⅝"W507B	6S	W120	6Y	W1165	W1787-CIP
6½"	W105SS	6½SS	⅝"W507B	6S	W974	6½Y	-	-
8"	W146	8SS	⅝"W683B	6SL	W121	8Y	W1162	W1788
10"	W141	10SS	⅞"W595B	14S	W142	10SS	-	OV-CIP
12"	W143	12SS	1⅛"W512B	12A	W144	12SS	-	OV-CIP
14"	W148	14SS	1⅛"W684B	14SS	W149	14SS	-	-
16"	W149	16SS	1¼"W514B	20A	W129	16Y	-	-
18"	W147	18SS	1¼"W685B	20SS	W131	18Y	-	-
20"	W1366	20SS	1¼"W685B	20SS	W133	20Y	-	-

* Numbers beginning with "W" (example: "W130", etc.) are casting numbers which can be located on each cast part.
Numbers which do not begin with "W" are part designations also found on most castings (example: "16A").

RED TOP OVERFLOW VALVE PARTS GUIDE *								
SIZE	COVER		SCREW		YAKIMA FRAME (CONCRETE)		TYPE-4 FRAME (PIP)	CIP FRAME (IPS-PIP)
3"	W114	3Y	½"W506B	5S	W115	3Y	-	-
3½"	W101	6-0	½"W506B	5S	W102	3½Y	-	-
4"	W116	4Y	½"W506B	5S	W117	4Y	W1296	W1757-CIP
5"	W103	5Y	½"W598B	5SL	W118	5Y	W1195	-
5" X 6"	W103	5Y	½"W598B	5SL	W118	5Y	-	-
6"	W119	6Y	⅝"W507B	6S	W120	6Y	W1165	W1787-CIP
6½"	W105	10-0	⅝"W507B	6S	W974	6½Y	-	-
8"	W107	8Y	⅝"W507B	6S	W121	8Y	W1162	W1788-CIP
10"	W122	10Y	¾"W586	10S	W123	10Y	W1163	W1808-CIP
12"	W124	12Y	¾"W586	10S	W125	12Y	W1164	W1809-CIP
14"	W126	14Y	⅞"W595B	14S	W127	14Y	W2080 W1194	-
16"	W128	16Y	1¼"W513B	16A	W129	16Y	-	-
18"	W130	18Y	1¼"W514B	20A	W131	18Y	W1659	-
20"	W132	20Y	1¼"W514B	20A	W133	20Y	W1660	-

* Numbers beginning with "W" (example: "W130", etc.) are casting numbers which can be located on each cast part.
Numbers which do not begin with "W" are part designations also found on most castings (example: "16A").

Attachment 2
Pipeline Loading and Floatation Computations

DVIP 24-inch SDR 51 (Typical Trench Design)

Project: Duck Valley Irrigation Project
Project No.: 4026.21024.02
Engineer: JKO
Date: 05/02/2017

Notes:
1) Minimum cover is 3.0 ft
2) E' of 400 and 3.0 ft cover with saturation to the ground surface does not provide 3.0 FS against buckeling; however this is an unlikely loading combination as saturation to the ground surface would prevent equipment access. 3.0 FS is achieved with farm equipment loading coupled with groundwater less than or equal to 1.5 ft below the ground surface.
3) Improved bedding (E'=1,000) allows loading in combination with saturation to the ground surface; this may be achievable using select native backfill depending on soil conditions.

1	**Input Parameters**				
2		Pressure Class (PIP PVC)	80	psi	
3		Nominal Pipe Size (PIP PVC)	24	in	
4	h	depth of cover	3	ft	Design Min. Cover
5	D_{GW}	depth of ground water above pipe invert	3.57	ft	Less than 1.5 ft from ground surface with wheel load
6	D_W	depth of flood water above ground	0	ft	
7	*Soil Properties*				
8	w	Unit weight of soil	120	pcf	
9	w_S	Saturated unit weight of soil	120	pcf	
10	*Pipe Properties*				
11	D_0	Pipe outside diameter	24.803	in	JM Eagle Manufacturer's Literature
12	D_I	Average inside diameter	23.77	in	JM Eagle Manufacturer's Literature
13	t	Minimum wall thickness	0.486	in	JM Eagle Manufacturer's Literature
14	W_P	Weight of the pipe per lineal foot	26.32	lbs	
15	E	Modulus of elasticity of pipe material	400,000	psi	NEH 636.5204a (PVC)
16	E'	Modulus of soil reaction	400	psi	NEH 636 Tabe 52-2
17	E_{long}	Long-term modulus of elasticity	140,000	psi	NEH 636.5204a(3)
18	SDR	Outside dimension Ratio (D_0/t)	51		
19	SIDR	Inside dimension Ratio (D_I/t)	48.9		
20	**Pipe Loading**				
21	W_S	Soil load per lineal foot of pipe	744	lbs	NEH 636.5203a Eqns. 52-17 and 52-18
22	P_S	Pressure on pipe due to weight of soil	360	psf	
23	P_L	Wheel load at the surface in pounds	10,000	lbs	NEH 636.5203b (Field Equipment)
24	I_f	Impact factor	1		NEH 636.5203b
25	W_L	Wheel load per lineal foot of pipe	944	lbs	NEH 636.5203b Eqn. 52-19 or Eqn 52-20
26		Load pressure distribution controlling equation	Eqn. 52-19		NEH 636.5203b
27	P_w	Pressure on pipe due to wheel load	457	psf	NEH 636.5203b Eqn. 52-21
28	P_v	Pressure on pipe due to internal vacuum pressure	0	psf	
29	W_v	Vacuum load per lineal foot of pipe	0	psf	NEH 636.5203c Eqn. 52-23
30	P_G	Pressure on pipe due to external hydrostatic pressure	94	psf	NEH 636.5204a Eqn. 52-24
31	P_T	Total pressure on pipe (prism load)	910	psf	NEH 636.5204a Eqn. 52-25
32	**Wall Crushing Design Check**				
33	T_{PW}	Thrust in pipe wall	941	lb/ft	NEH 636.5204a Eqn. 52-26
34	σ	allowable long-term compressive stress	2,000	psi	NEH 636 Appendix 52C, table 52C-1 (PVC cell class 12454)
35	A_{PW}	Required wall cross-sectional area	0.039	in^2/in	NEH 636.5204a Eqn. 52-27
36	t	Actual wall cross-sectional area	0.486	in^2/in	
37		**Required wall cross-sectional area < actual**	**OK**		
38	**Ring Deflection Design Check**				
39	L_{DL}	Deflection lag factor	1.5		NEH 636.5204a
40	K_{BED}	Bedding factor	0.1		NEH 636.5204a
41	$\Delta X/D_I$	Vertical Deflection	2.61	%	NEH 636.5204a Eqn. 52-29 (solid-wall plastic pipe)
42		Safe Deflection Limit (Percent of Diameter)	7.5	%	NEH 636.5204a (liquid conveyance practice)
43		**Percent Vert. Deflection < Safe Deflection Limit**	**OK**		
44	**Wall Buckling Design Check**				
45	FS	Design Factor of Safety	3		NEH 636.5204a(3)
46	R_w	Water Bouyancy Factor	0.835		NEH 636.5204a(3)
47	B'	Emperical coefficient of elastic support	0.6229		NEH 636.5204a(3)
48	I_{pw}	Pipe wall moment of inertia	0.0096	in^4/in	NEH 636.5204a(3)
49	q_a	Allowable buckling pressure	1,160	psf	NEH 636.5204a(3) Eqn. 52-33
50		**Allowable buckling pressure > Prism load**	**OK**		
51		**Safety Factor Against Buckling**	**3.82**		
52	C	Out-of-round reduction factor	0.7914		NEH 636.5204a(3) Eqn. 52-34
53	q_aC	Reduced Allowable Buckline Pressure	918	psf	NEH 636.5204a(3) Eqn. 52-34
54		**Reduced allowable buckling pressure > Prism load**	**OK**		
55		**Safety Factor Against Buckling (out-of-round reduced)**	**3.03**		
56	**Partially Submerged Pipe Bouyancy**				
57	d	distance from pipe center to water surface	NA	ft	
58	α	1/2 Section Angle	NA	rad	
59	β	Full Section Angle	NA	rad	
60	A_1	Section Area	NA	ft^2	
61	A_2	Triangular Segment Area	NA	ft^2	
62	A_3	Displaced Area	NA	ft^2	
63	F_B	Buoyant Force per lineal foot of pipe	NA	lbs	
64	**Buoyant Force Design Check**				
65	W_D	Weight of dry soil per lineal foot of pipe	372	lbs	Design of PE Piping Systems, Ch. 6, Eqn. 3-33
66	W_S	Weight of saturated soil per lineal foot of pipe	205	lbs	Design of PE Piping Systems, Ch. 6, Eqn. 3-34
67	W_L	Weight of liquid in the pipe	192	lbs	Design of PE Piping Systems, Ch. 6, Eqn. 3-35
68	W_{TE}	Cumulative Weight (Empty)	603	lbs	
69	W_{TF}	Cumulative Weight (Full)	795	lbs	
70	F_B	Buoyant Force	209	lbs	Design of PE Piping Systems, Ch. 6, Eqn. 3-31
71	F_{Net}	Net Force (Empty)	-394	lbs	Net force down
72	F_{Net}	Net Force (Full)	-586	lbs	Net force down
73		**Safety Factor Against Flotation (Empty)**	**2.89**		
74		**Safety Factor Against Flotation (Full)**	**3.8**		

DVIP 24-inch SDR 51 (Farm Access Crossing)

Project: Duck Valley Irrigation Project
Project No.: 4026.21024.02
Engineer: JKO
Date: 05/02/2017

Notes:
1) Minimum cover is 2.5 ft
2) Bedding requirements are a) coarse-grained soil with little or no fines with at least slight compaction or b) crushed rock. Fine-grained soils with moderate to high compaction are also acceptable. (See NEH Part 636 Table 52-2)
3) The addition of groundwater to this computation provides a worst case loading.

1	**Input Parameters**				
2		Pressure Class (PIP PVC)	80	psi	
3		Nominal Pipe Size (PIP PVC)	24	in	
4	h	depth of cover	2.5	ft	Design Min. Cover
5	D_{GW}	depth of ground water above pipe invert	4.57	ft	Assumed groundwater at ground surface
6	D_W	depth of flood water above ground	0	ft	
7	*Soil Properties*				
8	w	Unit weight of soil	120	pcf	
9	w_S	Saturated unit weight of soil	120	pcf	
10	*Pipe Properties*				
11	D_0	Pipe outside diameter	24.803	in	JM Eagle Manufacturer's Literature
12	D_I	Average inside diameter	23.77	in	JM Eagle Manufacturer's Literature
13	t	Minimum wall thickness	0.486	in	JM Eagle Manufacturer's Literature
14	W_P	Weight of the pipe per lineal foot	26.32	lbs	
15	E	Modulus of elasticity of pipe material	400,000	psi	NEH 636.5204a (PVC)
16	E'	Modulus of soil reaction	1000	psi	NEH 636 Tabe 52-2
17	E_{long}	Long-term modulus of elasticity	140,000	psi	NEH 636.5204a(3)
18	SDR	Outside dimension Ratio (D_0/t)	51		
19	SIDR	Inside dimension Ratio (D_I/t)	48.9		
20	**Pipe Loading**				
21	W_S	Soil load per lineal foot of pipe	620	lbs	NEH 636.5203a Eqns. 52-17 and 52-18
22	P_S	Pressure on pipe due to weight of soil	300	psf	
23	P_L	Wheel load at the surface in pounds	10,000	lbs	NEH 636.5203b (Field Equipment)
24	I_f	Impact factor	1		NEH 636.5203b
25	W_L	Wheel load per lineal foot of pipe	1,452	lbs	NEH 636.5203b Eqn. 52-19 or Eqn 52-20
26		Load pressure distribution controlling equation	Eqn. 52-19		NEH 636.5203b
27	P_w	Pressure on pipe due to wheel load	703	psf	NEH 636.5203b Eqn. 52-21
28	P_v	Pressure on pipe due to internal vacuum pressure	0	psf	
29	W_v	Vacuum load per lineal foot of pipe	0	psf	NEH 636.5203c Eqn. 52-23
30	P_G	Pressure on pipe due to external hydrostatic pressure	156	psf	NEH 636.5204a Eqn. 52-24
31	P_T	Total pressure on pipe (prism load)	1,159	psf	NEH 636.5204a Eqn. 52-25
32	**Wall Crushing Design Check**				
33	T_{PW}	Thrust in pipe wall	1,197	lb/ft	NEH 636.5204a Eqn. 52-26
34	σ	allowable long-term compressive stress	2,000	psi	NEH 636 Appendix 52C, table 52C-1 (PVC cell class 12454)
35	A_{PW}	Required wall cross-sectional area	0.050	in^2/in	NEH 636.5204a Eqn. 52-27
36	t	Actual wall cross-sectional area	0.486	in^2/in	
37		**Required wall cross-sectional area < actual**	**OK**		
38	**Ring Deflection Design Check**				
39	L_{DL}	Deflection lag factor	1.5		NEH 636.5204a
40	K_{BED}	Bedding factor	0.1		NEH 636.5204a
41	$\Delta X/D_I$	Vertical Deflection	1.27	%	NEH 636.5204a Eqn. 52-29 (solid-wall plastic pipe)
42		Safe Deflection Limit (Percent of Diameter)	7.5	%	NEH 636.5204a (liquid conveyance practice)
43		**Percent Vert. Deflection < Safe Deflection Limit**	**OK**		
44	**Wall Buckling Design Check**				
45	FS	Design Factor of Safety	3		NEH 636.5204a(3)
46	R_w	Water Bouyancy Factor	0.67		NEH 636.5204a(3)
47	B'	Emperical coefficient of elastic support	0.6096		NEH 636.5204a(3)
48	I_{pw}	Pipe wall moment of inertia	0.0096	in^4/in	NEH 636.5204a(3)
49	q_a	Allowable buckling pressure	1,626	psf	NEH 636.5204a(3) Eqn. 52-33
50		**Allowable buckling pressure > Prism load**	**OK**		
51		**Safety Factor Against Buckling**	**4.21**		
52	C	Out-of-round reduction factor	0.8922		NEH 636.5204a(3) Eqn. 52-34
53	q_aC	Reduced Allowable Buckline Pressure	1,451	psf	NEH 636.5204a(3) Eqn. 52-34
54		**Reduced allowable buckling pressure > Prism load**	**OK**		
55		**Safety Factor Against Buckling (out-of-round reduced)**	**3.76**		
56	**Partially Submerged Pipe Bouyancy**				
57	d	distance from pipe center to water surface	NA	ft	
58	α	1/2 Section Angle	NA	rad	
59	β	Full Section Angle	NA	rad	
60	A_1	Section Area	NA	ft^2	
61	A_2	Triangular Segment Area	NA	ft^2	
62	A_3	Displaced Area	NA	ft^2	
63	F_B	Buoyant Force per lineal foot of pipe	NA	lbs	
64	**Buoyant Force Design Check**				
65	W_D	Weight of dry soil per lineal foot of pipe	0	lbs	Design of PE Piping Systems, Ch. 6, Eqn. 3-33
66	W_S	Weight of saturated soil per lineal foot of pipe	324	lbs	Design of PE Piping Systems, Ch. 6, Eqn. 3-34
67	W_L	Weight of liquid in the pipe	192	lbs	Design of PE Piping Systems, Ch. 6, Eqn. 3-35
68	W_{TE}	Cumulative Weight (Empty)	350	lbs	
69	W_{TF}	Cumulative Weight (Full)	542	lbs	
70	F_B	Buoyant Force	209	lbs	Design of PE Piping Systems, Ch. 6, Eqn. 3-31
71	F_{Net}	Net Force (Empty)	-141	lbs	Net force down
72	F_{Net}	Net Force (Full)	-333	lbs	Net force down
73		**Safety Factor Against Flotation (Empty)**	**1.67**		
74		**Safety Factor Against Flotation (Full)**	**2.59**		

DVIP 24-inch SDR 51 (Floatation Check)

Project: Duck Valley Irrigation Project
Project No.: 4026.21024.02
Engineer: JKO
Date: 05/02/2017

Notes:
1) With saturation to ground surface and 3 ft of cover the FS against floatation empty is 2.0.

1	**Input Parameters**				
2		Pressure Class (PIP PVC)	80	psi	
3		Nominal Pipe Size (PIP PVC)	24	in	
4	h	depth of cover	3	ft	Design Min. Cover
5	D_{GW}	depth of ground water above pipe invert	5.07	ft	Assumed groundwater at ground surface
6	D_W	depth of flood water above ground	0	ft	
7	*Soil Properties*				
8	w	Unit weight of soil	120	pcf	
9	w_S	Saturated unit weight of soil	120	pcf	
10	*Pipe Properties*				
11	D_0	Pipe outside diameter	24.803	in	JM Eagle Manufacturer's Literature
12	D_I	Average inside diameter	23.77	in	JM Eagle Manufacturer's Literature
13	t	Minimum wall thickness	0.486	in	JM Eagle Manufacturer's Literature
14	W_P	Weight of the pipe per lineal foot	26.32	lbs	
15	E	Modulus of elasticity of pipe material	400,000	psi	NEH 636.5204a (PVC)
16	E'	Modulus of soil reaction	400	psi	NEH 636 Tabe 52-2
17	E_{long}	Long-term modulus of elasticity	140,000	psi	NEH 636.5204a(3)
18	SDR	Outside dimension Ratio (D_0/t)	51		
19	SIDR	Inside dimension Ratio (D_I/t)	48.9		
20	**Pipe Loading**				
21	W_S	Soil load per lineal foot of pipe	744	lbs	NEH 636.5203a Eqns. 52-17 and 52-18
22	P_S	Pressure on pipe due to weight of soil	360	psf	
23	P_L	Wheel load at the surface in pounds	0	lbs	NEH 636.5203b (Field Equipment)
24	I_f	Impact factor	1		NEH 636.5203b
25	W_L	Wheel load per lineal foot of pipe	0	lbs	NEH 636.5203b Eqn. 52-19 or Eqn 52-20
26		Load pressure distribution controlling equation	Eqn. 52-19		NEH 636.5203b
27	P_w	Pressure on pipe due to wheel load	0	psf	NEH 636.5203b Eqn. 52-21
28	P_v	Pressure on pipe due to internal vacuum pressure	0	psf	
29	W_v	Vacuum load per lineal foot of pipe	0	psf	NEH 636.5203c Eqn. 52-23
30	P_G	Pressure on pipe due to external hydrostatic pressure	187	psf	NEH 636.5204a Eqn. 52-24
31	P_T	Total pressure on pipe (prism load)	547	psf	NEH 636.5204a Eqn. 52-25
32	**Wall Crushing Design Check**				
33	T_{PW}	Thrust in pipe wall	566	lb/ft	NEH 636.5204a Eqn. 52-26
34	σ	allowable long-term compressive stress	2,000	psi	NEH 636 Appendix 52C, table 52C-1 (PVC cell class 12454)
35	A_{PW}	Required wall cross-sectional area	0.024	in^2/in	NEH 636.5204a Eqn. 52-27
36	t	Actual wall cross-sectional area	0.486	in^2/in	
37		**Required wall cross-sectional area < actual**	**OK**		
38	**Ring Deflection Design Check**				
39	L_{DL}	Deflection lag factor	1.5		NEH 636.5204a
40	K_{BED}	Bedding factor	0.1		NEH 636.5204a
41	$\Delta X/D_I$	Vertical Deflection	1.41	%	NEH 636.5204a Eqn. 52-29 (solid-wall plastic pipe)
42		Safe Deflection Limit (Percent of Diameter)	7.5	%	NEH 636.5204a (liquid conveyance practice)
43		**Percent Vert. Deflection < Safe Deflection Limit**	**OK**		
44	**Wall Buckling Design Check**				
45	FS	Design Factor of Safety	3		NEH 636.5204a(3)
46	R_w	Water Bouyancy Factor	0.67		NEH 636.5204a(3)
47	B'	Emperical coefficient of elastic support	0.6229		NEH 636.5204a(3)
48	I_{pw}	Pipe wall moment of inertia	0.0096	in^4/in	NEH 636.5204a(3)
49	q_a	Allowable buckling pressure	1,039	psf	NEH 636.5204a(3) Eqn. 52-33
50		**Allowable buckling pressure > Prism load**	**OK**		
51		**Safety Factor Against Buckling**	**5.7**		
52	C	Out-of-round reduction factor	0.8811		NEH 636.5204a(3) Eqn. 52-34
53	q_aC	Reduced Allowable Buckline Pressure	915	psf	NEH 636.5204a(3) Eqn. 52-34
54		**Reduced allowable buckling pressure > Prism load**	**OK**		
55		**Safety Factor Against Buckling (out-of-round reduced)**	**5.02**		
56	**Partially Submerged Pipe Bouyancy**				
57	d	distance from pipe center to water surface	NA	ft	
58	α	1/2 Section Angle	NA	rad	
59	β	Full Section Angle	NA	rad	
60	A_1	Section Area	NA	ft^2	
61	A_2	Triangular Segment Area	NA	ft^2	
62	A_3	Displaced Area	NA	ft^2	
63	F_B	Buoyant Force per lineal foot of pipe	NA	lbs	
64	**Buoyant Force Design Check**				
65	W_D	Weight of dry soil per lineal foot of pipe	0	lbs	Design of PE Piping Systems, Ch. 6, Eqn. 3-33
66	W_S	Weight of saturated soil per lineal foot of pipe	384	lbs	Design of PE Piping Systems, Ch. 6, Eqn. 3-34
67	W_L	Weight of liquid in the pipe	192	lbs	Design of PE Piping Systems, Ch. 6, Eqn. 3-35
68	W_{TE}	Cumulative Weight (Empty)	410	lbs	
69	W_{TF}	Cumulative Weight (Full)	602	lbs	
70	F_B	Buoyant Force	209	lbs	Design of PE Piping Systems, Ch. 6, Eqn. 3-31
71	F_{Net}	Net Force (Empty)	-201	lbs	Net force down
72	F_{Net}	Net Force (Full)	-393	lbs	Net force down
73		**Safety Factor Against Flotation (Empty)**	**1.96**		
74		**Safety Factor Against Flotation (Full)**	**2.88**		

Attachment 3
Pipeline Materials List

Materials List: Agency Lateral FG

Project: Duck Valley Irrigation Project

Client: Shoshone-Paiute Tribes of the Duck Valley Reservation

Notes:

List of materials and quantities are estimated and are intended for planning purposes only. In some cases fittings may be able to be combined to conserve costs. Work with materials suppliers prior to placing order to confirm the materials and quantities shown below and determine final parts order. Note also that not all individual components of an assembly feature are listed herein. For example, the air vent assembly includes saddle tee, weld neck flange, pipe, return bend, wire mesh, etc. review standard details with materials suppliers to determine individual components of assemblies prior to placing order.

Pipeline Station	Item Description	Quantity	Notes
10	PRECAST SUBMERGED ORIFICE INLET STRUCTURE WITH WALKWAY GRATING	1	
10	TRASH RACK	1	
10	CANAL GATE 24"	1	
10	AIR VENT PIPE ASSEMBLY (4")	1	
26	SDR41 PIP PVC 45 DEG. BEND 24" GSKT	1	VERTICAL DOWNWARD BEND
30	SDR41 PIP PVC 45 DEG. BEND 24" GSKT	1	VERTICAL BEND
1,072	AIR VENT PIPE ASSEMBLY (2")	1	
1,085	SDR41 PIP PVC 90 DEG. BEND 24" GSKT	1	
2,355	SDR41 PIP PVC 90 DEG. BEND 24" GSKT	1	
2,365	TYPE 1 DELIVERY	1	RT. TRACT 1101 (EAST DELIVERY)
2,400	AIR VENT PIPE ASSEMBLY (2")	1	
3,630	TYPE 1 DELIVERY	1	RT. TRACT 1101 (WEST DELIVERY)
3,672	COMBO AIR VALVE ASSEMBLY (2")	1	
3,688	TYPE 1 DELIVERY	1	RT. TRACT 1102
4,995	COMBO AIR VALVE ASSEMBLY (2")	1	
6,250	TYPE 1 DELIVERY	1	RT. TRACT 1103
6,323	COMBO AIR VALVE ASSEMBLY (2")	1	
6,330	TYPE 1 DELIVERY	1	USE 24" SOL WLD X 18" SOL WLD X 18" GSKT SDR41 PIP PVC TEE. TRACT 1138 DELIVERY IS INLINE, TEE LEG (RT)OF FITTING IS TO TRACT 1104 DELIVERY.
6,330	TYPE 1 DELIVERY	1	SHARES A TEE FITTING WITH TRACT 1138 DELIVERY
6,344	DRAIN ASSEMBLY TO OPEN CHANNEL	1	18" GSKT X 18" GSKT X 6" FLNG SDR41 PIP PVC TEE
6,344	6" BUTTERFLY VALVE W/ VALVE BOX AND RISER	1	WITH POLYETHYLENE WRAP
6,344	6" FLAP GATE	1	
6,362	SDR41 PIP PVC 45 DEG. BEND 18" SOL WLD	1	
0	18" SDR41 PIP PVC PIPE	150	DELIVERY PIPE: ASSUMED TO BE 30 FT PER DELIVERY
0	24" SDR51 PIP PVC PIPE	6,320	MAINLINE PIPE: MEASURED CONTINUOUS THROUGH FITTINGS, DOES NOT INCLUDE WASTE OR CONTINGENCY

Pipeline Station	Item Description	Quantity	Notes
0	6" CORRUGATED HDPE PIPE AND FLANGE ADAPTER	1,243	DRAIN PIPE: MEASURED CONTINUOUS THROUGH FITTINGS, DOES NOT INCLUDE WASTE OR CONTINGENCY. FITTINGS ARE NOT ITEMIZED SEPERATELY BUT CONSIDERED INCIDENTAL.