DESIGN REPORT

FOR

PITTMAN TERRACE WATER QUALITY IMPROVEMENT PROJECT

GLENBROOK, NEVADA

April 2018

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TABLE OF CONTENTS

1.0 INTRODUCTION....1

1.1 Project Location....1

1.2 Project Funding....2

2.0 EXISTING CONDITIONS....2

2.1 Land Capability....2

2.2 Existing Soils....3

2.3 Catchments....3

2.4 Design Flows....4

3.0 DESIGN....7

3.1 Conveyance Channels....7

3.2 Culvert and Microbasins....8

3.3 Infiltration Features....9

3.4 Trench Drain and Vegetated Access Road....9

3.5 Revegetation....10

3.6 Utility Conflicts....11

3.7 Lake Clarity Crediting....11

4.0 Project Permitting....12

4.1 TRPA EIP Project Permit....12

4.2 Stormwater Pollution Plan Prevention (SWPPP)....12

4.3 NDOT Permit....12

4.4 Douglas County Permit....12

5.0 Maintenance Plan....13

5.1 NDOT Maintenance Responsibilities....13

5.2 Pittman Terrace HOA Maintenance Responsibilities....13

6.0 REFERENCES....14

APPENDIX A: Calculations

APPENDIX B: Responses to 90 & 50 Percent Design Comments

LIST OF FIGURES

Figure 1. Project Area Vicinity Map 1

Figure 2. Project Area NRCS Soil Map Units. The area of interest is outlined in blue. 3

Figure 3. Catchments Overview (placeholder) 4

Figure 4. Catchments Detail (placeholder) 6

LIST OF TABLES

Table 1. Funders and Funding Amounts 2

Table 2. Existing Conditions Design Storm (25 year, 24 hour) HEC-HMS Results 4

Table 3. Existing Conditions Design Storm (25 year & 100 year, 24 hour) Rational Method Results 7

Table 4. Funders Seed mix for project revegetation. 10

Table 5. PLRM Results 11

1.0 INTRODUCTION

Pittman Terrace is a steep neighborhood that sits on Lake Tahoe's east shore directly below US Highway 50. For over a decade, residents in the neighborhood have expressed concern about sediment laden stormwater runoff traveling through their neighborhood and into Lake Tahoe. In 2015, the Nevada Tahoe Conservation District applied for and successfully received funding to plan, design, and construct the Pittman Terrace Water Quality Improvement Project (WQIP). The primary goal of the Pittman Terrace WQIP (Project) is to treat stormwater before discharge to Lake Tahoe. The Project employs a combination of stormwater treatment, outfall stabilization, and road operations in both NDOT Right-of-Way and the lakeside Pittman Terrace community. PLRM v1.1 Baseline modeling indicates the NDOT HWY 50 catchment is a high priority catchment due to being a high pollutant loading and directly connected catchment.

The objectives are as follows:

1. Stabilize the eroding channels and dirt paths within the Pittman Terrace neighborhood to convey runoff from Highway 50 without contributing additional pollutants and transporting those pollutants to Lake Tahoe.
2. Partner with the Pittman Terrace Homeowners to install stormwater treatment infrastructure in conjunction with their planned road repaving project.
3. Through PLRM modeling and catchment registration, garner Lake Clarity Credits for NDOT and Douglas County.

1.1 PROJECT LOCATION

The Pittman Terrace Water Quality Improvement Project (Project) is located within Douglas County, Nevada, T14NR18E Sec27. The nearest cross streets are Highway 50 and Friedhoff Street. The Project encompasses private, county, and state (Nevada Department of Transportation and Nevada Division of State Lands) property. Though the neighborhood only has ¼ mile of roads and 16 single family homes, its location on a steep hill directly adjacent to Lake Tahoe and immediately below the 4 lane US Highway 50 has 5 stormwater outfalls that are directly connected to Lake Tahoe. The steep slope and majority private ownership limits stormwater treatment opportunities. See Figure 1 below for Project vicinity.

Figure 1. Project Area Vicinity Map

1.2 PROJECT FUNDING

The Project received funding from the Nevada Division of Environmental Protection (NDEP), the Nevada Department of Transportation (NDOT), and the Nevada Division of State Lands (NDSL). The funding amounts are listed in Table 1.

Table 1. Funders and Funding Amounts

Funder	Funding Amount
Nevada Division of Environmental Protection (EPA 319h)	$127,000.00
Nevada Department of Transportation	$242,009.20
Nevada Division of State Lands	$127,758.84

Project partners include the funders and jurisdictions listed above as well as the following regulatory agencies and stakeholders: Pittman Terrace Homeowners Association (PTHOA), Douglas County, and the Tahoe Regional Planning Agency (TRPA).

2.0 EXISTING CONDITIONS

The Project contains the residential neighborhood of Pittman Terrace with single family dwellings on mostly ¼ acre or smaller lots. The Project area accepts run-on from a portion of Highway 50 adjacent to and up gradient of the neighborhood, which produces a majority of the runoff and sediment loading. Another source of water volume comes from an approximately 350 acres natural drainage that passes under Highway 50. The neighborhood and Highway 50 right-of-way are constrained in area available for stormwater treatment by both available open space and steep slopes throughout the Project area.

2.1 LAND CAPABILITY

The USFS and TRPA developed the Bailey land capability system in the early 1970s based primarily on the official US Department of Agriculture (USDA) soils maps for the Tahoe Region (Bailey, 1974). Each soil type was assigned to a land capability class ranging from 1 to 7, with capability 1 being the most environmentally fragile and sensitive to development. Wherever land was found to be influenced by a stream or high groundwater, it was assigned to capability 1B, also known as "Stream Environment Zone" or SEZ. The Pittman Terrace WQIP Project is located within TRPA land capability classes 1A, 1B, and 2. The 1B area is located in the natural drainage area in the center of the project area. The upland watershed mainly comprises the class 1A capability which indicates land sensitive to development due to its steep terrain. The class 2 capability includes the residential parcels. Project improvements are anticipated to be constructed in the 2 land capability classes along or adjacent to existing roadways. Some improvements may be constructed in the eroding drainage for natural, residential, and highway run-off, which is currently labeled as 1B. No improvements may be constructed within the TRPA-delineated backshore.

2.2 EXISTING SOILS

The Natural Resources Conservation Service (NRCS) soil survey indicates that the Project area is located within soil map units 7101, 7412-7414, 7421-7424. Soil unit 7101 is Caverock sandy loam, 9 to 50 percent slopes and Hydrologic Group C. This soil is a very small portion of the Project watershed containing the geologic feature Cave Rock which spans Highway 50. Soil units 7412 through 7414 is Cagwin-Rock outcrop complex, extremely stony with varying slopes and Hydrologic Group B. Units 7421-7324 is Cassenai gravelly loamy coarse sand, very stony with varying slopes and Hydrologic Group A. See Figure 2 for soils map. Locations of infiltration features are planned on group A soils only, which are very fast draining soils. Figure 2 shows NRCS soils groups for the watershed area.

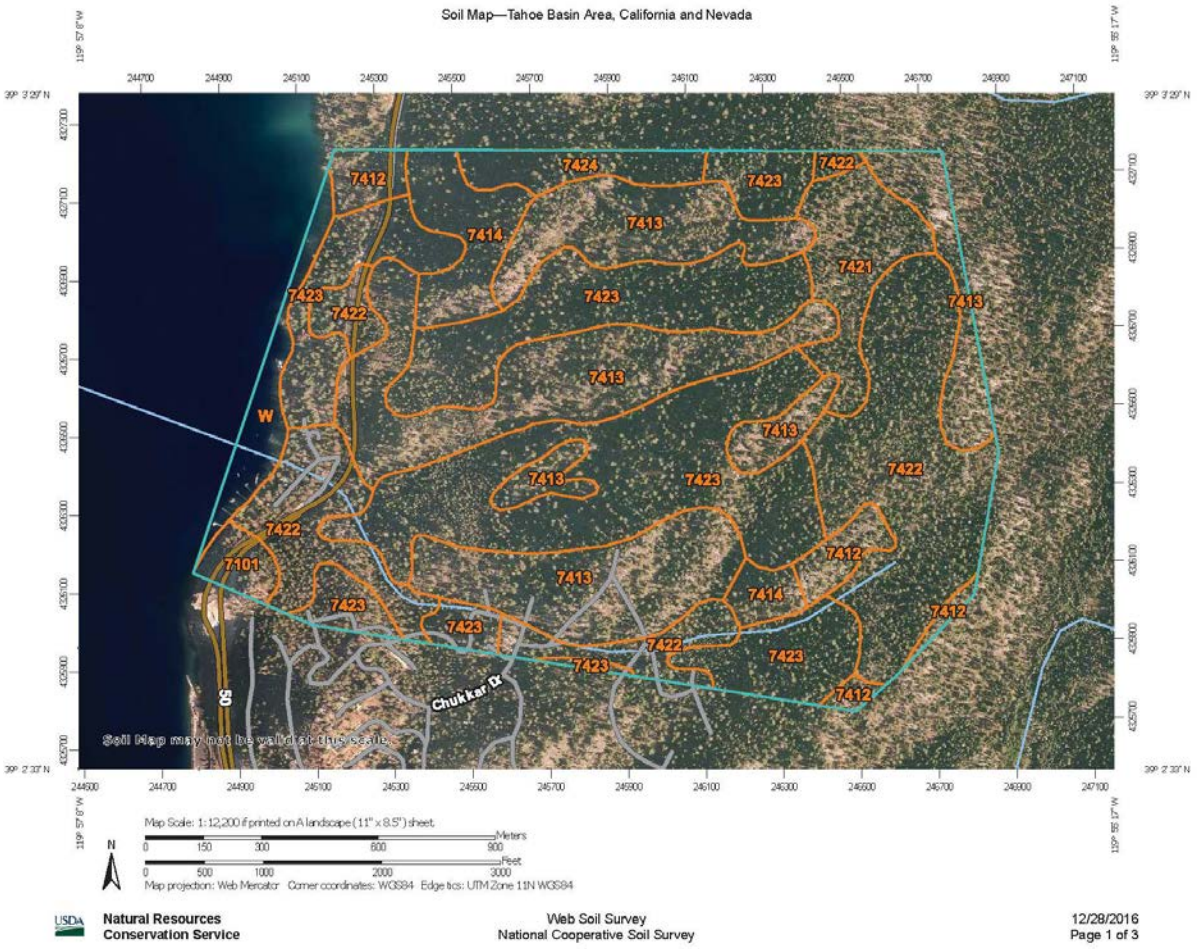


Figure 2. Project Area NRCS Soil Map Units. The area of interest is outlined in blue.

2.3 CATCHMENTS

The watershed area and sub-watersheds (or catchments) were delineated by NTCD using 2010 USGS 1 foot LiDAR and ESRI ArcGIS software ArcMap 10.3.1. Catchments were then refined to incorporate the effects of the existing drainage system under Highway 50 and throughout the neighborhood. Field verification and in person meeting with residents served as verification to the catchment delineation and

hydrologic modeling. Figures 3 and 4 display the catchment boundaries with drainage areas in acres and outfall locations. There are five stormwater outfalls in the Project area. Only three of the outfalls, (Outfall 2, Outfall 3, and Outfall 4) were considered for treatment due to project constraints (topology, private property, etc.) or lack of outlet connectivity directly to Lake Tahoe. The outlets are numbered from north to south. The largest catchment, producing the most water is PT06 with approximately 350 acres and is natural drainage above Highway 50 is routed under the highway and through the neighborhood. Most improvements have been focused downstream this area, which drains to Outfall 2. The second largest catchment, PT07 with approximately 28 acres has limited opportunities for improvements. NDOT has constructed several sediment cans in the right-of-way in this catchment. Downstream of the right-of-way, topology and private property constrain any possible infiltration. PT08 is the catchment encompassing the majority of the neighborhood and is the Lake Clarity Credit potential for Douglas County.

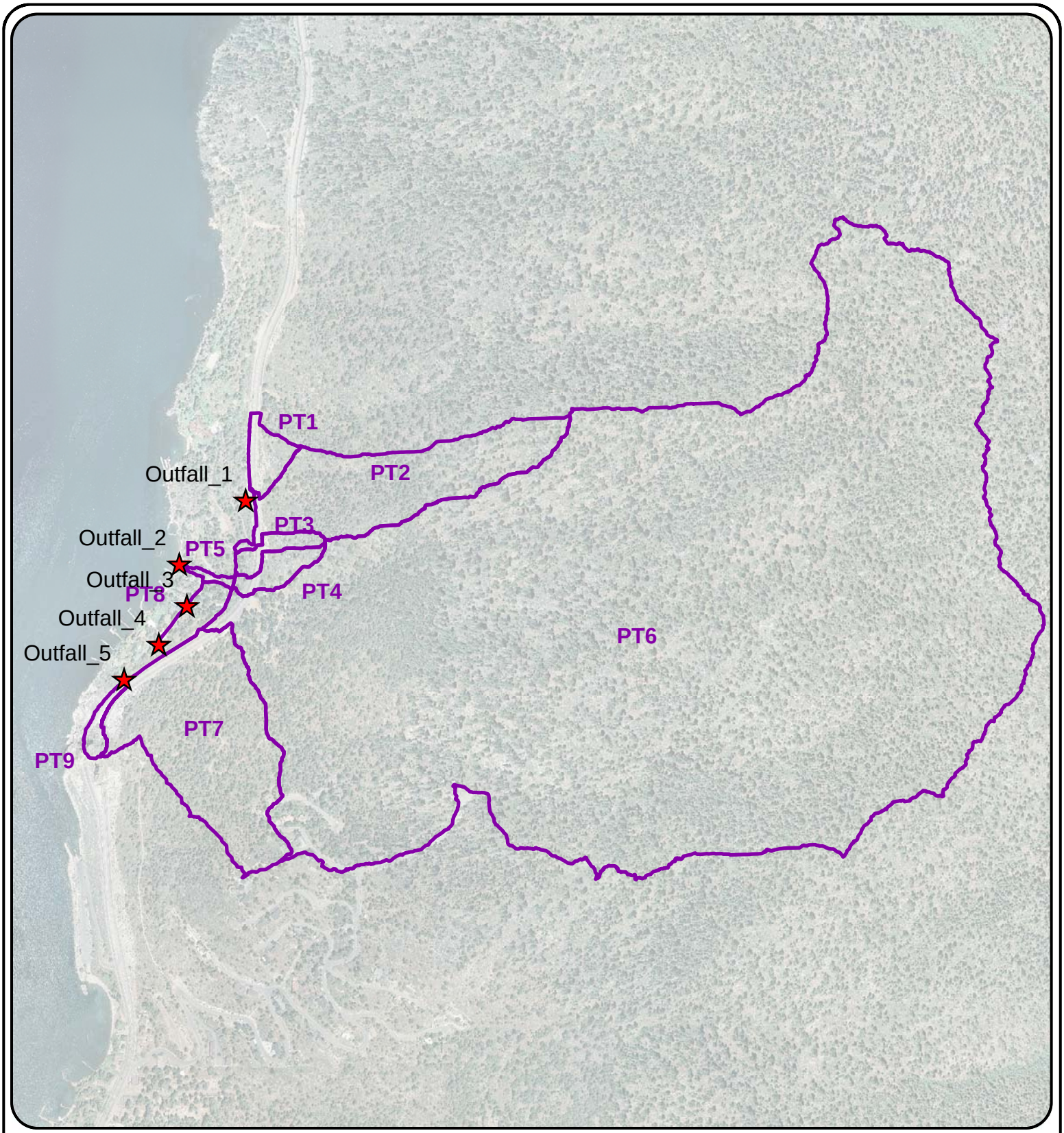
2.4 DESIGN FLOWS

Design flows including peak flow and volumes were calculated using the SCS method in the NRCS TR-55 Bulletin and utilizing HEC-HMS version 4.0.

The contributing watershed to the Pittman Terrace WQIP project area is approximately 410 acres. The watershed was divided into nine (9) existing catchments based on outlets and proposed treatment locations as described in Section 2.3. The peak flow and quantity of runoff for the 2, 25, 50, and 100-year, 24-hour storm events were determined for each catchment and each outlet. The precipitation intensity, i, was determined using the National Oceanic and Atmospheric Administration's (NOAA's) Precipitation Frequency Data Server. The 25-year storm is the design storm for Project conveyance per Douglas County standards. All treatment facilities are designed to the maximum extent practicable. The design storm results for the outfalls in existing conditions are summarized below in Table 3. The HEC-HMS input and results of the volume peak flow for existing conditions and all alternatives are displayed in Appendix A: Preliminary Hydrology (HEC-HMS).

Table 2. Existing Conditions Design Storm (25-year, 24-hour) HEC-HMS Results

Outfall No.: Description	Drainage Area (mi^2)	Peak Flow (cfs)	Volume (ac-ft)
1: North Hwy 50 (no improvements)	0.004	0.5	0.3
2: Main Drainage Path	0.587	3.9	2.5
3: Neighborhood Drainage	0.004	0.1	0.1
4: Draining PT07	0.043	0.4	0.3
5: Draining PT09 (no improvements)	0.002	0.7	0.2



Legend

- Outfalls
- Catchments

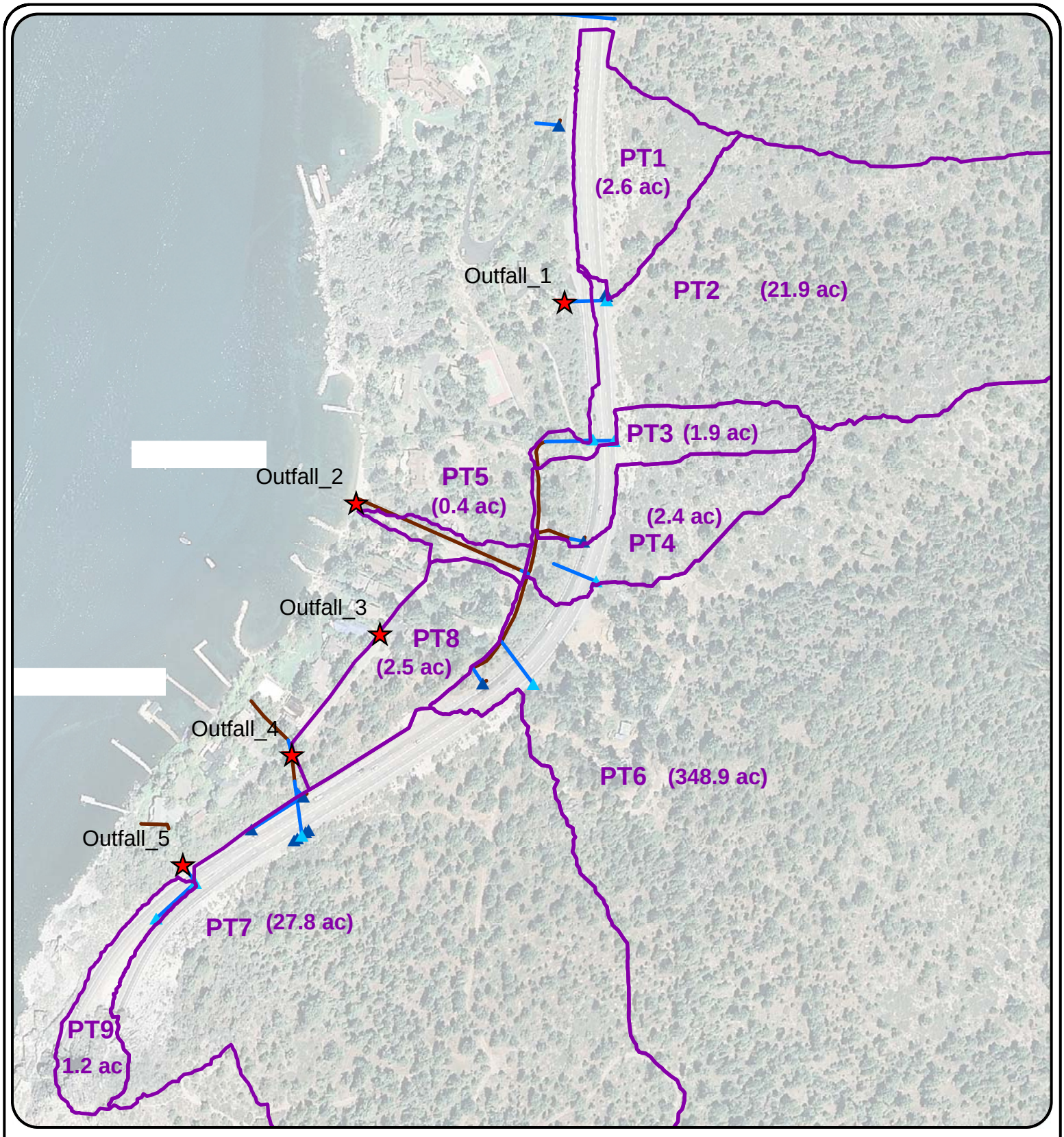
FIGURE 3:
Pittman Terrace WQIP
Existing Catchments Overall

1 in = 917 feet

0 260 520 1,040 1,560 2,080 Feet

UTM Zone 10N	NAD 83	horiz. units: feet
Prepared by NTCD		December 2016

Nevada Tahoe Conservation District



Legend

- Outfalls
- Catchments
- Ex Drainage Inlet
- Ex Sediment Trap
- Ex Conveyance Pipe
- Ex Conveyance Ditch

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FIGURE 4:
Pittman Terrace WQIP
Existing Catchments Detail

1 in = 292 feet

0 80 160 320 480 640 Feet

UTM Zone 10N	NAD 83	horiz. units: feet
Prepared by NTCD		December 2016

The rational method was used to design features that drain small areas, specifically the rock lined channel on Friedhoff Drive and the trench drain at the end of Douglas Boulevard. The short time of concentration makes the TR-55 method inappropriate for these drainage areas. The results were as follows:

Table 3. Existing Conditions Design Storm (25-year & 100-year, 24-hour) Rational Method Results

Drainage Area Description	Total A [SF]	Composite C25	Composite C100	i(25) [in/hr]	i(100) [in/hr]	Q25 [cfs]	Q100 [cfs]
PT05	18,449	0.7	0.80	0.479	0.694	0.13	0.23
PT06b (Friedhoff RLC)	34,256	0.8	0.90	0.315	0.456	0.21	0.32
Douglas Blvd to Trench Drain	3,889	0.8	0.87	0.479	0.456	0.03	0.04

3.0 DESIGN

The major design components of the project include conveyance ditches along Friedhoff Drive and Douglas Blvd, micro-basin grading, upgrading the culvert that passes under Flowers Ave, an infiltration feature along Friedhoff Drive and on Pittman Terrace, a trench drain and vegetated access road at the end of Douglas Blvd, and retrofitting the existing NDOT infiltration feature on the Highway 50 shoulder. Construction of design features is anticipated to be completed in spring/summer of 2018.

3.1 CONVEYANCE CHANNELS

Channels were sized using HEC-22: Urban Drainage Manual procedures for hydraulic capacity calculations. All conveyance channels are designed to Douglas County standards (Douglas County, 2017) with noted exceptions below. The County Standard is to design conveyance to the 25-year, 24-hour storm with 1-foot of freeboard in the channel. See Appendix A for calculations.

The conveyance channel adjacent to Friedhoff Drive is proposed to be built directly adjacent to the roadway pavement. The current shoulder is 3-5 feet of relatively flat ground before the start of a steep gradient that supports Highway 50. The topography does not allow for any significant shoulder area with proposed conveyance. Because of the proximity of the travel way, the channel has been designed as shallow as possible.

On Friedhoff Drive, the area upstream of the exiting 24-inch CMP culvert is designed as a rock lined channel with 2:1 slopes, a 3.5-foot top width, and a 0.75-foot depth. At a channel depth of 0.25 -feet, the channel will pass 0.43 cfs, which passes both the 25-year (0.21 cfs) and the 100-year (0.32 cfs) design storm with over 0.5-feet of freeboard. Considering the proximity to the roadway and the low design flow of the channel, at least 6-inches of freeboard was considered reasonable instead of the Douglas County standard 1-foot.

On Friedhoff Drive, the area downstream of the existing 24-inch CMP culvert needs to convey significantly more flow than the upstream rock lined channel and the slope is not as steep. A block channel was used to take advantage of steeper side slopes, 1:1, so that more depth and flow area could be achieved given the limited available width. The block channel will have a 4.3-feet top width and a 1.5 foot depth. At a channel depth of 1 -foot, the channel will pass 3.8 cfs, which exceeds both the 25-year design storm (3.2 cfs) with over 6-inches of freeboard. Considering the proximity to the roadway and the low design flow of the channel, at least 6-inches of freeboard was considered reasonable for the block channel instead of the Douglas County standard 1-foot.

The Douglas Boulevard conveyance channel also has sizing constraints. The channel was designed as a rock lined channel to fit between the property line, roadway, above and underground utilities, boulder outcroppings, and an existing historic column. The channel profile slope varies between 7% and 14%. The channel dimensions are 2:1 side slopes, a 7-foot top width, and a 1.5-foot depth. The channel conveys both the 25 and 100-year design storms. The 25-year design storm is passed with 0.8-feet of freeboard. Considering the constraints and the low design flow of the channel, at least 6-inches of freeboard was considered reasonable for the channel instead of the Douglas County standard 1-foot.

The rock drop structures within the Douglas Blvd channel are designed as added treatment features and have the additional advantage of making the conveyance channel look more natural. The rock drops will appear as a cascading stream as opposed to a roadside ditch. The drop structures are designed to pond 0.5-feet over 8 or 10 feet and will encourage infiltration and sediment removal in the channel.

A microbasin was called out in the 50% design within the Douglas Blvd channel downstream of Friedhoff Drive. This microbasin was adjusted for 90% to be called out as a wider part of the rock lined channel. This wider section of channel will fulfill the same purpose as a microbasin. Similar to the rock drops, it is designed to pond 1.8-feet over 17 feet and will encourage infiltration and sediment removal in the channel.

The rock in all channels was sized using HEC-15: Design of Roadside Channels with Flexible Linings and referencing Design and Construction of Urban Stormwater Management Systems, ASCE Manual No. 77.

3.2 CULVERT AND MICROBASINS

Culverts were sized using HEC-22: Urban Drainage Manual procedures for hydraulic capacity calculations. The existing 15” CMP culvert under Flowers Ave was found to be undersized. A new 15” RCP with a greater slope and a slightly different alignment will replace the existing. Minimum cover shall be 18-inches as required by Douglas County standards.

The microbasin was sized as big as possible considering property boundaries. The size was also limited due to proximity of the road and the depth limited by the relatively flat roadside conveyance in the area. The basin is 1.5-feet deep with 90 square feet of treatment area. The second microbasin presented in the 50% design is discussed in Section 3.1.

between 5 and 15 Rip-rap Protection or Energy Dissipater (see Riprap Protection at Outlets section in "Design and Construction of Urban Stormwater Management Systems" ASCE Manual No. 77).

3.3 INFILTRATION FEATURES

The Friedhoff infiltration feature runs adjacent to Friedhoff Drive, within and below the proposed roadside block channel. The feature will allow for infiltration and treatment that the block channel cannot necessarily provide. The feature has a drop inlet connected to two 35' long perforated HDPE pipe with 0% slope. When the feature reaches capacity, water will be bypassed by continuing down the conveyance channel. When the water infiltrates, additional water may enter the feature. The feature was designed to be as big as possible considering the available topography. The drop inlet was analyzed using the HEC-22 weir and orifice equations.

The Pitman Terrace infiltration feature will be constructed in place on an existing drainage inlet along Pittman Terrace Drive. The feature has a drop inlet connected to two 20' long perforated HDPE pipe with 0% slope. When the feature reaches capacity, water will pond in the roadway until infiltration occurs as it does in the existing design. The drop inlet was analyzed using the HEC-22 weir and orifice equations with a 50% clogging factor to protect against clogging for inlets in sump. The existing DI has no outlet and flooding can occur in the street. The proposed design also has no outlet and is anticipated to improve but not eliminate flooding.

The retrofitted Highway 50 infiltration system was designed to be as large as possible given cost and maintenance considerations. Perforated CMP was used because the improvement is located within the NDOT right of way. The 18" size of the new CMP and the depth of drain rock was based on the existing system size. The 100-foot length of pipe on each side was based on cost and a practical accessible length for NDOT maintenance crews.

The original preferred alternative also had an infiltration feature proposed on Flowers Ave.
Construction was not possible due to the proximity of private property boundaries to the existing paved road.

3.4 TRENCH DRAIN AND VEGETATED ACCESS ROAD

At the end of the paved section of Douglas Blvd, a 6-inch wide trench drain is proposed. The purpose of the trench drain is to catch any water coming from the steeply graded paved Douglas Blvd before it reaches the unpaved portion. The trench drain will be configured to drain directly into proposed rock lined channel, 0.5 ft above flowline. The outlet will be shaped to minimize its appearance and obstruction of the proposed rock lined channel. The trench drain sizing was calculated using the manufacturer's

design guide (ABT Inc., 2015). The sizing spreadsheet is included in Appendix A. The 22' long trench drain with a 6" grate and a 2.3% slope shown on the plans is capable of conveying 2.45 cfs, which is well above the 100-year peak flow for the drainage area, which is 0.04 cfs. This design was changed from 50-90% design to a trench drain from a valley gutter because of TAC comments on valley gutter performance concerns.

The unpaved portion of Douglas Blvd is an access route for both beach recreation and maintenance of a water pump station and other utilities. The access was designed to maintain a ten foot width to allow for occasional vehicle access. The TAC showed a preference in the 50% Design Comments, see Appendix B, to have vegetated erosion control on the access road instead of a hardscape feature. Due to the steep slope of the road, a rolling dip was added to catch any runoff falling on the road itself and prevent riling and soil erosion. The rolling dip was designed based on US Forest Service standard details (USFS, 2018) and NRCS recommended minimum spacing of 100' for grades of 15% (NRCS, 2018).

3.5 REVEGETATION

Revegetation proposed for the area of disturbance is an upland native seed mix covered by a layer of mulch for temporary erosion protection. All channels will be revegetated. The seed mix is listed in Table 4.

Table 4. Seed Mix for Project Revegetation.

SPECIES	Percent Seed Mix (%)
Streambank Wheatgrass 'Sodar'	9.40
Big Bluegrass	5.73
Fescue Idaho	12.01
Hard Fescue Durar	14.56
Squirreltail	4.80
Creeping Wildrye	4.96
Slender Wheatgrass	12.27
California Sierra Brome	6.77
Blue Flax	2.60
California Poppy	2.72
Sulfur-flower Buckwheat	2.79
Yarrow	2.48
Lupin Agenteus	2.54
Woods Rose	1.55
Mountain Big Sagebrush	1.23
Antelope Bitterbrush	2.54
Penstemon Eatonii	4.80

3.6 UTILITY CONFLICTS

There are several potential areas of conflict for utilities on the project. The design, to the extent practical, avoids potential conflicts but some accommodations will likely have to be made. All utility providers have been preliminarily alerted to potential conflicts.

Existing power poles and associated guy wires on Friedhoff and Douglas are within close proximity to grading boundaries. The power poles will be protected in place and may need temporary supports.

An existing private water system, owned by Vance and Rory Keeney has an active line buried within the existing Douglas Blvd drainage ditch. The Keeneys have expressed a willingness to move the lines, if necessary at their cost. There also may be up to two inactive lines within the Douglas Blvd ditch and road alignment.

An 8-inch DIP and PVC fire line and hydrant is proposed to be constructed in the 2018 construction season on the Douglas County parcel that will also contain the proposed Douglas Blvd rock lined channel. NTCD is working with the project owner and contractor to assure no conflict exists between the two projects. The fire line and hydrant are currently proposed to be constructed before the WQIP improvements.

3.7 LAKE CLARITY CREDITING

Table 5 details the results of the PLRM model used to calculate the potential FSP reduction as compared to the existing conditions for 50% design. The estimated PLRM credits achieved by this project are 10. One credit may be obtained by Douglas County and up to nine credits for NDOT. BMP rapid assessment method (RAM) will be performed by NTCD post construction.

Table 5. PLRM Results

	Water Quality Parameter			
Scenario	**FSP [lbs/yr]**	**FSP Load Reduction [lbs/yr]**	**Ave. Annual Removal % FSP**	**Est. PLRM Credit**
Baseline/Existing Conditions	4807			
Pittman Terrace Water Quality Improvement Project		1936	40.3%	10

Assumptions/Notes:

1. *Did not take into account private party BMPs. They remained at 7/19/5 for SFR/MFR/CICU respectively throughout the modeling*
2. *SFR/MFR/CICU % DCIA was estimated using PLRMv1.1 inputs and number of parcels discharging to the road vs. total number of parcels within sub-watersheds assuming each parcel is same size.*
3. *Based on NRCS soils maps, these load reductions and credit estimates are based on the higher default infiltration rates.*

4.0 PROJECT PERMITTING

The Project will require permits from the TRPA, NDOT, and Douglas County.

4.1 TRPA EIP PROJECT PERMIT

The Project will require a TRPA EIP Project Review Application and Initial Environmental Checklist.

4.2 STORMWATER POLLUTION PLAN PREVENTION (SWPPP)

The area of disturbance associated with the implementation of the preferred alternative is expected to be under an acre in size; therefore, a Stormwater Pollution Prevention Plan (SWPPP) will likely not be necessary. As the Project develops, the total disturbance area will be reassessed to assure SWPPP requirements are met.

4.3 NDOT PERMIT

Due to construction within the NDOT right-of-way, the Project will require an NDOT encroachment permit. Permit review will occur once the TAC meets and reviews the 90% design plans.

4.4 DOUGLAS COUNTY PERMIT

Due to construction within the Douglas County right-of-way, the Project will require a Douglas County Site Improvement Permit.

5.0 MAINTENANCE PLAN

The Project will require regular maintenance from NDOT and the Pittman Terrace GID. Maintenance requirements were considered during design to make each asset maintainable using equipment currently owned by those responsible entities.

5.1 NDOT MAINTENANCE RESPONSIBILITIES

NDOT will maintain the installed conveyance along Friedhoff Drive and Douglas Blvd as well as the installed infiltration features on Highway 50 and Friedhoff Drive. Drainage inlets/outlet structures as well as infiltration features will be cleaned at least annually using a vactor truck. Pipe maintenance and sediment buildup should not be an issue as culvert calculations show greater than the minimum 0.25 percent slope and 3 fps requirement.

Thorough cleaning/replacement of the rock lined channel is not expected to be necessary over the 20-year maintenance requirement for the project. Removal of sediment from the microbasin and rock drop structures is expected every five years or less frequently. Channel should be inspected after large events (greater than the 25-year, 24-hours design storm) to identify any damages and repair as necessary.

5.2 PITTMAN TERRACE HOA MAINTENANCE RESPONSIBILITIES

The Pittman Terrace HOA will be responsible for maintenance of the improvements not related to NDOT run off from the highway. These improvements include the Pittman Terrace infiltration feature, the trench drain, and the vegetated access path. The infiltration feature and trench drain will need annual inspection after spring runoff events and shall be maintained as necessary. These improvements are expected to need to be cleaned out at least every two years. The vegetated access path is expected not to need maintenance unless damage occurs from vehicle overuse. In the case of damage to the path, the HOA would be responsible for reestablishing vegetation and any regrading of the rolling dip.

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APPENDIX A: CALCULATIONS

Rational Method Calculations

Variable	Description
A	Area
V	Velocity
S	Slope
L	Length
i	rainfall intensity, in inches per hour, for the period of maximum rainfall of a given frequency having a duration equal to the time of concentration
Tt	travel time in gutter
Ti	initial flow time
Tc	time of concentration
C	runoff coefficient (composite based on land use %)
tc check	this is a way to check tc calcs, use the minimum of the 2.

Equations

Tt=L/V

Tc =Ti+Tt

(check) Tc = L/180 +10

$$V = 20.3282\sqrt{S}$$

$$Ti5 = \frac{1.8(1.1 - C5)\sqrt{L}}{S^{1/3}}$$

$$Ti100 = \frac{1.8(1.1 - C100)\sqrt{L}}{S^{1/3}}$$

$$Q = CiA$$

NDOT minimum tc of 5 min for pavement, 10 for land and pavement

Design Sub-catchment	Description	Total A (sf)	Gutter/ Channel Slope (S) (%)[4]	Avg V (ft/s)[1]	Paved L (ft)	Travel time Tt (min)	Land S (%)[2]	Land L (Ft)	Composite C5	Ti5 (min)	Composite C25	Ti25 (min)	Composite C100	Ti100 (min)	Tc5 (min)	Tc25 (min)	Tc100 (min)	Total L (ft)	Tc check (min)	Final Tc5 (min)	i(5) (in/hr)	Final Tc25 (min)	i(25) (in/hr)[3]	Final Tc100 (min)	i(100) (in/hr)	Q5 (cfs)	Q25 (cfs)	Q100 (cfs)
1	PT05	18,449	17.30	8.46	160	0.32	2	240	0.64	10.3	0.7	9.9	0.80	6.7	10.6	10.2	7.0	400	12.2	10.6	0.304	10.2	0.479	7.0	0.694	0.08	0.13	0.23
2	PT06b (Friedhoff RLC)	34,256	3.00	3.52	400	1.89	10	150	0.83	2.8	0.8	2.6	0.90	2.0	4.7	4.5	3.9	550	13.1	4.7	0.2	4.5	0.315	3.9	0.456	0.13	0.21	0.32
3	Douglas Blvd to trench drain	3,889	13.70	7.52	160	0.00	2	215	0.77	7.0	0.8	6.6	0.87	4.8	7.0	6.6	4.8	375	12.1	7.0	0.304	6.6	0.479	4.8	0.456	0.02	0.03	0.04

Notes:

1. V calcs best suited for flow paths > 100ft
2. Land slopes and lengths in pavement only areas are based on cross slopes
3. A duration of 5 minutes was used for all time of concentrations less than 5 minutes
4. NDOT minimum gutter slope of 0.3 was used in flat areas
5. Calculation methods based on 2009 Truckee Meadows Regional Drainage Manual

Rational Method Summary Table

Design Sub-catchment	Description	Total A (sf)	Composite C25	Composite C100	i(25) (in/hr)	i(100) (in/hr)	Q25 (cfs)	Q100 (cfs)
1	PT05	18,449	0.7	0.80	0.479	0.694	0.13	0.23
2	PT06b (Friedhoff RLC)	34,256	0.8	0.90	0.315	0.456	0.21	0.32
3	Douglas Blvd to trench drain	3,889	0.8	0.87	0.479	0.456	0.03	0.04

Composite Runoff Coefficient, C, Values										
		Land Use Area (sf)								
Area	Description	Paved Road	Open Space: Park	Undeveloped Forest	Business/ Commercial: Downtown	Residential: Multi-Family	Total Area (sf)	Composite C5	Composite C25	Composite C100
1	PT05	2,388	-	-	-	16,061	18,449	0.64	0.65	0.80
2	PT06b (Friedhoff RLC)	28,123	-	-	-	6,133	34,256	0.83	0.85	0.90
3	Douglas Blvd to trench drain	2,335	-	-	-	1,554	3,889	0.77	0.79	0.87
4										
5										
6										
7										

Summary of C Values*			
Land Use	C5	C25	C100
Paved Road	0.88	0.90	0.93
Open Space: Park	0.05	0.10	0.30
Undeveloped Forest	0.05	0.10	0.30
Business/ Commercial: Downtown	0.82	0.83	0.85
Residential: Multi-Family	0.60	0.62	0.78

**Source: Table 701 of 2009 Truckee Meadows Regional Drainage Manual*

Proposed Storm Drain System Capacity

Sizing of conveyance ditches and pipes for Friedhoff Dr and Douglas Blvd

Assumptions: Use Hec-22 proceedures for hydraulic capacity calculations. To be conservative assume full flow in the pipe, not under pressure. Peak flow will actually occur at 93% of the height of the pipe. Where multiple slopes exist, the most shallow slope is used to determine channel size.

Existing Friedhoff ditch is 0.4 to 0.9 feet deep off the existing edge of pavement, room available for improvements is about 3-5 feet width along shoulder

Proposed Friedhoff drainage channel (rock channel)	**value**	**notes**
Q25 (cfs)- from rational method	**0.21**	used rational method for small area
Q100 (cfs)- from rational method	**0.32**	
Length (ft)		
Upper Elevation (ft)		
Lower Elevation (ft)		
Slope (ft/ft)	8.50%	and 10.7%
Channel Size: Trapezoidal	3.5' top, .5' bttm, 0.75 ft deep, filled .25 ft	
Manning's n	0.035	veg and stone channel; Appendix 19.A, Lindeburgh: Civil Engineering Reference Manual, Tenth Edition
Shape	Trapezoidal	
Bottom Width (ft), b	0.5	assume rock channel
Side Slope (xH:1V)	2:1	
angle of Incline, θ, degrees	26.57	1:1 = 45deg; 2:1 = 26.6deg; 3:1 = 18.4deg
wetted depth, d	0.15	
P= Wetted Perimeter [ft]	0.80	b+ 2*(d/sin θ)
A= Cross sectional flow area [ft^2]	0.08	(b+(d/tanq))*d
R= Hydraulic Radius = A/P	0.10	
Velocity [ft/sec]	2.6	
Maximum Q [cfs]	**0.21**	meets required 25 year event frequency with over 0.6' freeboard. Passes 100 year with about 0.54' freeboard

Proposed Friedhoff drainage channel (turfstone)	**value**	**notes**
Q25 (cfs)- from PT06	**3.20**	HEC-HMS value
Q100 (cfs)- from PT06	**8.50**	
Length (ft)		
Upper Elevation (ft)		
Lower Elevation (ft)		
Slope (ft/ft)	0.50%	is 2.5% on steeper part but uniform channel is preferred
Channel Size: Trapezoidal	4.33'top, 16" bttm, 1.5 ft deep, filled 1 ft	
Manning's n	0.035	veg and stone channel; Appendix 19.A, Lindeburgh: Civil Engineering Reference Manual, Tenth Edition
Shape	Trapezoidal	
Bottom Width (ft)	1.333333333	turfstone = 16" x24" for one block
Side Slope (xH:1V)	1:1	
angle of Incline, θ, degrees	45.00	1:1 = 45deg; 2:1 = 26.6deg; 3:1 = 18.4deg
wetted depth, d	1.00	
P= Wetted Perimeter [ft]	3.68	b+ 2*(d/sin θ)
A= Cross sectional flow area [ft^2]	1.95	(b+(d/tanq))*d
R= Hydraulic Radius = A/P	0.53	
Velocity [ft/sec]	2.0	
Maximum Q [cfs]	**3.8**	exceeds required 25 with 0.5 ft freeboard and exceeds 100 year event frequency. 2.5% has ~7" freeboard at 25 year

Proposed douglas drainage channel	**value**	**notes**
Q25 (cfs)- from Outfall 02	**3.90**	
Q100 (cfs)- from Outfall 02	**9.80**	
Length (ft)	136.15	
Upper Elevation (ft)		
Lower Elevation (ft)		
Slope (ft/ft)	7.00%	min slope; 14% max slope
Channel Size: Trapezoidal	7'top, 1' bttm, 1.5 ft deep, 1 ft filled	
Manning's n	0.035	veg and stone channel; Appendix 19.A, Lindeburgh: Civil Engineering Reference Manual, Tenth Edition
Shape	Trapezoidal	
Bottom Width (ft), b	1	
Side Slope (xH:1V)	2:1	
angle of Incline, θ, degrees	26.57	1:1 = 45deg; 2:1 = 26.6deg; 3:1 = 18.4deg
wetted depth, d	1.00	filled 1 ft, 0.5' freeboard
P= Wetted Perimeter [ft]	3.02	b+ 2*(d/sin θ)
A= Cross sectional flow area [ft^2]	1.14	(b+(d/tanθ))*d
R= Hydraulic Radius = A/P	0.38	
Velocity [ft/sec]	5.9	
Maximum Q [cfs]	**6.7**	exceeds 25 year at min 2.5% 0.5 ft freeboard, need 5% for 100 year with no freeboard

Proposed Storm Drain System Capacity

Sizing of conveyance ditches and pipes for Friedhoff Dr and Douglas Blvd

Assumptions: Use Hec-22 proceedures for hydraulic capacity calculations. To be conservative assume full flow in the pipe, not under pressure. Peak flow will actually occur at 93% of the height of the pipe. Where multiple slopes exist, the most shallow slope is used to determine channel size.

Across Flowers culvert- existing	value	notes
Q25 (cfs)- 2,3,4, &6 = reach 3 peak	**3.90**	
Q100 (cfs)- 2,3,4, &6= reach 3 peak	**9.80**	
Length (ft)	17.3	
Upper Elevation (ft)	6300.7	
Lower Elevation (ft)	6300.6	
Slope (ft/ft)	0.58%	existing slope
Pipe Size, diameter (ft)	1.25	15" CMP
pipe radius	0.625	
Manning's n	0.024	value for CMP; Appendix 19.A, Lindeburgh: Civil Engineering Reference Manual, Tenth Edition
Shape	circle	
Bottom Width (ft)	n/a	
Side Slope (xH:1V)	n/a	
P= Wetted Perimeter [ft]	3.93	
A= Cross sectional flow area [ft^2]	1.23	
R= Hydraulic Radius = A/P	0.31	
Velocity [ft/sec]	2.2	
Maximum existing Q [cfs]	**2.7**	existing conditions do **NOT** pass the required 25 year event frequency

Across Flowers culvert - proposed	value	notes
Q25 (cfs)- 2,3,4, &6= reach 3 peak	**3.90**	
Q100 (cfs)- 2,3,4, &6= reach 3 peak	**9.80**	
Length (ft)	16	
Upper Elevation (ft)	6299	PAVEMENT SURFACE 6302 (1.5 FT PIPE COVER INCLUDING PAVEMENT)
Lower Elevation (ft)	6298.6	with elevation change
Slope (ft/ft)	2.50%	
Pipe Size, diameter (ft)	1.25	proposed 15" RCP
pipe radius	0.625	
Manning's n	0.013	value for ave Concrete; Appendix 19.A, Lindeburgh: Civil Engineering Reference Manual, Tenth Edition
Shape	circle	
Bottom Width (ft)	n/a	
Side Slope (xH:1V)	n/a	
P= Wetted Perimeter [ft]	3.93	
A= Cross sectional flow area [ft^2]	1.23	
R= Hydraulic Radius = A/P	0.31	
Velocity [ft/sec]	8.3	
Maximum existing Q [cfs]	**10.2**	exceeds required 25 and 100 year event frequency;

Douglas culvert - existing	value	notes
Q25 (cfs)- 2,3,4, 5 &6 = outfall 2	**3.90**	
Q100 (cfs)- 2,3,4, 5 &6= outfall 2	**9.80**	
Length (ft)	21	
Upper Elevation (ft)	6281.3	
Lower Elevation (ft)	6279.2	
Slope (ft/ft)	10.00%	existing slope
Pipe Size, diameter (ft)	1.5	18" CMP with debris
pipe radius	0.75	
Manning's n	0.024	value for CMP; Appendix 19.A, Lindeburgh: Civil Engineering Reference Manual, Tenth Edition
Shape	circle	
Bottom Width (ft)	n/a	
Side Slope (xH:1V)	n/a	
P= Wetted Perimeter [ft]	4.71	
A= Cross sectional flow area [ft^2]	1.77	
R= Hydraulic Radius = A/P	0.38	
Velocity [ft/sec]	10.2	
Maximum existing Q [cfs]	**18.0**	exceeds required 25 year event frequency

INFILTRATION FEATURE GRATE SIZING

Freidhoff Drainage Ditch

Proposed channel DI Grate Size

Assumptions: Use 2' wide curved vane grate, no side flow interception because spread is contained within channel. Q25 design storm

assume wier flow for depressed inlet

Design Subatchment PT06	value	notes
Q = C*P*d^1.5, where...		equation 4-26 from HEC-22
Q25= Flow to proposed inlet in cfs, from subcatchment PT06	3.20	PT06 from HEC-HMS
C = 3.0 for English units	3.0	
d= average depth across grate	1.00	depth in channel is 1 foot at 25 year storm
P = Perimeter of grate (disregarding the one side of grate)		
P = Q/(C*(d)^1.5)	1.07	
L = P-2*W	-3	2' width, 2'x2' grate is adequate

Infiltration Feature on Pittman terrace

C&G Spread

Question: How far does the 25 year storm spread from proposed C&G onto Pitman Terrace?

Assumptions: The Pittman longitudunal and cross slope was taken from LiDAR surface

Design Subatchment PT05	value	notes
Q25 [cfs]	0.13	flow is coming at both sides of DI but spread calculated from one
longitudinal slope, Sl	4.00%	from CAD surface
cross slope, Sx	3.85%	from CAD surface
Manning's, n	0.015	per NDOT, 2006
cub and gutter spread, T	**1.68**	equation 4-2 from HEC 22
T= [Q_{25}*n/(K*Sx^1.67*Sl^0.5)]^0.375		
Allowable spread = gutter width only [ft]	<= 2.0	OKAY!
check depth [ft]	0.06	d= T*Sx, <= 0.5

Proposed DI Grate Size

Assumptions: Use 2' wide curved vane grate, no side flow interception because spread is contained within gutter. Q25 design storm

assume wier flow for inlet

Design Subatchment 6	value	notes
Q = C*P*d^1.5, where...		equation 4-26 from HEC-22
Q25= Flow to proposed inlet in cfs, from subcatchment PT05	0.13	
C = 3.0 for English units	3.0	
d= average depth across grate = T*Sx	0.06	
P = Perimeter of grate (disregarding the curb side of grate)		
P = Q/(C*(T*Sx)^1.5)	2.6	
L = P-2*W	-1	assuming 2' width and 50% clogging factor, 30"x30" grate is adequate

Rock Sizing Calculations

Assumptions: Use HEC-15 proceedures, uniform flow, maximum slopes used

Proposed Friedhoff drainage channel (rock channel)	value	notes
Q100 (cfs)- from rational method	**0.32**	used rational method for small area
Slope (ft/ft)	10.70%	8.5% minimum and 10.7% maximum
Channel Size: Trapezoidal	3.5' top, .5' bttm, 0.75 ft deep	
Shape	Trapezoidal	
Bottom Width (ft), b	0.5	assume rock channel
Side Slope (xH:1V)	2:1	
angle of Incline, θ, degrees	26.57	1:1 = 45deg; 2:1 = 26.6deg; 3:1 = 18.4deg
P= Wetted Perimeter [ft]	0.94	b+ 2*(d/sin θ)
A= Cross sectional flow area [ft^2]	0.12	(b+(d/tanq))*d
R= Hydraulic Radius = A/P	0.12	
SG (spec gravity) of rock	2.65	
D50 initial [ft]	0.5	Class 150: D50=6"; Class 300: D50=12"
channel fill depth, d [ft]	0.22	max available 0.75'
d/D50	0.44	For mannings: If >= 1.5 use Eqn 6.1, if <1.5 use Eqn. 6.2
Channel Top Width, T [ft]	3.5	
effective roughness, b	0.24	b =1.14*((D50/T)^0.453)*((d/D50)^0.814)
Manning's n	0.04	n= (1.49*d^(1/6))/(sqrt(32.2)*f(Fr)*f(REG)*f(CG))
Calculated discharge [cfs]	0.32	=(1.49/n)*A*R^(2/3)*S^(1/2) within 5% of design discharge? YES
particle Reynolds number, Re	35769	Eqn. 6.8: Re = (Vs*D50)/(1.217*10^-5)
Shear Velocity, Vs	0.87	Eqn .10: Vs = sqrt(32.2*d*S)
Sheilds parameter, F	0.047	since Re <= 4x10^4, Table 6.1
Safety Factor, SF	1	since Re <= 4x10^4, Table 6.1
D50	0.30	If channel slope greater than 10%, use Eqn. 6.11 = (SF*d*S)/(F*(SG-1)); D50< 0.5 OKAY

Choose Dmin .30' or 4" for Friedhoff Drive Channel

Douglas County Specs dictate Class 150 Riprap, D50 = 6"

Proposed douglas drainage channel	value	notes
Q25 (cfs)- from Outfall 02	**3.90**	
Q100 (cfs)- from Outfall 02	**9.80**	
Slope (ft/ft)	14.00%	7% min slope; 14% max slope
Channel Size: Trapezoidal	7'top, 1' bttm, 1.5 ft deep	
Manning's n	0.035	veg and stone channel; Appendix 19.A, Lindeburgh: Civil Engineering Reference Manual, Tenth Edition
Shape	Trapezoidal	
Bottom Width (ft), b	1	
Side Slope (xH:1V)	2:1	
angle of Incline, θ, degrees	26.57	1:1 = 45deg; 2:1 = 26.6deg; 3:1 = 18.4deg
wetted depth, d	1.06	filled 1 ft, 0.5' freeboard
P= Wetted Perimeter [ft]	3.14	b+ 2*(d/sin θ)
A= Cross sectional flow area [ft^2]	1.22	(b+(d/tanθ))*d
R= Hydraulic Radius = A/P	0.39	
Velocity [ft/sec]	8.5	
Maximum Q [cfs]	**10.3**	exceeds 25 year at min 2.5% 0.5 ft freeboard, need 5% for 100 year with no freeboard
SG (spec gravity) of rock	2.65	
D50 initial [ft]	1	Class 150: D50=6"; Class 300: D50=12"; Class 400: D50=16"
channel fill depth, d [ft]	1.06	max available 1.5'
d/D50	1.06	For mannings: If >= 1.5 use Eqn 6.1, if <1.5 use Eqn. 6.2
Channel Top Width, T [ft]	3.5	
effective roughness, b	0.68	b =1.14*((D50/T)^0.453)*((d/D50)^0.814)
Fr = Froude number	1	
f(FR)	0.96	=((0.28*Fr)/b)^(LOG(0.755/b))
f(REG)	16.86	=13.434*((T/D50)^0.492)*b
f(CG)	0.45	=(T/d)^-b
Manning's n	0.04	n= (1.49*d^(1/6))/(sqrt(32.2)*f(Fr)*f(REG)*f(CG))
Calculated discharge [cfs]	9.79	=(1.49/n)*A*R^(2/3)*S^(1/2) within 5% of design discharge? YES
particle Reynolds number, Re	179620	Eqn. 6.8: Re = (Vs*D50)/(1.217*10^-5)
Shear Velocity, Vs	2.19	Eqn .10: Vs = sqrt(32.2*d*S)
Sheilds parameter, F	0.14	Re dependant, Table 6.1
Safety Factor, SF	1.44	Re dependant, Table 6.2
channel geo coefficient, a		
D50	0.94	If channel slope greater than 10%, use Eqn. 6.11 = (SF*d*S)/(F*(SG-1)); D50< 1.0 OKAY

Choose Dmin .94' or 11.3" for Douglas Blvd Channel

Douglas County Specs dictate Class 300 Riprap, D50 = 12"

APPENDIX B: RESPONSES TO 90&50 PERCENT COMMENTS

Comments on Pittman Terrace Water Quality Improvement Project				
			Commenter: Meredith Gosejohan, NDSL	**Responder: NTCD Engineering**
Comment #	Document	Page	Comment	Response
NDSL-1	Draft Design Report	11	*various typos*	corrected
NDSL-2	Draft Design Report	12	*typo: change is to it*	corrected
NDSL-3	Draft Design Report	13	*typo:change and to an*	corrected
NDSL-4	Draft Design Report	15	HOA	"GID" changed to "HOA"
NDSL-5	Draft Design Report	15	Annual maintenance of these improvements is recommended for the HOA after spring runoff events (in particular during the first few years to see how treatments are holding up).	Text was added to final report to include annual inspection of improvements and clean out as necessary. Considering the low runoff draining to these particular improvements, annual clean out is not expected.
NDSL-6	Draft Design Report	15	at least	text added to final report

Comments on Pittman Terrace Water Quality Improvement Project				
			Commenter: Ed Skudlarek, NDEP	**Responder: NTCD Engineering**
Comment #	Document	Page	Comment	Response
NDEP-1	Draft Design Report	7	Sentence unclear, words missing?	"of" added to sentence
NDEP-2	Draft Design Report	9	To monitor and clean perf pipe and drain rock bed, clean out ports will be needed at the ends of each side of the perf pipe. CMP has been used in other underground infiltration features installed in recent years.	NDOT indicated in the 50% design meeting that their maintnenance crews could clean out the pipe without clean out ports or a DI on the ends of the feature.
NDEP-3	Draft Design Report	9	side	typo corrected
NDEP-4	Draft Design Report	10	delete "d"	typo corrected
NDEP-5	Draft Design Report	11	The stated purpose of the project is to treat storm water runoff from Hwy 50. This is a good place to identify the pollutant controls that PLRM estimates show will contribute most to the potential load reduction.	PLRM values are based on 50% design. Giving estimates for each BMP/pollutant control not in asbuilt condition may be misleading and is not within the Project scope. Clarifying language and credit breakdown per entity is included in this section.
NDEP-6	Draft Design Report	11	*various text changes and deletions*	corrected
NDEP-7	Draft Design Report	11	Paragraph above Table 4 says the 1936 number is load after project built (expected condition). However, column header says the number is load reduction. Clarification needed.	Column header was correct. Text clarified.
NDEP-8	Draft Design Report	11	Rationale for using higher default infiltration rates will be requested when registered. When, how will field measurement of Ksat get done?	BMP RAM will be preformed after construction by NTCD.
NDEP-9	Draft Design Report	12	I've not read this anywhere before. Is there a reference report?	
NDEP-10	Draft Design Report	12	Are ports needed for cleaning? Underground infiltration features like those proposed for Friedhoff and Pittman Terrace were installed in other places in the LT Basin with clean-out pipe for observing accumulation of sed and storm water and vactoring.	NDOT indicated in the 50% design meeting that their maintnenance crews could clean out the pipe without clean out ports or a DI on the ends of the feature.
NDEP-11	Draft Design Report	12	Based on recent past localized rain and rain/snow events. some events generate larger runoff flows than anticipated adn have undermined armored conveyances and outfalls. Recommend identifying inspection after large events and repair as needed.	text added to recommend inspection after large events
NDEP-12	Draft Design Report	12	*various deletions*	corrected
NDEP-13	Draft Design Report	12	Would annual inspections and after major storm events be appropriate to protect the vegetated access road and rolling dip? This is a key part of preventing a short-circuit of runoff collection and conveyance and protecting access to the structures and utilities below.	Project grading will make the channel the low point instead of the dirt road as in existing conditions. The proposed channel will contain the 100 year storm. Therefore, channel breakouts and erosion on the road are unlikely. There is a posibility of rilling on the road if vegetation does not properly establish. Maintaining vegetation is discussed in the section.

Comments on Pittman Terrace Water Quality Improvement Project				
			Commenter: Erik Nilssen P.E., Douglas County	**Responder: NTCD Engineering**
Comment #	Document	Page	Comment	Response
DC-1	50% Plans	i	Add the 811 USA Diggs Logo to the cover sheet	The logo was added to the 90% plan cover sheet
DC-2	50% Plans	i	Need signature line for the County Engineer to approve the plans	A signature line was added to the 90% plans for County Engineer approval
DC-3	50% Plans	ii	Douglas County has a new Design Criteria and Improvement Standards Manual (DC IS) which becomes effective December 15th The Design Manual can be found on the Engineering Division's Webpage or at: http: //www.douglascountvnv.gov/DocumentCenter/HomelView/ 1153 Please see Table 2.1 for General Notes required to be on the plan set. Not all notes are applicable and the Design Engineer omit the notes that do not apply to the project (i.e. Douglas County Water Utility or Douglas County Wastewater Utility Notes).	The new DC IS along with the applicable general notes and details have been incorporated into the 90% design package.
DC-4	50% Plans	ii	General Note 25 - Add "any road closures require the contractor to obtain a road closure permit from Douglas County."	This language has been added to note 25 on sheet ii of the 90% plans
DC-5	50% Plans	iii	All parcels should have an address or APN shown. On the next sheet, the text for the APN and property owners name is too light to read.	Text darkened for 90%
DC-6	50% Plans	G1	I would add "NPI", Non Pay Item to the legend on Sheet i and use it throughout the plan set on items you do not intend to pay the contractor for. On this sheet for the staging area "surround with K-Rail or approved equal - NPI" (unless you are going to pay them for that).	It is not NTCD's standard practice to add NPI to sheet call outs. Instead a bid item list is developed and included in the bid documents. Additionally, the specifications also clarify what is included in each bid item and the units.
DC-7	50% Plans	C-2	All Rights of Ways and Easements need to be dimensioned as well as all utilities on the plan set (Sheets C-I through C-3). See DCIS 2.2.5 Stationing and Orientation.	Stationing, offsets, and line/curve tables have been provided for the 90% design plans. An NDOT benchmark, which was used for the supplemental survey, has been added to sheet C-1
DC-8	50% Plans	C-2	Provide details for pervious pavers including a STA for start and end.	Stationing, offsets, and line/curve tables have been provided for the 90% design plans.
DC-9	50% Plans	C-2	"Fill and Compact Existing Ditch" is not enough information. What type offill should be used and what are the compaction requirements? In the ROW should be 90% minimum per ASTMDI557	Compaction requirements are given as 90% in the Draft Standard Specification
DC-10	50% Plans	C-2	Note "Install 36-inch Sediment Trap with Grate ... " does not callout a detail. I have a hard time envisioning what will be installed here. Please include the detail.	This item has been removed per TAC preference of a trench drain vs a valley gutter. The trench drain has been detailed.
DC-11	50% Plans	C-2	Clogged 18-inch CMP. Should this project replace with a larger concrete culvelt? In any case callout "Contractor to remove all sediment. NPI."	"clean out sediment" has been added to the call out. The calculations show that the culvert is of adequate size. Cleaning out culverts will be included in the Rock Lined channel bid item.
DC-12	50% Plans	C-2	Remove and Restore Existing Historic Fence ... NPI?	Removing and restoring the fence will be a pay item. Additional notes have been added to the sheet for clarification.
DC-13	50% Plans	C-2	The "Existing Abandoned Waterline" how deep is it and what material is it? I ask because if the construction of the channel will conflict with the water line it will need to be removed. If it is Asbestos Cement Pipe then there needs to be special provisions and a cost to deal with the Asbestos Removal.	Potholing determined that the line is 2" PVC and is buried 1-2' below the surface. The line will conflict with the proposed channel but the system owner is willing to move the line away from the channel. An MOU is in process.
DC-14	50% Plans	C-2	I don't understand the "Micro Basins." They show on this sheet as 2-feet deep. There is no detail referenced. There is a detail on Sheet D-2 (Detail 4) for a Micro Basin, but it says 18-inches of scarified native soil and is not 2-feet deep at all.	The details have been revised for 90%. One micro basin follows the detail on D-2 and the other is a widened section of rock lined channel. Detail D-2 does not specify a depth the vertical finished grade and grading boundary will be given by NTCD staking in the field.
DC-15	50% Plans	C-2	Add Match Line to this Sheet and Sheet C-3.	A match line was not included because it made improvements difficult to read. Improvements on each sheet are associated with each alignment. A note has been added for clarity

Comments on Pittman Terrace Water Quality Improvement Project				
			Commenter: Erik Nilssen P.E., Douglas County	**Responder: NTCD Engineering**
Comment #	Document	Page	Comment	Response
DC-16	50% Plans	D-1	I think the dimensions of the gravel bags needs to be listed, especially the height.	an additional note has been added; "ADDITIONAL OR OVERLAPPING GRAVEL BAGS MAY BE NECESSARY AS DIRECTED BY ENGINEER FOR PROPER FUNCTIONING OF BMP."
DC-17	50% Plans	D-1	Need STA limits in the profile for rock bowl start and end and flat top rock channel.	STA limits have been added to all features
DC-18	50% Plans	D-1	Need rim and invelt elevations of catch basins and manholes on the plan sheet	Vertical design has been preformed for 90% design and elevations added to the plan sheets
DC-19	50% Plans	D-1	Need elevations every 50' or 100' for new pavement installation.	pavement shall match existing
DC-20	50% Plans	D-3	The "Retrofit Infiltration System" is not called out on the plan set (Detail I). Is it going to be used? I cannot tell what is existing and what is proposed. Remember CMP is not allowed in the Douglas County ROW. If it is retrofitting an existing structure then ok, but not for the new components.	This improvement has been clarified as "RETROFIT NDOT INFILTRATION SYSTEM" and is called out on sheet C-1. This improvement is not tin the County ROW.
DC-21	50% Plans	D-3	Detail 3 & 4 - Lots of missi ng information on these details.	Additional information has been added to the details and the plan sheets for these improvements
DC-22	50% Plans	D-3	a. What is the length of each perforated pipe?	Pipe lengths added to each detail
DC-23	50% Plans	D-3	b. What blocks is the sediment can resting on?	Detail has been changed to eliminate open concrete base for sediment can.
DC-24	50% Plans	D-3	c. "Native Backfill" may only be used if it meets Class E Backfi ll of the Standard Specification for Public Works Construction.	Detail has been updated
DC-25	50% Plans	D-3	d. What is the minimum depth of the perforated pipe?	The top of the perforated pipe must be 6" (of drain rock) below the improvements above. For the Pittman Terrace Feature, it is 1' 5" and for the Friedhoff Channel Feature, it's a minimum of 1' 10"
DC-26	50% Plans	D-3	e. Grate needs to be better specified.	Grate detail added to 90% Plans
DC-27	50% Plans	D-3	f. The CMP Sediment Can "size varied per plan." Is this accurate? (CMP can't be used).	A precast concrete inlet called out for 90% design
DC-28	50% Plans	D-3	g. On Detail 3 it states "Asphalt and AB, See Douglas County Road Detail." This detail needs to be added to the plan sheet. It will need to be the new standard details that take affect December l5th	The most recent Douglas County " Street Cut Repair" detail has been added to the 90% Plans as detail 1/D-4
DC-29	50% Plans	D-3	h. Detail states "Sed iment Trap Sump, Depth Varies Per Plan." I don' t see any variation perplan. What is the sump material? Needs to be called out on the plans.	Detail has been clarified by stating precast concrete structure size for 90% Plans.

Comments on Pittman Terrace Water Quality Improvement Project				
			Commenter: Meredith Gosejohan, NDSL	**Responder: NTCD Engineering**
Comment #	Document	Page	Comment	Response
NDSL-1	General comment		General comment regarding operation and maintenance of treatments. Improvements using NDSL water quality funds fall under a minimum 20 year maintenance requirement. Who will be responsible for maintaining the project and infrastructure over the twenty year period? NDSL suggests an agreement between NTCD and NDOT for O&M.	Noted. NDOT and the Pittman Terrace HOA will be responsible for maintenance.
NDSL-2	50% Estimate		General comment regarding Probable Costs budget. Why is contingency 30%? This seems high.	25-30% is standard for 50% design Contingency will continue to drop as design percentage and certainty move forward
NDSL-3	50% Plans	C-1	See sheet C-4 for improvements on Friedhoff Rd. No Sheet C-4, Sheet C-3 instead.	The call out has been revised in the 90% Plans
NDSL-4	50% Plans	C-2	Pervious paver path. What are the improvements to water quality associated with the path? NDSL funds are for water quality improvement and cannot be used for construction of a pedestrian/vehicle path; please base treatments on best water quality benefit. Why not restore and revegetate the area?	The pervious block access path provides armor to a very steep (over 15%) dirt pedestrian path/vehicle access that runs parallel and adjacent to the existing ditch. It is currently producing sediment itself and allowing water from both the existing ditch and the paved portion of the road to run-on and cause further erosion. The access has actually become a fork of the ditch. An access must be maintained for recreation and utility maintenance. The pavers provided more protection for and would not need to be maintained as often as a vegetated path. The TAC decided at the 50% design meeting that a vegetated path with rolling dips is preferable to a paver path.
NDSL-5	50% Plans	C-2	See Sheet C-3 for improvements on Flowers Ave. Saw nothing specific for Flowers Ave. on C-3.	This note has been remove. There are no improvements on Flowers Ave due to property ownership issues.
NDSL-6	50% Plans	C-2 & C-3	Proposed tree removal. Why remove living trees (one ≥ 30")? Upon inspection of the site, the split tree (presumed to be the two trees for removal) has power lines attached to it. If the trees are healthy and can be salvaged, this is preferred. The most cost effective method should be used. Individual homeowner line relocation in this case does not appear to be eligible for NDSL funding. Sizes of trees removed in the proposed tree removal tables on C-2 and G-1 don't match.	The trees have been preserved and labeled "protect in place" for 90% design.
NDSL-7	50% Plans	D-2	Micro Basin. What are the revegetation specifications for micro basins based on their intent?	Draft specification have been added to the 90% design package
NDSL-8	50% Plans	D=3	features: What is the length of perforated pipes for infiltration features? Recommend subsurface investigations that could help determine cost effectiveness of length.	Length of pipes has been added to the 90% details. Length was maximized based on existing slope/available space and ability to maintain.

Comments on Pittman Terrace Water Quality Improvement Project				
			Commenter: Ed Skudlarek, NDEP	**Responder: NTCD Engineering**
Comment #	Document	Page	Comment	Response
NDEP-1	50% Plans		Sed cans trap sediment that would otherwise fill the treatment BMP in the course of a large event or a series of events. So the treatment BMP would perform less effectively before next maintenance got done. The experience of Washoe County staff who have regularly maintained BMPs for years tell us a sed can is less effort and expense to maintain than a rock-lined ditch or basin. NDEP encourages sed traps as appropriate to the objective to optimize performance of treatment BMPs.	Noted. Some sump is provided in most of the drainage inlets on Highway 50 leading to the neighborhood. Unfortunately design constraints at the highway such as available space, rock obstruction, and slope cut, prevent adding extensive pre-treatment.
NDEP-2	50% Plans		What inspection and maintenance action is recommended by NTCD to PTHOA? What assurance is PTHOA making that the feature will bemaintained? If it prevents erosion damage, that probably motivation enough for a private property owner. I looked but did not see erosion inthe front yard that would like have occurred during the period that the existing infiltration facility was not functioning.	An MOU is being developed with the Pittman Terrace HOA to assure regular maintenance. Erosion damage will not likely be an issue.
NDEP-3	50% Plans		Pretreatment for sed removal important to extend performance and life of infiltration feature.	Noted. Some sump is provided in most of the drainage inlets on Highway 50 leading to the neighborhood. Unfortunately design constraints at the highway such as available space, rock obstruction, and slope cut, prevent adding extensive pre-treatment.
NDEP-4	50% Plans		NDEP supports design of block lined channels with underlying bio-infiltration medium to promote infiltration and establishment of vegetation. Michael Pook had a knack for putting specifications together. Maybe NDOT can tap into his experience on developing a specification for the bioinfiltration medium and a seed mix of hardy grass and forbe species.	Noted.
NDEP-5	50% Plans		Please follow up with NDOT on this observation about infiltration in block lined channels and let TAC know how NDOT's experience might affect BMPs selected for PT project.	NDOT has indicated that they have not had good experience with blocks used in the bottom of infiltration basins. The majority of the block proposed on the PT project is to protect a drainage channel, which will have an infiltration feature underneath it. Because of the limited space on the road shoulders, the purpose of the block is more to facilitate conveyance rather than promote infiltration.

Comments on Pittman Terrace Water Quality Improvement Project				
			Commenter: Shannon Friedman, TRPA	**Responder: NTCD Engineering**
Comment #	Document	Page	Comment	Response
TRPA-1	50% Plans	C-1	Perhaps if there is extra money in the from not constructing the pervious paver path there are locations throughout the development where a similar treatment to the one on page C-1 (detail 3/D-3) could constructed to infiltrate more stormwater.	The inlet utilized for the feature (detail 3/D-3) is the only stormdrain inlet available within the neighborhood project area.
TRPA-2	50% Plans	C-1	It is my understanding that NDOT will maintain the treatment system within their right-of-way, the rock lined swale, and micro-basins and Pittman Terrace will be responsible for maintaining the infiltration features off of Pittman Terrace and Friedhoff drive. Douglas County also said there is no mechanism to make sure Pittman Terrace maintains these systems. Is there any way NDOT will vactor them out when they are in the neighborhood maintaining the other systems?	An MOU is being developed with the Pittman Terrace HOA to assure regular maintenance.
TRPA-3	50% Plans	C-2	TRPA will look into the permit for development off of flowers ave. to see if we can get the owners to install the rock lined channel in lieu of the CMP when the decommission the construction access road. At a minimum the CMP should be cleaned out at the end of this project.	The culverts adjacent to and within improvements will be cleaned as part of the channel construction
TRPA-4	50% Plans	C-2	Recommend trying to save the two trees to avoid the utility relocation.	The trees have been avoided in the 90% design
TRPA-5	50% Plans	C-2	Seems the consensus in the meeting was to install rev-vegetation and water bars instead of the pervious paver path. May still want to inquire with Pittman Terrace to see if it is a feature they want, perhaps they are willing to pay for it.	The Pittman Terrace HOA is not interested in paying for the paver path.
TRPA-6	50% Plans	D-2	The details 2/D-2 and 3/D-2 do not identify any vegetation treatment, but sheet R-1 shows these areas being treated with vegetation. These details should e refined in the next design,	A note has been added to the details for clarity
TRPA-7	50% Plans	D-3	Coordinate with NDOT on the infiltration feature details to determine the best design for maintenance. There was discussion during the meeting to relocate sediment cans to end of the perf piped vs. the middle to facilitate maintenance.	The sediment cans have been eliminate to save costs because NDOT has indicated that they can maintain long extents of pipe from one access point (hundreds of feet)

Comments on Pittman Terrace Water Quality Improvement Project				
			Commenter: Matt Nussbaumer P.E., NDOT	**Responder: NTCD Engineering**
Comment #	Document	Page	Comment	Response
NDOT-1	50% Plans	C-1	There appears to be room to grade in a basin in the area	Because of the elevation of the road and the steep slope adjacent, there is not room to grade a basin in the area that was drawn in the comments
NDOT-2	50% Plans	C-1	"See Sheet C-4 for improvements on Friedhoff Dr" should be C-3?	Revise for 90%
	50% Plans	C-2	A 2' or 3" dia steel pipe has been exposed and is visible running along the existing backslope of the ditch.	NTCD has not observed any pipe running along the Friedhoff Drive ditch. No utilities have indicated ownership of such a line. Prehaps it is further up the backslope from the planned construction area.
NDOT-3	50% Plans	C-1	What utilities are out there/ present?	Utilities inclue overhead and some ungerground electric, private water, TDD sewer, and Frontier communications.
NDOT-4	50% Plans	C-2	Will this still be an erosion potential if all the flow is contained?	The slope of the road is over 15%. Therefore, erosion is possible just from rain falling on the road surface.
NDOT-5	50% Plans	C-2	Is there room to grade in a basin?	Because of the elevation of the road and the steep slope adjacent, there is not room to grade a basin in the area that was drawn in the comments
NDOT-6	50% Plans	C-3	Steel Pipe? Is visible	NTCD has not observed any pipe running along the Friedhoff Drive ditch. No utilities have indicated ownership of such a line. Prehaps it is further up the backslope from the planned construction area.
NDOT-7	50% Plans	C-3	"Construct rock lined channel" What are the dimensions? I don't believe there is room for much	The dimensions have been give in detail 3/D-2 of the 90% plans
NDOT-8	50% Plans	D-2	"Rock lined channel" thickness. What size rip rap?	The size is class 150 given in detail 3/D-2 of the 90% plans
NDOT-9	50% Plans	D-2	"varies see civil sheets" wasn't provided	The dimensions have been give in detail 3/D-2 of the 90% plans
NDOT-10	50% Plans	D-3	Differentiate between existing & proposed. Do you need a version in CADD?	Detail has been clarified in the 90% plans