Appendix H | **2024 City of New Braunfels Reports**

Appendix H1 | **2024 Old Channel Flow Decrease Event**

City of New Braunfels

MEMORANDUM – Oct. 23, 2024 Old Channel Flow Decrease Event

November 20, 2024

On October 23, 2024, a flow decrease event occurred affecting the Old Channel of the Comal Springs system. Prior to October 23, 2024, the City of New Braunfels staff had begun coordinating efforts to perform maintenance to the spring-fed pool during the 2024/ 2025 winter season. The spring-fed pool was drained to begin the process of drying the accumulated sediment for removal. While most of the water in the spring-fed pool drained without assistance, a small amount of water remained in the deep end of the pool. In an effort to further promote the draining and drying process of the pool, a city staff member who was unfamiliar with the function of the Old Channel flow split gate closed the main gate that provides water to the Old Channel of the Comal River on the morning of October 23, 2024. While the main flow split gate was closed, the auxiliary flow gate was left open and was providing approximately 5 cfs to the Old Channel. EAHCP contractor Biowest had staff working in the Comal Spring system the morning of October 23rd and noticed a decline in the water level of the Old Channel and alerted City staff that participate in the EAHCP. City staff was immediately dispatched to the flow split gate to reset the gate to an appropriate level. Once the flow gate was reset, the water level quickly returned to the target flow of 35 - 40 cfs through the Old Channel.

A padlock and chain are used to secure the flow gate wheel to prevent unauthorized manipulation of the flow gate. The original lock is a commonly used lock for city-managed locations thus providing many city employees with the correct key access to the flow gate. Going forward, city staff will continue to use a padlock and chain to secure the flow gate but switching to a key that is only accessible to the appropriate city staff that manage the flow split and emergency response staff. We also plan to install signage instructing anyone to contact the River and Watershed Division prior to making any adjustments to the flow split gate. Third, we will be reaching out to city staff that commonly work in that area to educate them on the function of the flow split as well as the significance of the Old Channel, as we have many new staff members each summer season.

Regards,

Greg Malatek
Director of Public Works
City of New Braunfels

Appendix H2 | **Native Aquatic Vegetation Restoration in the Comal River System**

BIO-WEST, Inc.
1405 United Drive
San Marcos, Texas 78666

MEMORANDUM

TO: Phillip Quast

FROM: BIO-WEST

DATE: December 30, 2024

SUBJECT: **City of New Braunfels Aquatic Vegetation Restoration**

EXECUTIVE SUMMARY

This technical memorandum summarizes the activities conducted by the BIO-WEST team for aquatic vegetation restoration in the Comal River with primary focus on Landa Lake and the Old Channel . This year marked the eleventh consecutive year for BIO-WEST's enactment of restoration and maintenance activities to improve Fountain Darter (*Etheostoma fonticola*) habitat as part of the Edwards Aquifer Habitat Conservation Plan (EAHCP). The work areas for this project include Landa Lake, Upper Spring Run and the Old Channel. Extents and boundaries of these sections are shown in **Figure 1**. Restoration activities occur in Long-term Biological Goal Reaches (LTBG) designated by the EAHCP biomonitoring program as well as supportive restoration reaches which provide further habitat enhancement objectives.

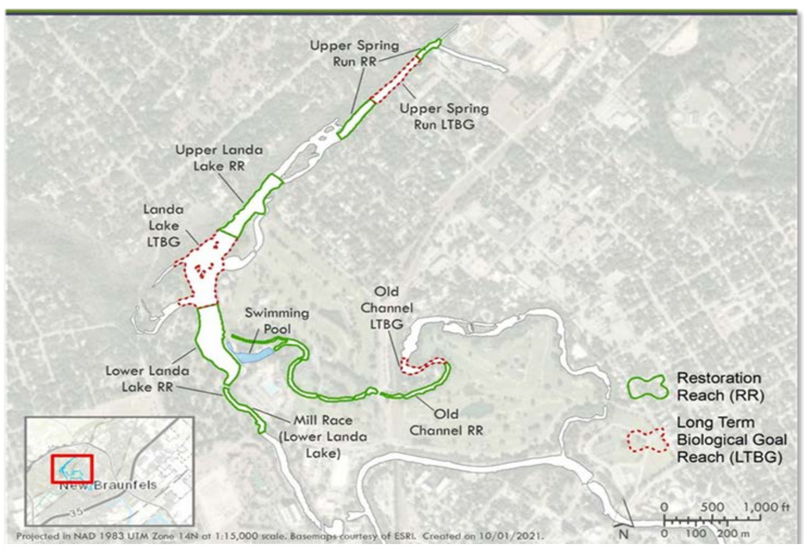

Figure 1. Restoration project areas. Long-term Biological Goal Reaches are in red. Restoration Reaches are outlined in green.

The native aquatic plant species targeted for this project include: *Ludwigia repens* (Ludwigia), *Cabomba caroliniana* (Cabomba), *Sagittaria platyphylla* (Sagittaria), *Potamogeton illinoensis* (Potamogeton) and *Vallisneria neotropicalis* (Vallisneria). Currently, only Ludwigia and Cabomba are propagated and planted. Sagittaria, Potamogeton and Vallisneria have shown to be ultra-competitive species that do not need assistance in maintaining cover and can self-propagate effectively. Project activities for 2024 were hampered by low flow conditions which have occurred consistently since 2022. Low flow conditions for the Comal system are designated by the EAHCP Incidental Take Permit as any flow pattern below 130 cubic feet per second (cfs). When river discharge falls below this point, restoration activities are moderated per Condition M of the EAHCP to prevent unnecessary disturbance to Fountain Darter habitat during these sensitive time periods. Low flow conditions this year were observed in the Comal system from May 17 onward (**Figure 2**). During this time, any activities digging in or disturbing the substrate were excluded. This included utilizing Mobile Underwater Plant Propagation Trays (MUPPTs) to grow plants, moving or setting benthic barriers, large-scale vegetation removal and large-scale plantings. In general, the BIO-WEST team strives to limit any disturbance during low flows to as small of a footprint and impact as possible. For example, instead of using mature rooted plants grown in MUPPTs, BIO-WEST uses sprigging to accomplish planting. Sprigging is defined as inserting cut stems of plants into the soil by hand. With sprigging there is less disturbance to the sediment compared to digging holes for pot grown plants. Sprigged plants may not be as successful, but they allow for work to continue during times of low flow with minimized impact.

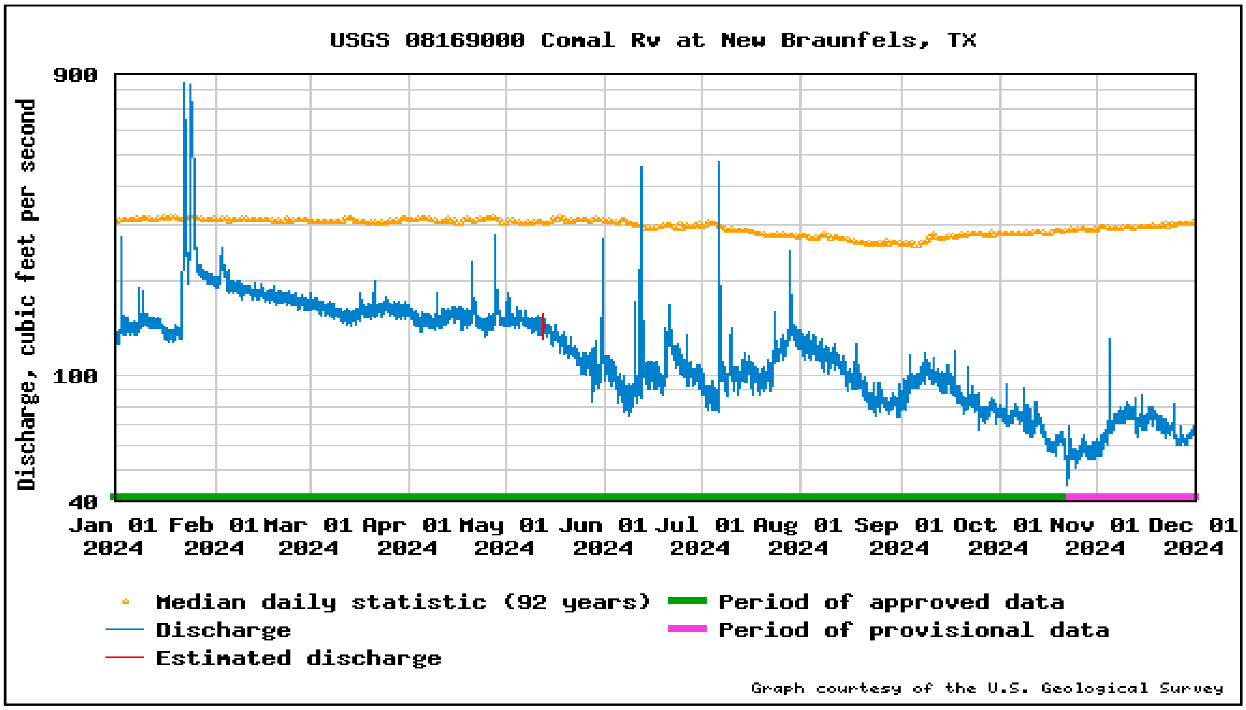

Figure 2. Discharge in the Comal River from January to December 2024 (USGS 2024).

An additional part of regular activities includes continued surveys and removal of *Hygrophila polysperma* (Hygrophila). This submerged aquatic invasive plant was the only non-native aquatic plant present in the Comal system in large quantities at the beginning of EAHCP restoration activities. It was of major concern and accounted for nearly 60% of the aquatic plant coverage in the Old Channel, 3% of aquatic vegetation habitat in Landa Lake and 20% of aquatic vegetation coverage in the Upper Spring Run. In the years since, the team has succeeded in limiting this non-native plant in all project areas. This year approximately 24 m^2 of Hygrophila was removed from locations shown in **Figure 3**. Plant material was disposed of in an on-site city dumpster.

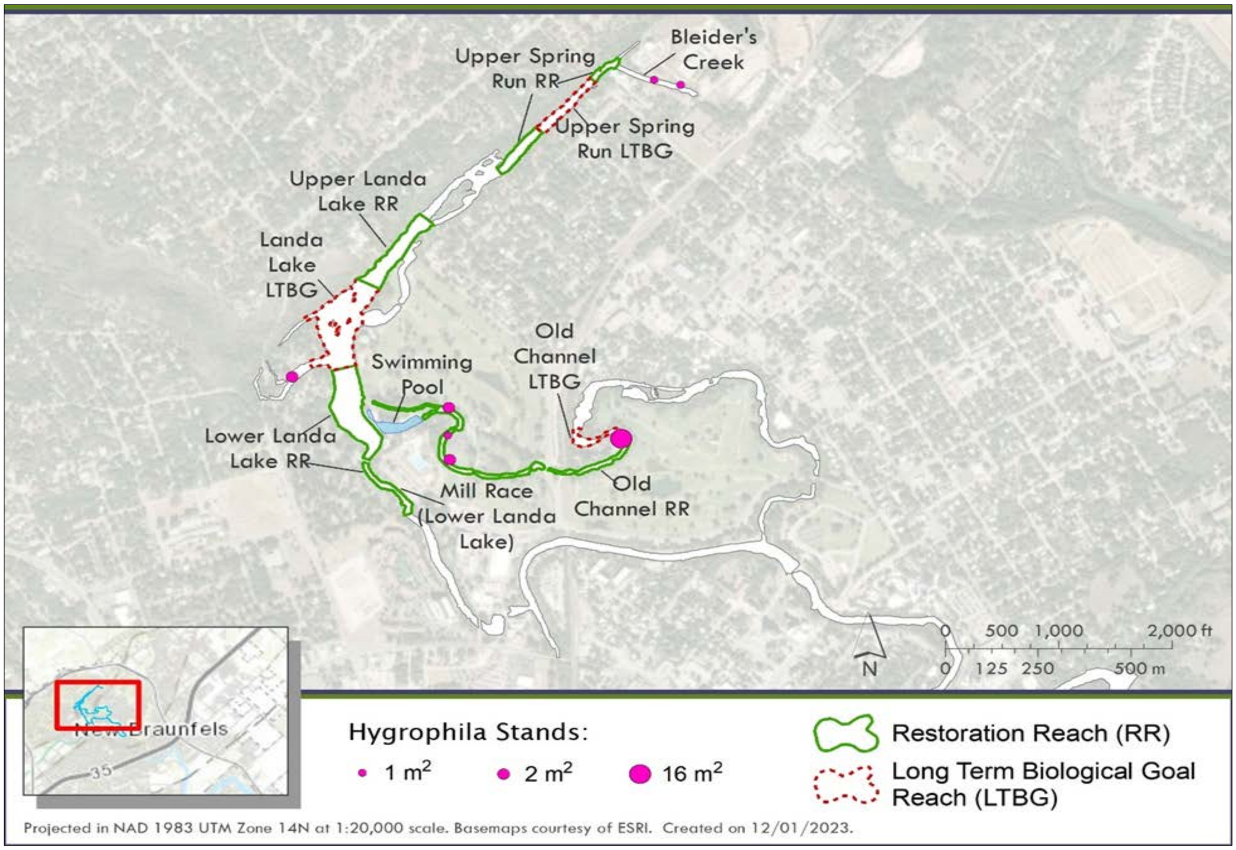

Figure 3. Locations of *Hygrophila polysperma* removed in the project area.

Another important component of restoration activities includes aquatic vegetation mapping to assist with planning and implementation as well as track success. BIO-WEST maps the designated restoration reach areas in **Figure 1** at least three times per year at designated times to monitor EAHCP vegetation coverage goals. A baseline mapping event occurs in January, a spring event occurs in April/May and a fall event occurs in September/October. In addition, other events may be included during low flow conditions. This year a low flow event was conducted in November when total system discharge declined below 60 cfs. Map preparation and data analysis from this event is still being processed and will be incorporated into next year's technical memorandum. Map sets for the three routine mapping events for each project area are available in Appendix A (**Figures A2** through **A10**) with coverage results provided in tables in their respective sections below.

Other supporting activities conducted by the team this year included moving vegetation mats and trimming/removing fallen trees/woody debris. In summary the BIO-WEST team planted 5,382 aquatic plants in Landa Lake and 6,598 plants in the Old Channel in 2024. Overall, a total of 104,754 plants have been planted since 2013. Most of the Cabomba used during 2024 activities was transplanted from the spring fed swimming pool which was undergoing renovations. More detailed information and observations are provided in the project area sections below. A few representative pictures documenting work throughout the year can be found in Appendix B.

Old Channel Reaches

The BIO-WEST team focused considerable effort on the Old Channel in 2024. The Old Channel Restoration and LTBG reaches continue to provide high quality habitat for the Fountain Darter. The focus this year was on expanding Ludwigia and Cabomba within both reaches. This native species decreases over time as it is more easily outcompeted by other plants. Although originally included in the planting regime, Sagittaria and Potamogeton have both proven to be superior competitors and are no longer planted for Fountain Darter habitat in these reaches. In fact, it was necessary to remove some Sagittaria to encourage proliferation of Ludwigia and Cabomba in its place. Restoration plantings occurred in four plots in the restoration reach and one plot in the LTBG reach. In total the team planted 650 m^2 in five designated plots. A map delineating the location of these plots can be found in Appendix A (**Figure A-1**). Restoration plots may be planted with a single species or mixed species depending on the site conditions. The team sprigged 4,170 Cabomba and 2,228 Ludwigia. The restoration team also sprigged 200 American waterwillow (*Justicia americana)*. This species has been planted recently to help stabilize shorelines, although it is not included in the EAHCP coverage objectives.

On October 22nd, the Old Channel experienced limited to zero flow for a total of 21.5 hours due to maintenance contractor miscommunication. However, there were no apparent lasting impacts to aquatic vegetation health or distribution. Vegetation coverage in the Old Channel reaches remained dense and abundant. Coverage for target species, including Ludwigia and Cabomba, trended upward over the course of the year (**Table 1**). Conversely, the total vegetation coverage for the Old Channel LTBG reach trended downward. This was a result of bryophyte decrease which is attributed to lower flow conditions. Total vegetation coverage in the Old Channel Restoration Reach trended upward partially because of focused plantings in this reach through the year. Despite low flow conditions, bryophyte remains a major vegetation component in both reaches of the Old Channel.

Table 1. Coverage (m^2) of target plant species and other vegetation.

Species	Fall 2023	Baseline 2024	Spring 2024	Fall 2024
Old Channel LTBG Reach				
Ludwigia	152	189	230	229
Cabomba	0	0	0	0
Sagittaria	0	0	0	0
Bryophyte	580	456	426	241
Other	37	82	83	110
Total	**769**	**727**	**739**	**580**
Old Channel Restoration Reach				
Ludwigia	428	483	533	679
Sagittaria	726	786	717	636
Cabomba	29	9	11	404
Bryophyte	707	542	526	235
Other	1,387	1,518	1,530	2,245
Total	**3,277**	**3,338**	**3,317**	**4,199**

In past years, some areas of the Old Channel have been too shaded to allow for rooted vegetation growth. Riparian restoration efforts and natural tree loss has recently opened up some areas to sunlight, allowing the team to plant target species in places where they previously could not grow. It is too soon to say whether vegetation establishes or not, but this has allowed for the increased Cabomba coverage in 2024. As described in previous year's reporting, Cabomba has struggled to do well in the LTBG Reach due to overabundance of bryophyte and shade. Finally, just over 16 m^2 of Hygrophila was removed from the Old Channel reaches in 2024 (**Figure 3**).

Landa Lake Reaches

Landa Lake is composed of two restoration reaches and one LTBG reach. No restoration activities were conducted in either of these restoration reaches in 2024. The restored aquatic vegetation in the Landa Lake LTBG reach continues to do well. An important goal for the restoration team each year is to expand the restored aquatic vegetation footprint while also maintaining the areas planted in past years. Vallisneria is the dominant aquatic plant in Landa Lake LTBG reach and the Lower Landa Lake Restoration reach but is not present in the upper part of Landa Lake. While native, Vallisneria is associated with significantly lower Fountain Darter densities compared to Ludwigia and Cabomba as indicated by quantitative drop net sampling conducted through the EAHCP Biological Monitoring Program. However, Vallisneria is a superior competitor to these other two native species. Therefore, an ongoing objective for the restoration team in the Landa Lake LTBG reach is to selectively remove Vallisneria to convert that space to target species. Thus far, the team has been successful in this regard and will continue to strive to connect and enlarge patches of Ludwigia and Cabomba in Landa Lake. It is also important to note that during extremely low flow conditions, Vallisneria naturally recedes. This is evident by the increase of open spaces in the middle of Landa Lake during these periods. When evident, the team takes advantage of this natural phenomenon by halting efforts to reduce Vallisneria and instead planting target species within these open spaces.

For the first time, a significant amount of Justicia was sprigged within the LTBG reach to stabilize bank and sediment erosion. A total of 502 plants were sprigged in areas at the water's edge on the three islands and along the eastern shoreline downstream of the end of Pecan Slough. The low flow conditions resulted in exposed sediment along the banks and abundant shallow areas in and amongst the islands which presented ideal planting areas for this species.

As the majority of the year was spent under Condition M, the restoration team only moved benthic barriers one time. Under typical flow conditions, benthic barriers are moved two to three times per year. The movement of barriers allows the team to efficiently and effectively kill Vallisneria without significant labor. The focus in 2024 was on concentrating the benthic barriers in Spring Run 1 and near Pecan Slough as these areas will be targeted for restoration plantings when flows reach above 130 cfs. The current plan is to maintain the barriers at these locations until total system discharge increases above 130 cfs.

In total, the team planted five restoration plots in Landa Lake covering 385 m^2 (Appendix A **Figure A-1**). Restoration plots were planted with a single species or mixed species depending on the site conditions. During 2024, the coverage of target species reached some of the highest levels that have been documented for Landa Lake since the implementation of the Biological Monitoring Program in 2001 (**Table 2**). Ludwigia exceeded the EAHCP goal of 900 m^2 in the Landa Lake LTBG reach and remained above that coverage level for the entirety of the year. The coverage of Cabomba also remained high in 2024 compared to previous restoration years. Unlike

2023, extensive algae blooms were not observed in Landa Lake and no areas of the lake became dewatered. Bryophyte continues to remain minimal which is attributed to low flows creating undesirable growing conditions. During the prolonged drought conditions extending into 2024, natural populations of Cabomba increased vigorously in the restoration reaches of Landa Lake. This was an expected result of warmer water and more silt deposition. In the lower restoration reach the macro algae Muskgrass (*Chara sp.)* and Cabomba were noted expanding into areas of Vallisneria as it was receding. Finally, approximately 2 m^2 of Hygrophila was removed from several locations in Spring Run 1 by covering it with rubber mats or by hand removal.

Table 2. Coverage (m^2) of target species and total vegetation in the Landa Lake reaches.

Species	Fall 2023	Baseline 2024	Spring 2024	Fall 2024
Landa LTBG Reach				
Ludwigia	955	1,363	1,050	1,051
Cabomba	1,005	970	790	735
Sagittaria	3,033	3,620	3,178	3,252
Bryophyte	103	190	113	8
Other	8,952	8,147	8,251	9,233
Total	**14,048**	**14,290**	**13,382**	**14,279**
Upper Landa Restoration Reach				
Ludwigia	7	8	1	0
Cabomba	199	84	31	265
Sagittaria	961	866	30	570
Bryophyte	233	0	0	0
Other	110	228	86	113
Total	**1,510**	**1,186**	**148**	**948**
Lower Landa Lake				
Ludwigia	0	0	0	0
Cabomba	497	497	376	651
Sagittaria	1	1	47	38
Bryophyte	119	119	0	90
Other	11,388	11,388	11,635	13,582
Total	**12,005**	**12,005**	**12,058**	**14,361**

Upper Spring Run

The BIO-WEST team did not conduct native restoration activities in the Upper Spring Run (USR) LTBG or Restoration reach this year. However, the team did routinely survey for Hygrophila in this upstream section. No Hygrophila was found in 2024 in the USR, but a few small sprigs were found and removed moving up into Blieders Creek. Aquatic vegetation was mapped to track changes in vegetation diversity and coverage during this extended drought period (**Table 3**). During 2024, this reach which is usually dominated by Sagittaria has become dominated by *Chara*. This vegetation switch was also documented during the prolonged drought of 2013-2014. *Chara* is a native macro algae typically found in lotic conditions. In most cases Sagittaria was not reduced in coverage but rather, over grown by *Chara*. It is anticipated that once springflows return to normal, *Chara* will likely die off as observed later in 2015 and subsequently during more typical flow years

Table 3. Coverage (m^2) of target species and total vegetation in the Upper Spring Run reaches.

Species	Fall 2023	Baseline 2024	Spring 2024	Fall 2024
USR LTBG Reach				
Ludwigia	11	16	18	0
Sagittaria	1,185	1,081	1,180	1,483
Cabomba	113	146	80	124
Bryophyte	0	0	227	0
Other (includes Chara)	367	818	1,481	492
Total	**1,676**	**2,061**	**2,986**	**2,099**
USR Restoration Reach				
Ludwigia	1	36	59	0
Sagittaria	853	1,048	1,275	1,167
Cabomba	333	272	217	256
Bryophyte	0	0	0	0
Other (includes Chara)	684	1,349	1,916	634
Total	**1,871**	**2,705**	**3,467**	**2,057**

CONCLUSION

Despite low flow conditions in 2024, the aquatic vegetation community in USR, Landa Lake and the Old Channel remains abundant and continues to provide quality habitat for Fountain Darters and other aquatic species. Each year, species competition, species life cycles and growing conditions all factor into the results of EAHCP native aquatic vegetation restoration activities. While some species-specific goals presented in **Table 4** have not yet been met, the team will continue to strive to enhance the Comal system with the fundamental objective of improved habitat for Fountain Darters. As evident herein, 2024 trends for Ludwigia and Cabomba were mostly favorable to the overall program objectives of Fountain Darter habitat enhancement (**Figure 4**). Moving into 2025, the restoration team will continue to follow best management practices under low flow conditions, actively work towards the goals set forth by the EAHCP and use the many years of accrued experience and lessons learned to guide this important EAHCP conservation measure.

Table 4. EAHCP Program goals for each target aquatic plant species per reach.

Reaches	Aquatic Vegetation Species	Native Aquatic Species HCP Long-term Program Goals
Old Channel LTBG	*Ludwigia* *Cabomba* *Sagittaria*	425 180 450
Landa Lake LTBG	*Ludwigia* *Cabomba* *Vallisneria* *Potamogeton*	900 500 12,500 25
Upper Spring Run LTBG	*Ludwigia* *Cabomba* *Sagittaria*	25 25 850
Landa Lake Upper Restoration Reach	*Ludwigia* *Cabomba* *Sagittaria*	25 250 250
Landa Lake Lower Restoration Reach	*Ludwigia* *Cabomba* *Sagittaria*	50 125 100
Old Channel Restoration Reach	*Ludwigia* *Cabomba* *Sagittaria* *Vallisneria* *Potamogeton*	850 200 750 750 100

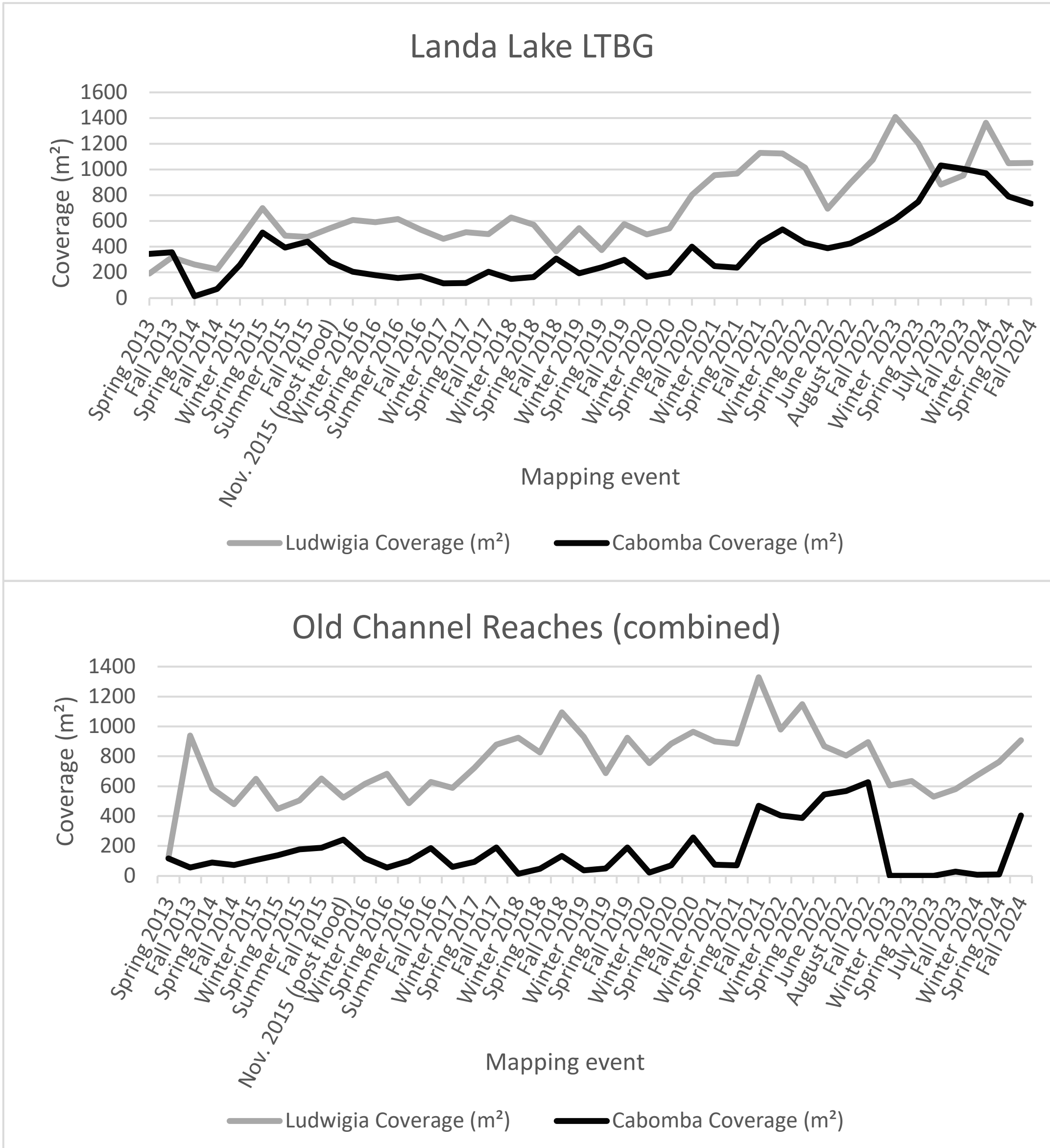

Figure 4. Eleven-year trend for Ludwigia and Cabomba coverage in Landa Lake LTBG Reach (top) and both Old Channel reaches (bottom).

Appendix A

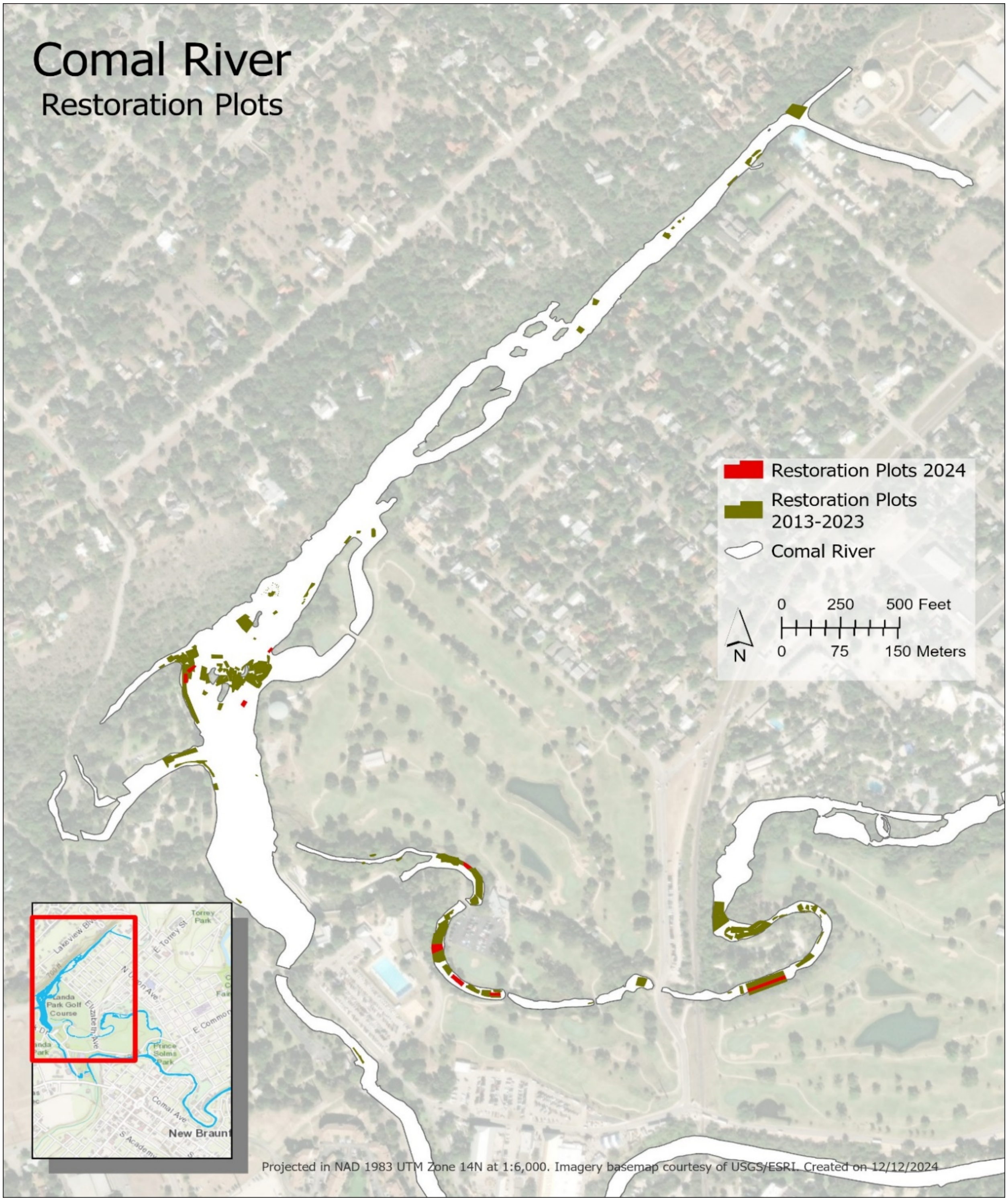

Figure A1. Locations of the 2024 planted restoration plots (red) in Landa Lake and the Old Channel project reaches.

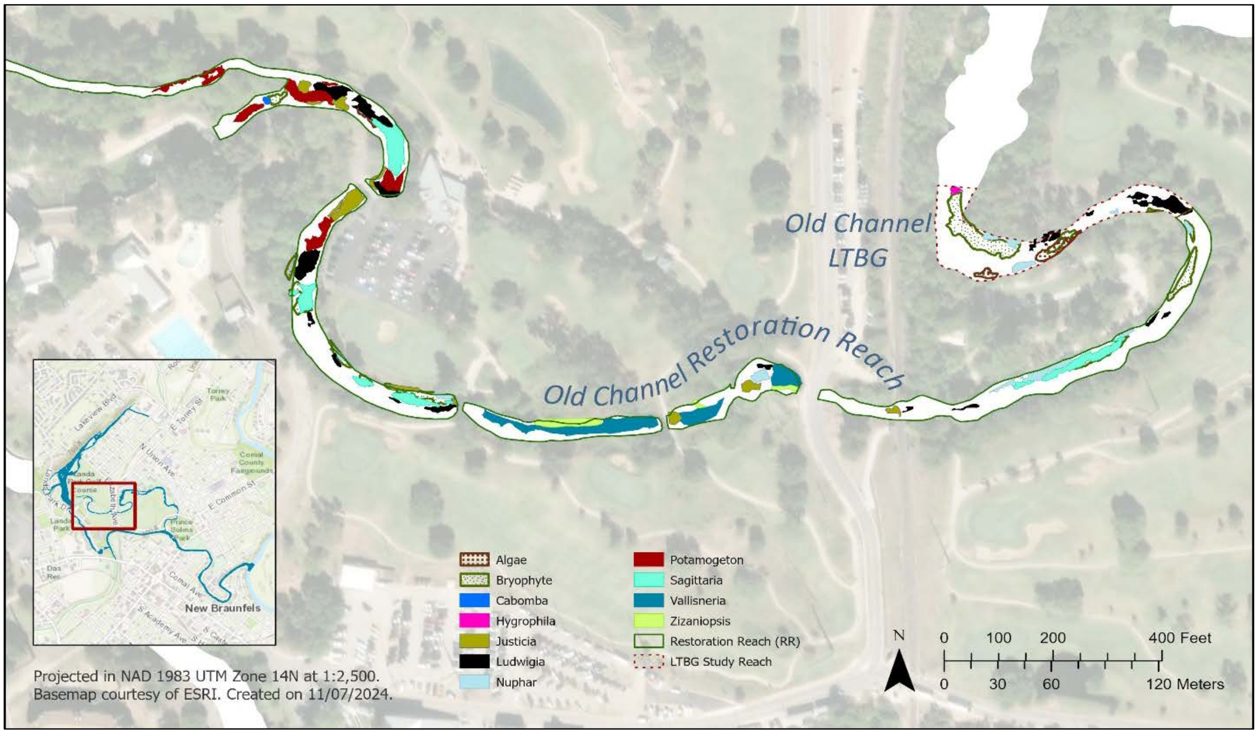

Figure A2. Distribution of aquatic vegetation during baseline 2024 mapping in the Old Channel reaches.

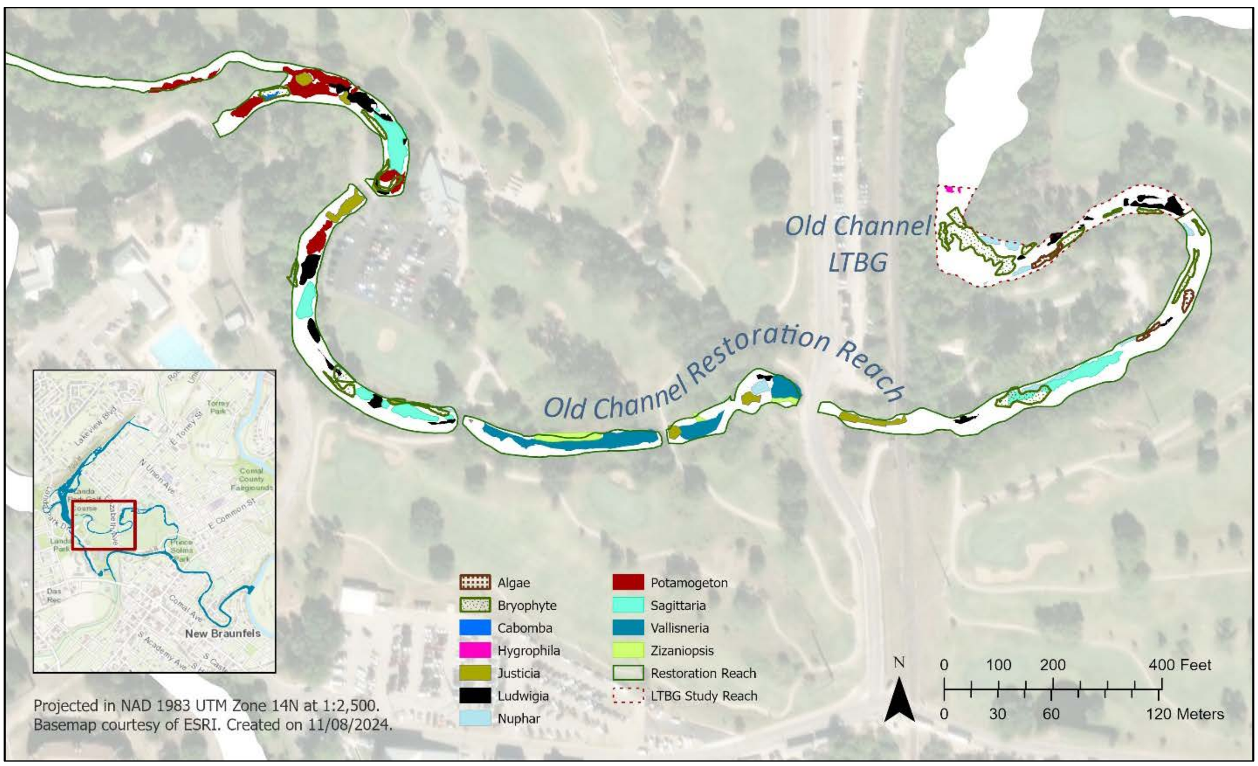

Figure A3. Distribution of aquatic vegetation during Spring 2024 in the Old Channel reaches.

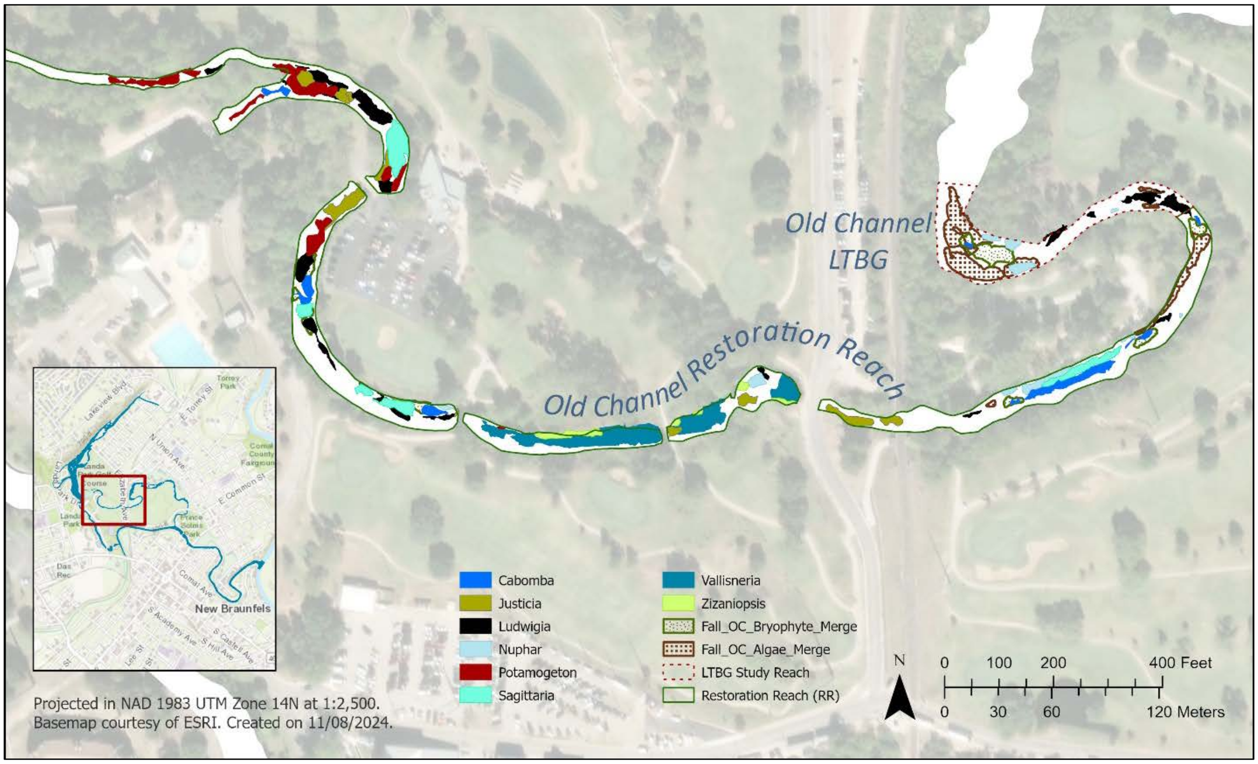

Figure A4. Distribution of aquatic vegetation during Fall 2024 in the Old Channel reaches.

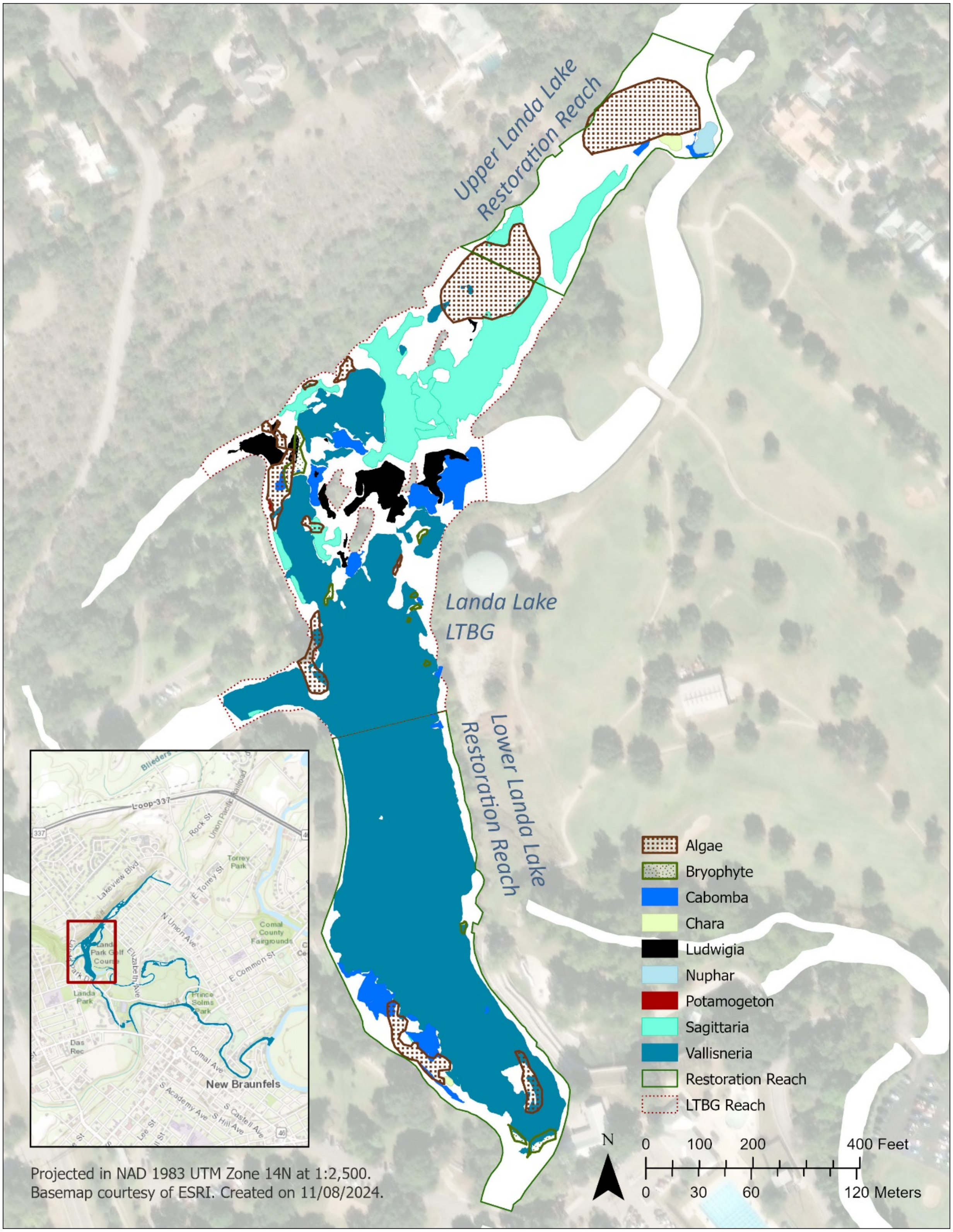

Figure A5. Distribution of aquatic vegetation during the baseline 2024 mapping in the Landa Lake reaches.

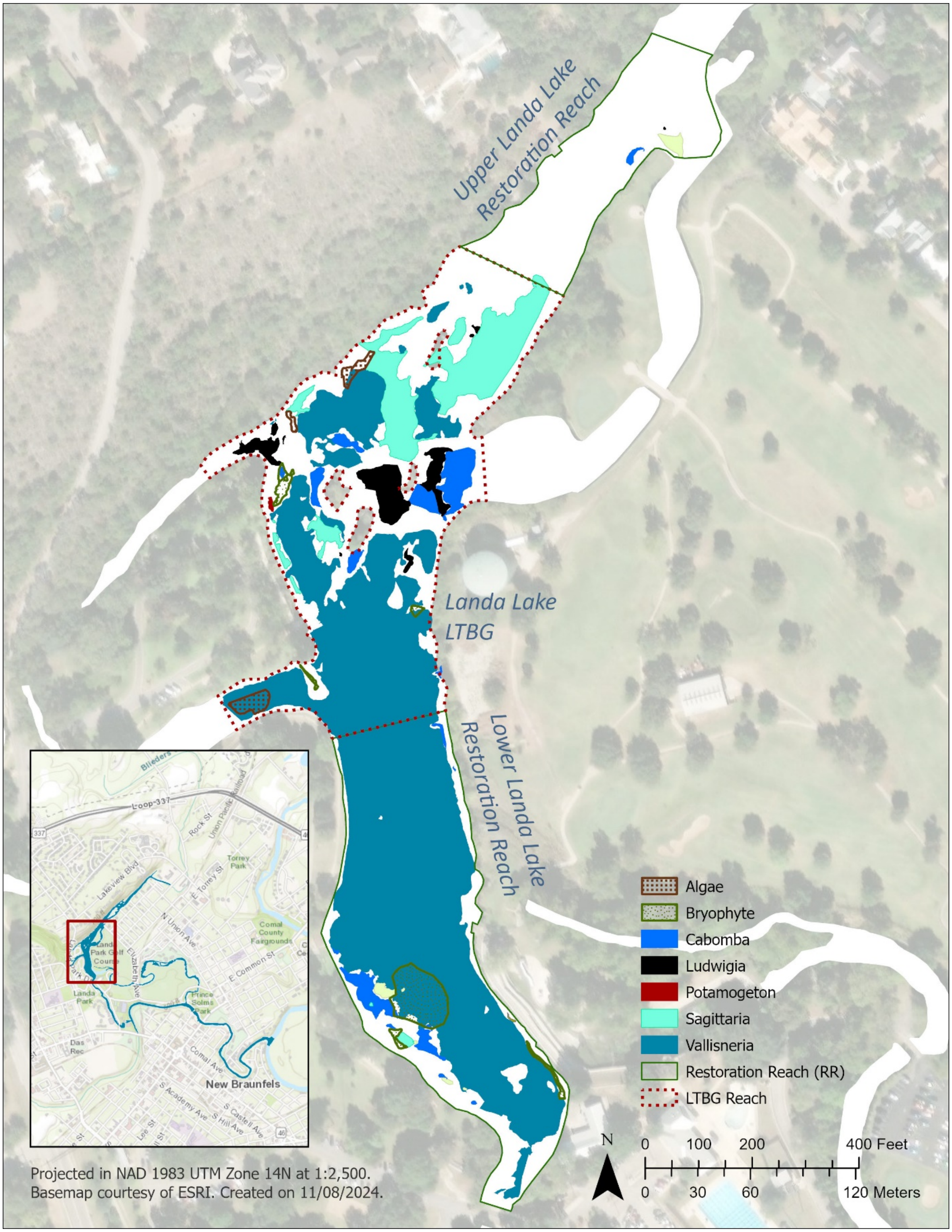

Figure A6. Distribution of aquatic vegetation during the Spring 2024 mapping in the Landa Lake reaches.

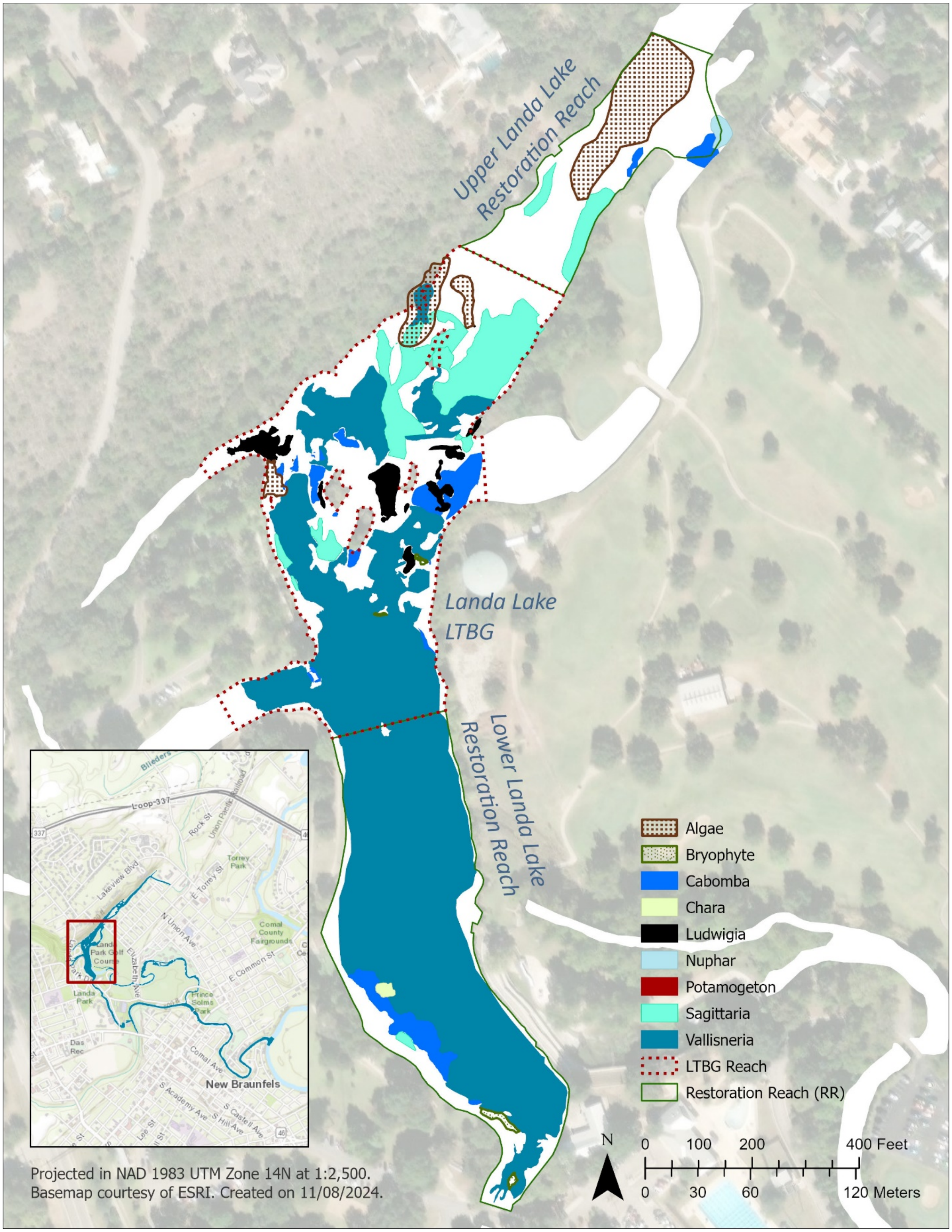

Figure A7. Distribution of aquatic vegetation during the Fall 2024 mapping in the Landa Lake reaches.

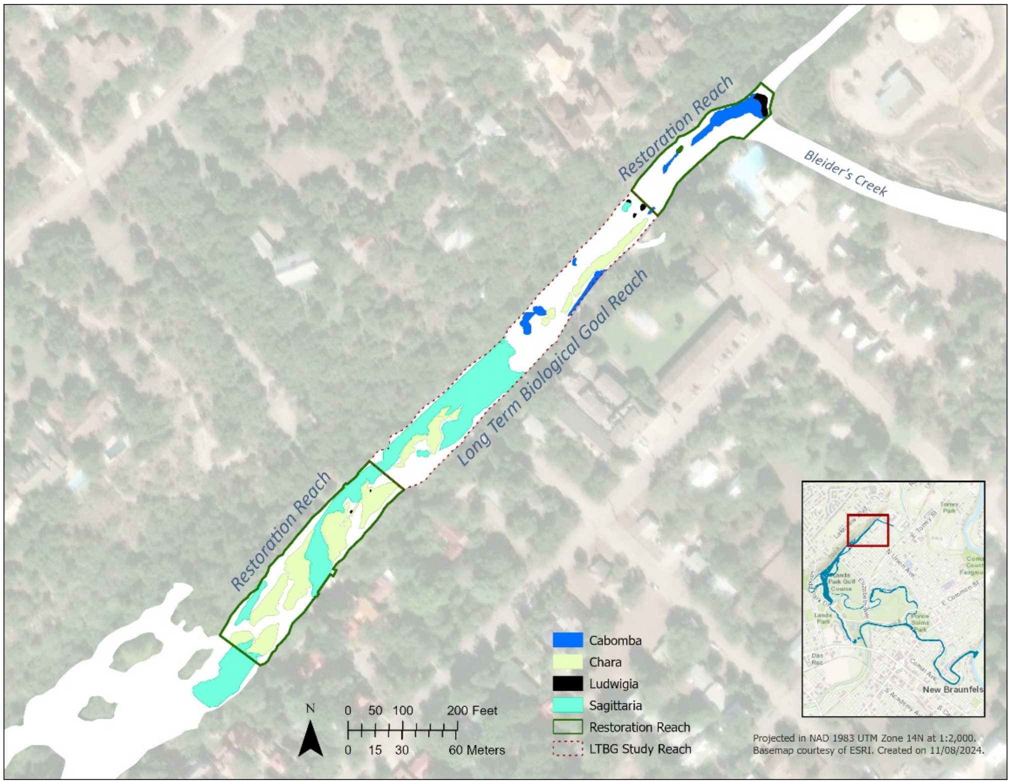

Figure A8. **Distribution of aquatic vegetation during the baseline mapping in the Upper Spring Run reaches.**

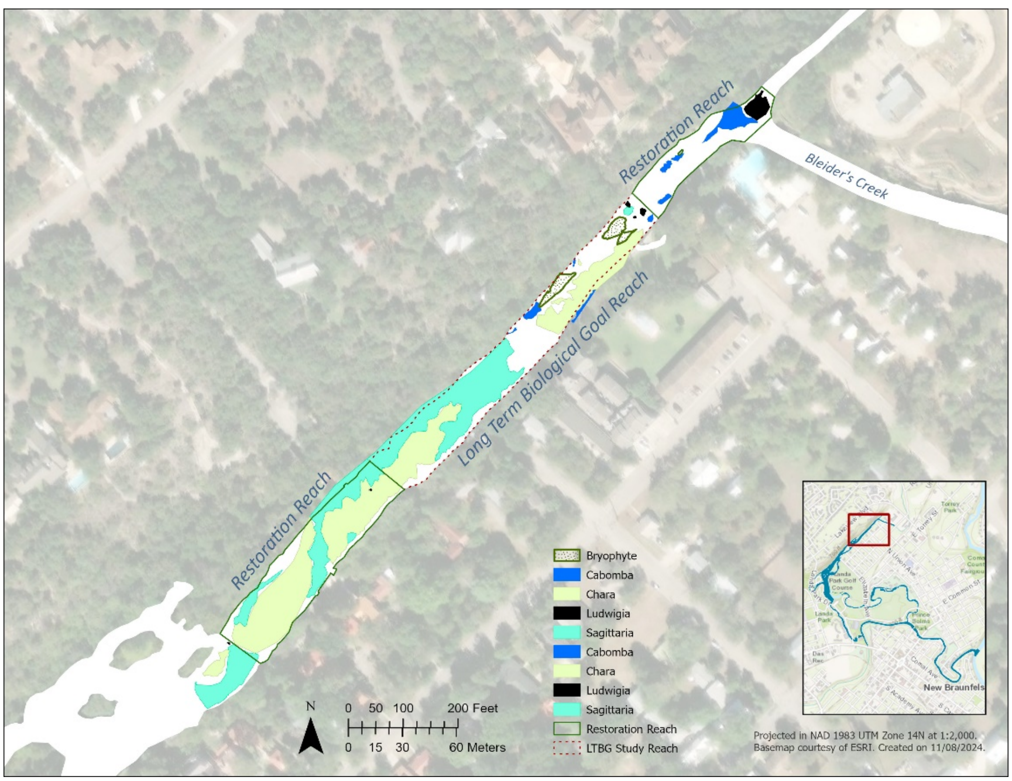

Figure A9. **Distribution of aquatic vegetation during the Spring 2024 mapping in the Upper Spring Run reaches.**

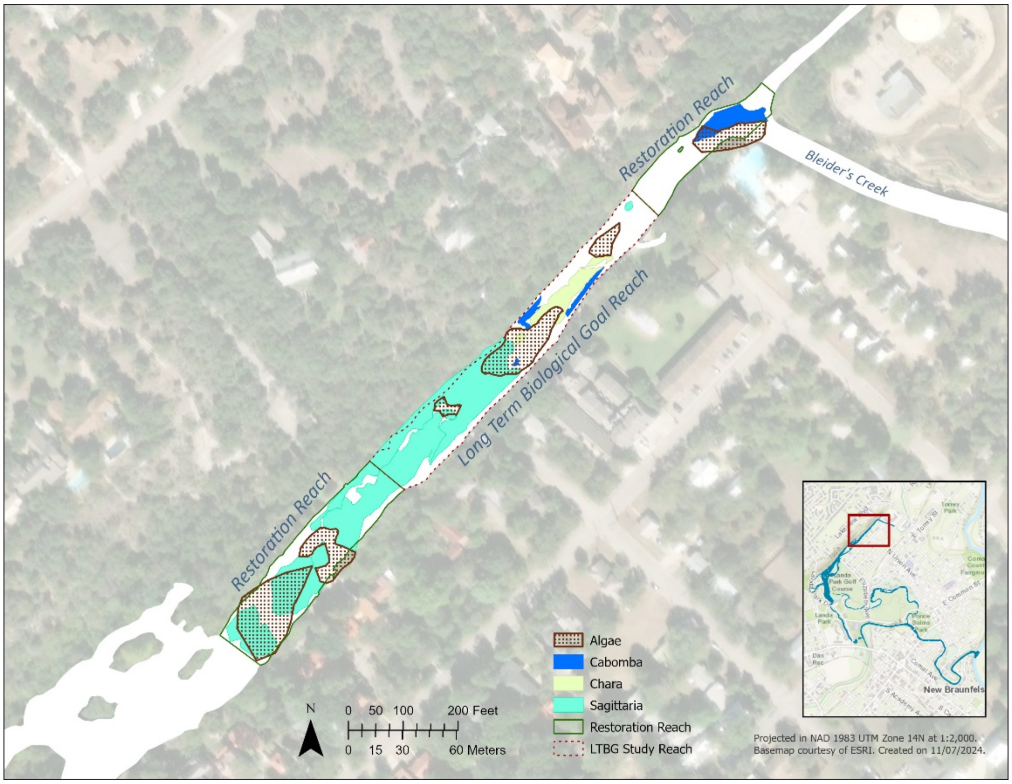

Figure A10. Distribution of aquatic vegetation during the Fall 2024 mapping in the Upper Spring Run reaches.

Appendix B

Figure B1. Landa Lake upstream of Three Islands. February 12, 2024.

Figure B2. Spring Run 1 looking into Landa Lake from the pedestrian bridge. February 27, 2024.

Figure B3. Spring Run 1looking into Landa Lake from pedestrian bridge with benthic barriers in place. Benthic barriers are being used to passively remove Vallisneria. June 17, 2024.

Figure B4. The Old Channel Restoration Reach with Ludwigia, Cabomba and bryophyte. July 15, 2024.

Figure B5. Landa Lake, October 28, 2024.

Figure B6. Ludwigia and Cabomba in Spring Lake near Spring Run 3. October 28, 2024.

Figure B7. A dry Spring Run 1. October 28, 2024.

Figure B8. Planted Cabomba in Spring Run 1. October 28, 2024.

Appendix H3 | **Dissolved Oxygen Monitoring**

MEMORANDUM

TO: Phillip Quast (City of New Braunfels)

FROM: BIO-WEST

DATE: **December 30, 2024**

SUBJECT: BIO-WEST Dissolved Oxygen Management Plan 2024 Activities

2024 SUMMARY

This annual memorandum summarizes BIO-WEST's 2024 activities associated with the City of New Braunfels Dissolved Oxygen Management Plan (Plan). BIO-WEST's involvement in 2024 centered around the Low spring flow conditions triggered monitoring as summarized below from annual scope of work:

- Deploy near-continuous DO monitoring sensors at strategic locations within the Comal River system upon the onset of low-flow conditions (<100cfs) at Comal Springs. Monitoring shall be focused in monitoring locations within prime Fountain Darter habitat in Landa Lake.
- Maintain and service DO monitoring sensors.
- Off-load DO data from sensors on a routine basis.
- Inform City of New Braunfels staff of low-dissolved oxygen conditions as measured by sensors or other method and recommend mitigation actions based on the Landa Lake Dissolved Oxygen Management Plan.
- Evaluate and analyze collected DO data. Assess the linkage between DO concentrations as measured at the six sensors and observed Fountain Darter data collected as part of the Edwards Aquifer Habitat Conservation Plan (EAHCP) Biological Monitoring Program;

Five strategic locations were used in 2024 based on previous years sampling and continuously monitored when total system discharge was consistently below 100 cfs. The five sites (including one in the Upper Spring Run, three in Landa Lake, and one in the Old Channel) were first deployed on July 12th and currently remain in operation in the Comal system as total system discharge remains under 70 cfs. Compilation and preliminary analysis of 2024 data collection reveal that dissolved oxygen (DO) suitable for Fountain Darters was typically maintained in key Fountain Darter areas consistent with both the EAA near-continuous sonde monitoring in Comal Springs as well as the EAHCP biological monitoring data collected during drop net sampling. Although periodic observances of DO below 3.0 mg/L were observed, these were typically only exhibited for short durations of time mostly associated with early morning hours. Fountain Darters have been and were again collected in 2024 in all these areas through the EAHCP biological monitoring program drop net and dip net sampling. As the sondes are currently still operating in the Comal system, the project team will combine the 2024 with the upcoming 2025 information for a more comprehensive and cohesive technical analysis and reporting next year.

Our conclusion based on the DO sampling performed in 2024 is that no revisions to the existing City of New Braunfels Dissolved Oxygen Management Plan regarding the Low spring flow conditions triggered monitoring is recommended at this time. The project team supports the DO Low spring flow monitoring Work Plan components in place and recommends the City of New Braunfels continue implementation in 2025.

Appendix H4 | **Control of Harmful Non-Native Animal Species**

CoNB Control of Harmful Non-Native Animal Species (EAHCP § 5.2.5)

The CONB continued to implement a non-native fish and animal species management program focused on the removal of tilapia (*Oreochromis sp.*), nutria (*Myocastor coypus*) and vermiculated sailfin catfish (family Loricariidae). In 2024, divers utilized primarily polespears and spearguns for capture of non-native fish species and baited box traps to capture nutria. Tilapia were targeted primarily in the main body of Landa Lake, near the confluence of Blieders Creek/ Landa Lake and in the Upper Spring Run while sailfin catfish were targeted primarily in the downstream portion of Landa Lake. Efforts to capture nutria were focused primarily around Landa Lake, in the Upper Spring Run area and along Blieders Creek. **Table 1** summarizes the number of non-native fish and animal species removed from the Comal River system in 2024.

Table 1. Summary of Non-Native Fish & Animal Species Removal (January – December 2024)

Species	Number Removed	Biomass (lbs.)	Average Biomass (lbs./individual)
Vermiculated Sailfin Catfish	65	149.13	2.3
Tilapia	698	1512.7	2.2
Nutria	24	212	8.8
Goldfish	12	21.75	1.8

Appendix H5 | **Gill Parasite Monitoring in the Comal River System**

BIO-WEST, Inc.
1405 United Drive, Suite 111
San Marcos, Texas 78666

MEMORANDUM

TO:	**Phillip Quast, City of New Braunfels**
FROM:	BIO-WEST, Inc.
DATE:	**November 12, 2024**
SUBJECT:	**2024 Gill Parasite Monitoring in the Comal River**

Introduction

To benefit populations of the federally-endangered Fountain Darter *Etheostoma fonticola*, the Edwards Aquifer Habitat Conservation Plan (EAHCP) has conducted studies aimed at monitoring and reducing concentrations of the non-native gill parasite *Centrocestus formosanus* in the Comal River. Studies initially included data collection targeted at identifying the distribution, abundance, and density of the free-swimming cercariae of *C. formosanus* as well as its host snail, *Melanoides tuberculata*. They also included studies to document current prevalence of *C. formosanus* in host snails and Fountain Darters, and pilot studies to evaluate host snail removal as a means of potentially reducing *C. formosanus* concentrations. Additionally, during this time period, data were also collected on the abundance and density of the cercariae of another exotic trematode parasite, *Haplorchis pumilio*, which has the potential to negatively impact Fountain Darter populations. Lastly, repeat monitoring was implemented to track host snail (2013–2018) and parasite cercariae concentration (2013–2024) through time.

From 2014 through 2018, parasite cercariae monitoring was conducted three times per year (Winter, Spring, and Summer seasons) at three transects (Landa Lake [LL], Old Channel Reach [OCR], and RV Park [RVP]; **Figure 1**). In 2019, at the request of the City of New Braunfels and Edwards Aquifer Authority, monitoring efforts were decreased to one event per year, and a fourth sampling transect was added at Pecan Island (PI) due to concerns of potentially high parasite concentrations at this location (**Figure 1**). Since 2019, BIO-WEST biologists have conducted a single summer-season parasite monitoring event at these four transects in the Comal River system. In 2024, this data collection took place on September 5–6, and included quantification of cercariae densities for both *C. formosanus* and *H. pumilio* at each transect. These data were combined with previously collected data from 2014–2023 and the full dataset was analyzed with updated statistical techniques to examine the relationship between multiple predictor variables (discharge, year, season, and site) and parasite concentrations. Details of the methods utilized, a summary of the results and subsequent analyses, a discussion on the utility of this information, and recommendations for further research and monitoring are provided below.

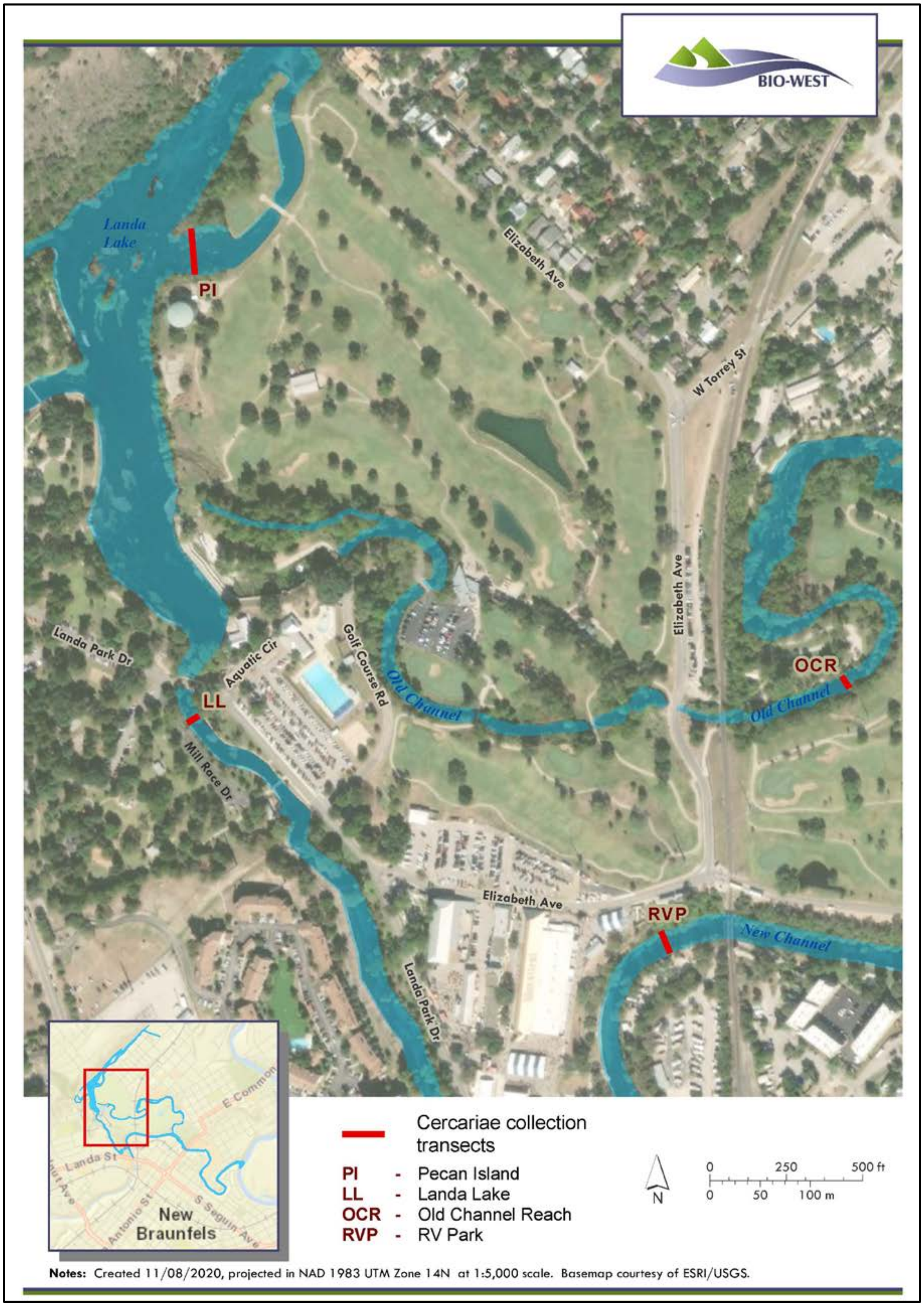

Figure 1. Map of cercariae collection transects in the Comal River system.

Methods

Data Collection

At each transect, 5-liter (L) water samples were collected from six points evenly distributed throughout the water column both vertically and horizontally. Three evenly spaced sampling stations were established across the stream channel, perpendicular to flow. At each station, two 5-L samples were collected, one at 60% stream depth, and one approximately 5 centimeters (cm) below the water surface, totaling six samples per site. Cercariae were collected using a modified live-well pump attached to an incremental wading rod which pumped water through clear acrylic tubing to collection buckets. At time of collection, each water sample was immediately treated with 5 milliliters (ml) of formaldehyde to kill all parasite cercariae. Each sample was then filtered using a specialized filtration device consisting of three progressively finer nylon filters, with the final filter having pores of 30 microns (µm). After filtration of each sample, the 30-µm filter containing cercariae was removed from the filtration device and placed in a Petri dish. Each sample was then stained with a Rose Bengal solution and fixed with 10% formalin, at which point the Petri dish was closed and sealed with Parafilm for storage. After fixation and staining, the samples were then observed using high-power microscopy (40–100× magnification) and all cercariae were identified to species and enumerated in the BIO-WEST laboratory.

Data Analysis

Spatiotemporal trends in cercariae density of both species were summarized and compared by calculating mean (±SE) cercariae/L for each site per season and year. Random forest regression models were used to examine relationships between river discharge and density of *C. formosanus* and *H. pumilio* cercariae in the water column. Random forest regression is a type of ensemble decision tree model that generates a large number of trees via bootstrapping that are combined to make predictions. These types of models are advantageous for assessing ecological data, due to their ability to depict nonlinear trends and better generalize to new data (Breiman 2001; Prasad et al. 2006).

For all sampling events, discharge values (cfs) specific to each site were taken or calculated from USGS gaging stations on the Comal River (USGS gages #08168913, #08168932, #08169000) at 10:00 am on the day of collection. Specifically, discharge data for LL and PI were taken from the Comal River New Channel gage (#08168932), data for OCR were taken from the Comal River Old Channel gage (#08168913), and data for the RVP site were calculated as the difference of the total system gage (#08169000) and Old Channel gage (#08168913) to account for potential streamflow contributions from Dry Comal Creek. Discharges were then standardized by median discharge (discharge(x)/Q50) for the study duration to make observations comparable between sites. In addition to standardized discharge, year and day of year were included as an additional continuous variable to assess temporal trends and site was used as categorical predictors to account for spatial variation in cercariae densities.

Random Forest models were fit using 500 trees and tuned to maximize predictive performance (Breiman 2002). Statistics calculated to assess each model's performance were based on out-of-bag sample predictions and included mean of squared residuals, percent variation explained, and correlation between observed and predicted cercariae densities. Percent increase in mean squared error (MSE) was also calculated for each predictor variable, which represents the increase in predictive error when observed values of the predictor are randomly permuted in the out-of-bag-samples (Breiman 2002). Higher percent increase in MSE means a variable has a stronger influence on predictive accuracy relative to other variables (Breiman 2002). Lastly, partial dependence plots are provided to display cercariae density trends as a function of all four predictor variables. All analyses were conducted in R (4.2) with the packages 'randomForest' (Liaw 2022), 'pdp' (Greenwell 2022), 'dataRetrieval' (DeCicco 2022), and 'ggplot2' (Wickham 2023).

Results

In 24 individual five-liter samples collected in 2024, 33 total *C. formosanus* and 25 *H. pumilio* cercariae were detected, resulting in an overall system wide mean (±SE) of 0.28 (±0.07) and 0.21 (±0.05) cercariae/L, respectively. Overall mean densities have decreased since 2022 and were more similar to means in 2020 and 2021. Among sites, mean density of *C. formosanus* was highest at RVP (0.53 ±0.16 cercariae/L) and LL (0.43 ±0.13 cercariae/L). Mean density of *H. pumilio* in 2024 was also greatest at LL (0.37 ±0.12 cercariae/L) and RVP (0.33 ±0.10 cercariae/L). From 2023 to 2024, mean density of both species decreased at all sites except *C. formosanus* at RVP. At this site, *C. formosanus* mean density showed a minimal increase from 2023 (0.47 ± 0.12 cercariae/L) to 2024 (0.53 ± 0.16 cercariae/L) (**Table 1**).

Temporal trends in standardized discharge throughout the duration of cercariae monitoring were similar in the New Channel near Landa Lake and downstream of Dry Comal Creek, increasing from 2014 (~0.15) to 2017 (~1.50) and decreasing from 2017 to 2024 (~0.20). In the Old Channel, standardized discharge was also lower in 2014 (~0.70 in winter), but remained stable from 2015 to 2022, varying within proximity of its Q50 magnitude. This period of stability was followed by a decline in 2023 (0.61), and an increase closer to the long-term Q50 in 2024 (0.83) (**Figure 2**).

Random Forest Models were fit based on 516 observations in PI (n = 36), LL (n = 156), OCR (n = 162) and RVP (n = 162). Both models performed well with correlations between observed and predicted values ≥0.69, though model correlation and percent variation explained were much higher for *C. formosanus* (0.92 and 84.8%, respectively) than *H. pumilio* (0.69 and 47.4%, respectively) (**Table 2**). Based on percent increase in MSE, standardized discharge (30.9%) was the most influential predictor of *C. formosanus* density, followed by site (26.4%), day of year (24.2%), and year (20.1%). Site (43.0%) and standardized discharge (38.6%) were more important for predicting *H. pumilio* density relative to year (25.5%) and day of year (17.2%) (**Figure 3**).

Partial dependence plots visualizing relationships between parasite density showed some similarities between species. Standardized discharge displayed a nonlinear relationship for both species and showed that density sharply decreased with increasing standardized discharge from about 0.10 to 0.80 units. Parasite densities of both species were also highest at LL and RVP.

Densities generally showed minimal variation across days of the year, though peaked around day 225 (mid-August) for *C. formosanus* and day 75 (mid-March) to 150 (early-June) for *H. pumilio*. Lastly, *C. formosanus* densities have decreased annually over the study duration. Trends of *H. pumilio* over time in contrast displayed multiple inflection points, which decreased from 2014 to 2020, increased through 2022, then decreased again through 2024 (**Figure 4**).

Table 1. Mean cercariae/liter (±SE) collected during parasite monitoring events from 2014-2024.

C. formosanus						*H. pumilio*					
Transect	**Year**	**Season**				**Transect**	**Year**	**Season**			
		Winter	**Spring**	**Summer**	**OVERALL**			**Winter**	**Spring**	**Summer**	**OVERALL**
LL						**LL**					
	2014	4.4 (±0.4)	6.1 (±0.5)	13.3 (±0.6)	**7.9 (±1.0)**		2014	0.2 (±0.09)	0.3 (±0.08)	0.9 (±0.24)	**0.5 (±0.11)**
	2015	2.6 (±0.3)	2.6 (±0.3)	3.4 (±0.3)	**2.9 (±0.2)**		2015	0.5 (±0.09)	0.3 (±0.06)	0.2 (±0.03)	**0.3 (±0.04)**
	2016	0.8 (±0.9)	2.3 (±0.8)	1.9 (±0.8)	**1.6 (±2.2)**		2016	0.03 (±0.03)	0.3 (±0.08)	0.2 (±0.08)	**0.2 (±0.04)**
	2017	1.3 (±0.1)	1.4 (±0.3)	1.0 (±0.2)	**1.2 (±0.1)**		2017	0.06 (±0.04)	0.03 (±0.03)	0.03 (±0.03)	**0.04 (±0.02)**
	2018	0.8 (±0.1)	1.5 (±0.2)	1.6 (±0.4)	**1.3 (±0.2)**		2018	0.1 (±0.07)	0.1 (±0.04)	0.1 (±0.04)	**0.1 (±0.03)**
	2019			0.4 (±0.1)			2019			0.0 (±0.0)	
	2020			0.3 (±0.1)			2020			0.03 (±0.03)	
	2021			0.2 (±0.07)			2021			0.07 (±0.04)	
	2022			0.63 (±0.06)			2022			1.03 (±0.09)	
	2023			0.63 (±0.21)			2023			0.57 (±0.10)	
	2024			0.43 (±0.13)			2024			0.37 (±0.12)	
OCR						**OCR**					
	2014	0.4 (±0.1)	1.0 (±0.2)	2.0 (±0.3)	**1.1 (±0.2)**		2014	0.1 (±0.04)	0.1 (±0.07)	0.2 (±0.09)	**0.1 (±0.04)**
	2015	1.4 (±0.2)	1.9 (±0.2)	2.4 (±0.2)	**1.9 (±0.1)**		2015	0.2 (±0.06)	0.3 (±0.07)	0.1 (±0.03)	**0.2 (±0.03)**
	2016	2.0 (±1.1)	1.2 (±0.9)	1.8 (±1.2)	**1.7 (±1.1)**		2016	0.1 (±0.07)	0.1 (±0.07)	0.1 (±0.07)	**0.1 (±0.04)**
	2017	0.7 (±0.1)	0.6 (±0.2)	0.5 (±0.1)	**0.6 (±0.1)**		2017	0.0 (±0.0)	0.0 (±0.0)	0.0 (±0.0)	**0.0 (±0.0)**
	2018	0.6 (±0.1)	0.3 (±0.1)	0.2 (±0.1)	**0.4 (±0.1)**		2018	0.0 (±0.0)	0.0 (±0.0)	0.03 (±0.03)	**0.01 (±0.01)**
	2019			0.4 (±0.1)			2019			0.2 (±0.06)	
	2020			0.4 (±0.1)			2020			0.2 (±0.1)	
	2021			0.1(±0.04)			2021			0.03 (±0.03)	
	2022			0.06(±0.06)			2022			0.23 (±0.08)	
	2023			0.17 (±0.10)			2023			0.23 (±0.10)	
	2024			0.10 (±0.07)			2024			0.13 (±0.08)	
RVP						**RVP**					
	2014	3.8 (±0.3)	7.8 (±0.9)	4.8 (±0.4)	**5.6 (±0.2)**		2014	0.7 (±0.11)	0.9 (±0.25)	1.6 (±0.50)	**1.0 (±0.20)**
	2015	4.5 (±0.7)	3.1 (±0.3)	3.6 (±0.3)	**3.7 (±0.2)**		2015	0.4 (±0.06)	0.4 (±0.07)	0.2 (±0.06)	**0.3 (±0.04)**
	2016	2.1 (±1.1)	2.5 (±0.8)	2.3 (±0.8)	**2.3 (±0.6)**		2016	0.2 (±0.10)	0.2 (±0.10)	0.1 (±0.07)	**0.2 (±0.05)**
	2017	2.0 (±0.6)	2.3 (±0.2)	1.5 (±0.2)	**1.9 (±0.2)**		2017	0.2 (±0.16)	0.2 (±0.08)	0.1 (±0.07)	**0.2 (±0.06)**
	2018	1.6 (±0.2)	1.5 (±0.3)	2.1 (±0.2)	**1.7 (±0.2)**		2018	0.1 (±0.07)	0.2 (±0.10)	0.2 (±0.07)	**0.2 (±0.05)**
	2019			0.9 (±0.1)			2019			0.1 (±0.06)	
	2020			0.6 (±0.2)			2020			0.1 (±0.1)	
	2021			0.2 (±0.08)			2021			0.5 (±0.13)	
	2022			0.73 (±0.04)			2022			1.8 (±0.3)	
	2023			0.47 (±0.12)			2023			0.80 (±0.13)	
	2024			0.53 (±0.16)			2024			0.33 (±0.10)	
Pecan Island						**Pecan Island**					
	2019			0.03 (±0.03)			2019			0.0 (±0.0)	
	2020			0.1 (±0.1)			2020			0.0 (±0.0)	
	2021			0.1 (±0.07)			2021			0.03 (±0.03)	
	2022			0.03 (±0.03)			2022			0.0 (±0.0)	
	2023			0.07 (±0.07)			2023			0.03 (±0.03)	
	2024			0.03 (±0.03)			2024			0.0 (±0.0)	
OVERALL						**OVERALL**					
	2014	2.9 (±0.5)	4.9 (±0.8)	6.7 (±1.2)	**4.8 (±0.5)**		2014	0.3 (±0.08)	0.4 (±0.12)	0.9 (±0.22)	**0.6 (±0.09)**
	2015	2.9 (±0.3)	2.5 (±0.2)	3.2 (±0.2)	**2.9 (±0.1)**		2015	0.4 (±0.04)	0.3 (±0.04)	0.2 (±0.03)	**0.3 (±0.02)**
	2016	1.6 (±0.2)	2.0 (±0.2)	1.9 (±0.1)	**1.9 (±0.1)**		2016	0.1 (±0.04)	0.2 (±0.05)	0.1 (±0.04)	**0.1 (±0.03)**
	2017	1.3 (±0.2)	1.4 (±0.2)	1.0 (±0.1)	**1.2 (±0.1)**		2017	0.1 (±0.06)	0.07 (±0.03)	0.04 (±0.03)	**0.07 (±0.02)**
	2018	1.0 (±0.1)	1.1 (±0.2)	1.3 (±0.2)	**1.1 (±0.1)**		2018	0.07 (±0.03)	0.1 (±0.04)	0.1 (±0.03)	**0.09 (±0.02)**
	2019			0.4 (±0.1)			2019			0.1 (±0.02)	
	2020			0.3 (±0.1)			2020			0.1 (±0.03)	
	2021			0.2 (±0.05)			2021			0.2 (±0.04)	
	2022			0.6 (±0.37)			2022			0.75 (±0.16)	
	2023			0.33 (±0.08)			2023			0.41 (±0.08)	
	2024			0.28 (±0.07)			2024			0.21 (±0.05)	

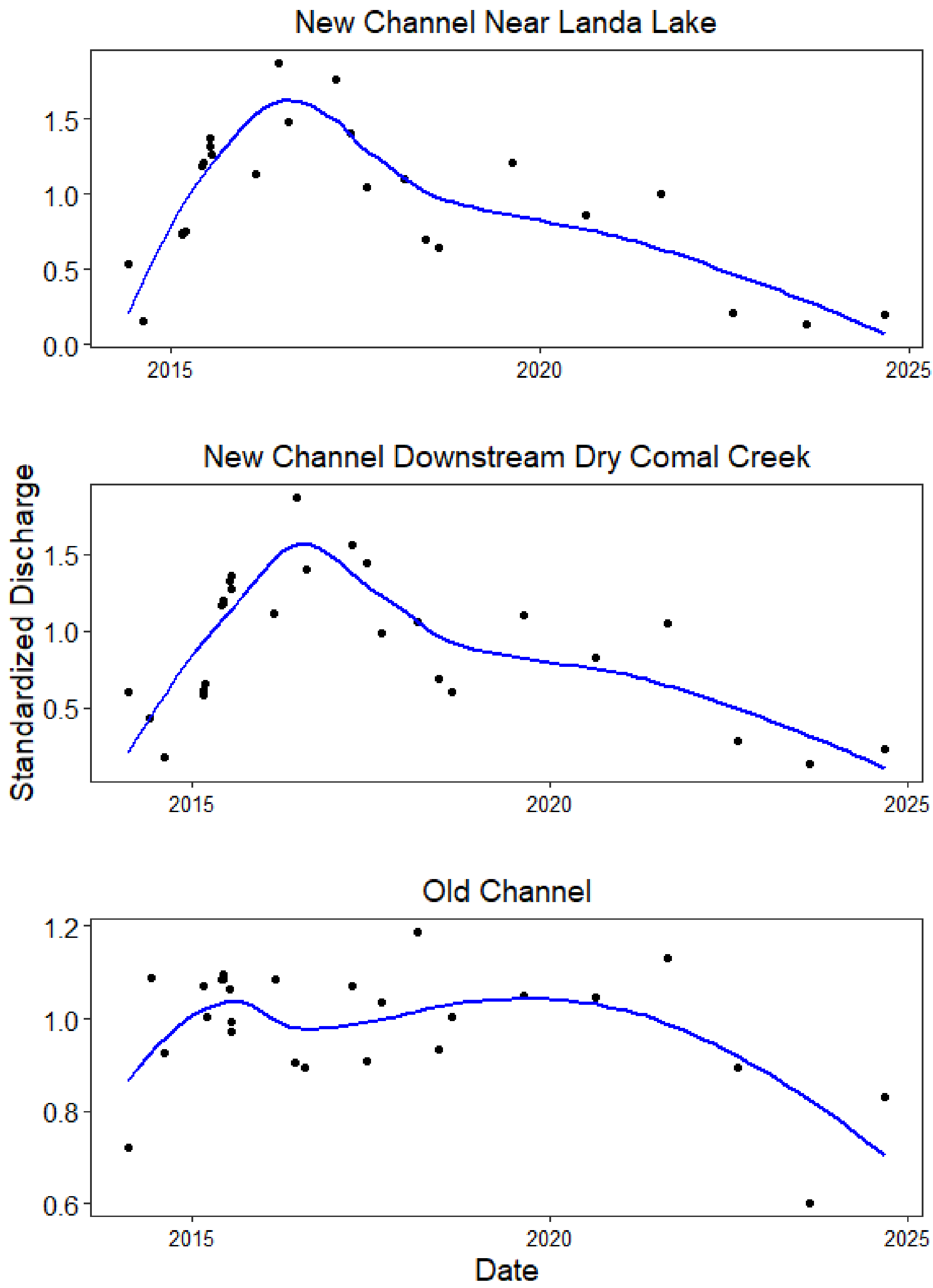

Figure 2. Times series displaying trends in standardized discharge during parasite monitoring at PI (top panel), LL (top panel), RVP (middle panel), and OCR (bottom panel). The blue line denotes LOESS smoothed regression fitted to observed standardized discharge values (black dots).

Table 2. Summary of optimal hyperparameters and predictive performance for random forest regression models used to examine trends in cercariae density in the Comal Springs/River System.

	C. formosanus	*H. pumilio*
Model Hyperparameters		
# of trees	500	500
# of variables tried per split	2	2
node size	5	5
Model Performance Statistics		
mean of sqaured residuals	0.71	0.08
% variation explained	84.83	47.37
correlation	0.92	0.69

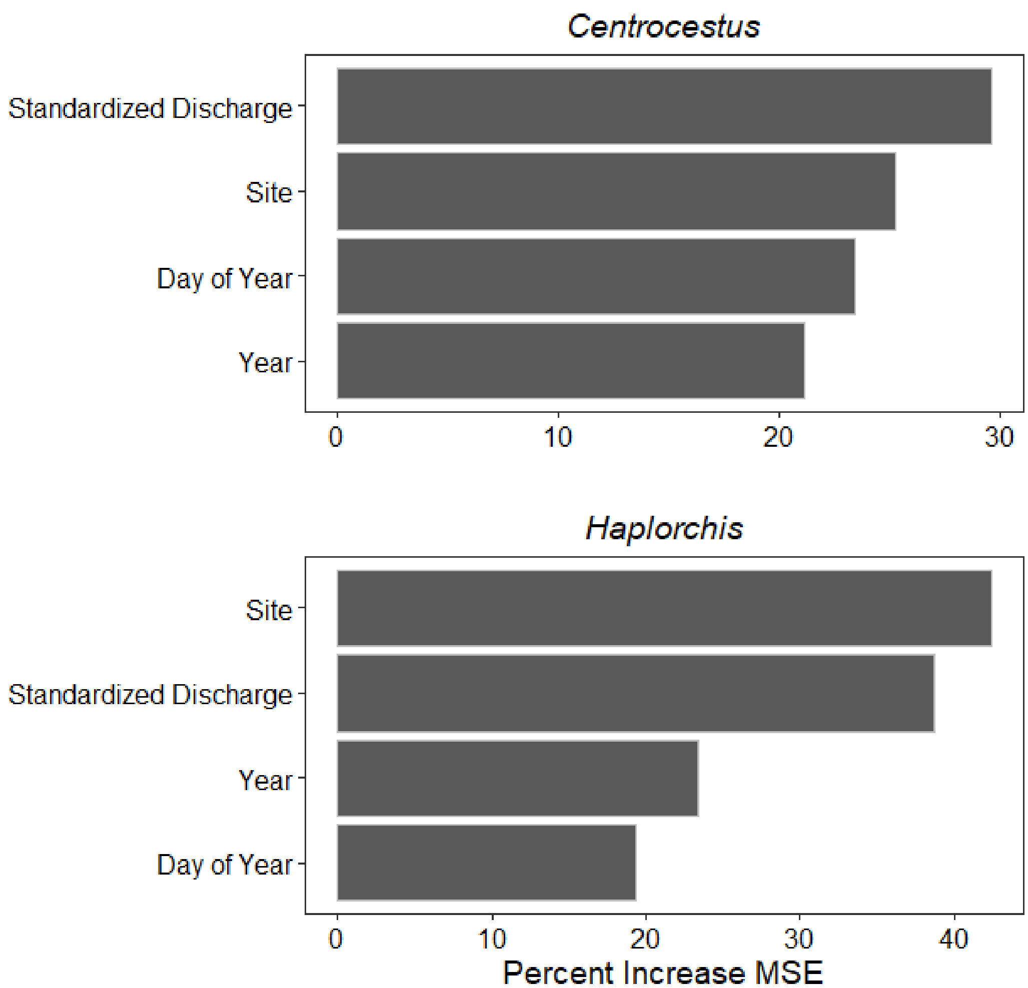

Figure 3. Bar graph displaying the percent increase in mean squared error (MSE) of variables used to predict *Centrocestus formosanus* and *Haplorchis pumilio* density in the Comal Springs/River system.

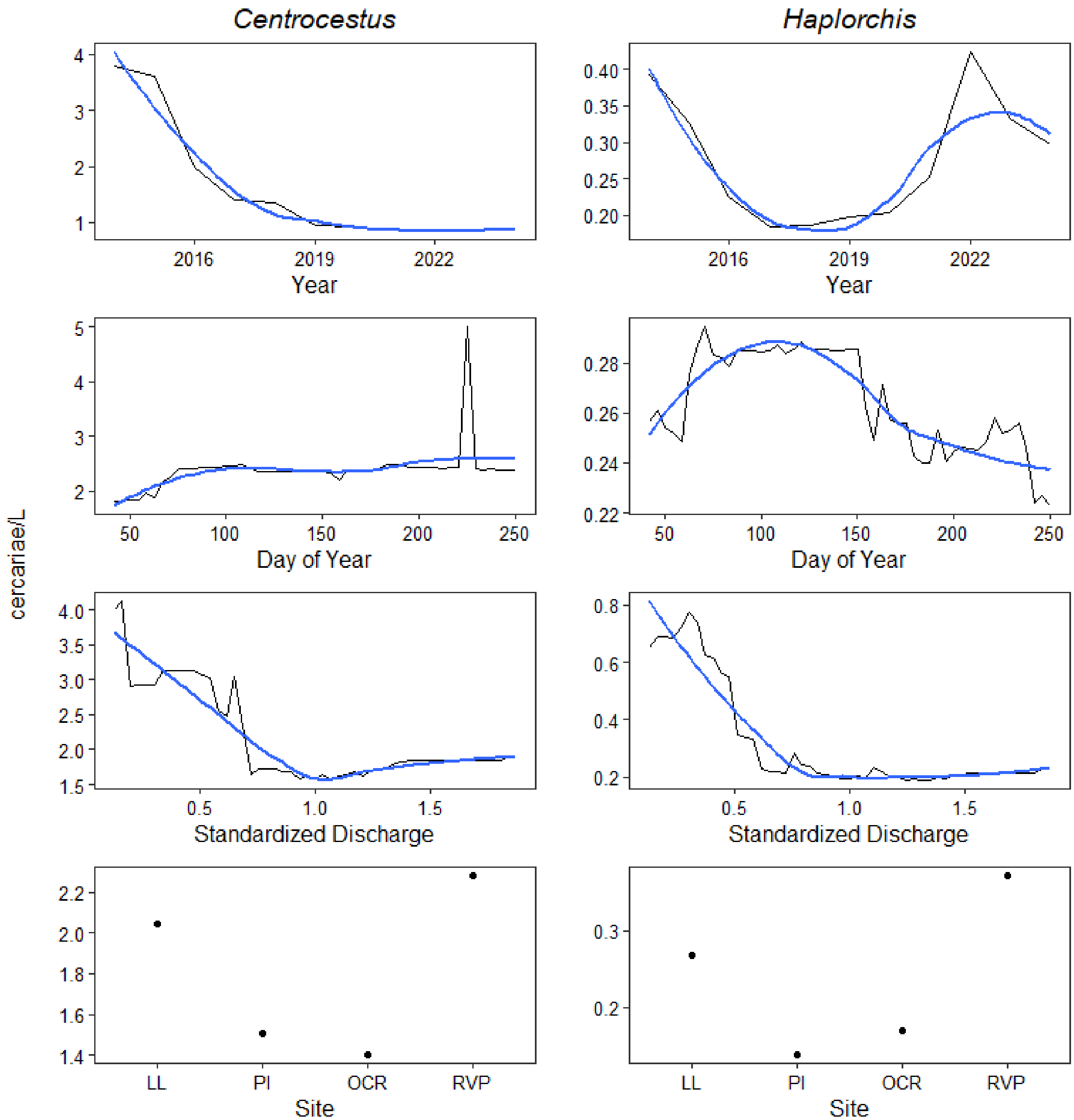

Figure 4. Partial dependence plots displaying variation of cercariae density as a function of year, day of year, standardized discharge, and site for *Centrocestus formosanus* and *Haplorchis pumilio* in the Comal Springs/River system. The blue line denotes a loess smoothed regression of the fitted function. Note differences in y-axis scales for each panel.

Discussion and Recommendations

Results from 2024 sampling provide further evidence to support that overall cercariae densities of *C. formosanus* have steadily declined since 2014. Despite some variability between sites, *C. formosanus* densities have been <1 cercariae/liter since 2018. In contrast, overall mean cercariae densities of *H. pumilio* were only near 1 cercariae/liter in 2014. Relative trends in *H. pumilio* cercariae density generally aligned with *C. formosanus* until 2020, when *H. pumilio* density began increasing to concentrations similar to 2014 by 2022. However, densities have been decreasing from 2022 to 2024. Despite asynchronous density trends between species, their mean densities have been mostly congruent among sites since 2019.

Random Forest models yielded similar predictive performance in 2024 compared to models fit in 2022 and 2023, though the relative influence of each predictor variable has varied across model iterations. Interestingly, ranks of predictor importance were more similar between species in 2024 compared to previous years. Relative importance of site on *C. formosanus* predictions was greater in 2024. In contrast, the importance of year on *C. formosanus* density has decreased and may be due to cercariae densities being more stable since 2019. This could also explain why the importance of site increased. With overall densities being generally similar from 2019-2024, it would be reasonable to suggest that relatively static local abiotic (e.g., water depth, current velocity) and biotic (e.g., *M. tuberculata* density) features not incorporated into the models are driving spatial variation in cercariae densities across sites. Despite several differences in predictor importance, standardized discharge consistently displayed a greater influence on model predictions. Cercariae density demonstrated a negative nonlinear relationship with standardized discharge for both species, confirming expectations that parasite densities increase under low flow conditions. Lastly, lower percent variation explained for *H. pumilio* indicates that there are likely other important covariates not included in this analysis.

Specific mechanisms driving recent declines in *C. formosanus* concentrations in the Comal Springs/River are currently unknown. In 2018, BIO-WEST collected data on snail distributional and density patterns of *M. tuberculata* throughout the study reaches, which showed large densities of snails upstream of the LL and RVP transects (**Figure 5**). However, *M. tuberculata* data have not been collected since 2018, and it is unclear if snail densities have changed. Collecting current data on snail distribution and density could help elucidate whether recent declines in *C. formosanus* concentration align with recent *M. tuberculata* population trends. In addition to snail distribution and density, changes in snail infection rates may be influencing *C. formosanus* concentrations. However, there is also a lack of data on temporal changes in snail infection rates in the Comal system. A previous study from the late 1990s found ~6% of *M. tuberculata* were shedding *C. formosanus* (Mitchell et al. 2000), yet it is unknown whether that percentage has changed through time. Lastly, there is a lack of data on definitive host (i.e., bird) infection rates or data on the number and intensity of infected fish in the system. Available information on fish infection rates is limited to manipulated experiments (McDonald et al. 2006; Huston et al. 2014; Scott 2019). Greater knowledge of all the different life history stages of *C. formosanus* would be required to develop a mechanistic understanding of the spatiotemporal patterns observed during this study.

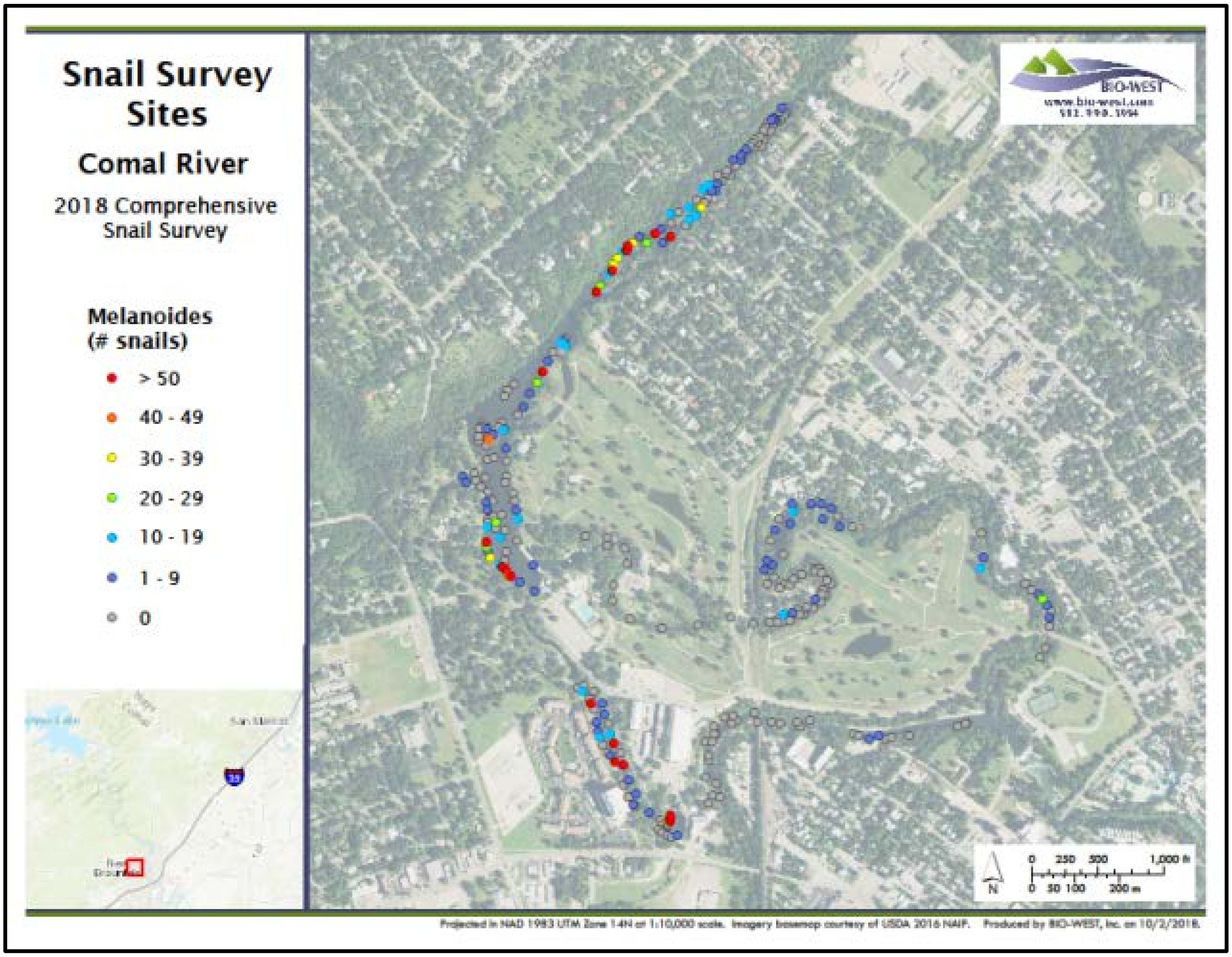

Figure 5. 2018 comprehensive survey of *M. tuberculata* in the Comal River**.**

In summary, parasite monitoring show that overall densities have generally remained less than 1 cercariae/L for both species since 2018. Random forest models identified multiple variables influencing *C. formosanus* densities. Incorporating additional data, as described above, could provide a more mechanistic understanding on ecological factors driving parasite population dynamics for both species. Identifying the underlying mechanisms could explain recent declines in *C. formosanus*, despite lower system-level discharge since 2021, and could also help improve predictions of *H. pumilio* density. Continued monitoring of parasite concentrations in the Comal Springs/River system is important to provide data at flow levels not yet observed, as well as to assess responses of the *C. formosanus* population when flows return to normal magnitudes.

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Appendix H6 | **Riffle Beetle Riparian Habitat Restoration**

MEMORANDUM

TO:	Phillip Quast
FROM:	Casey Williams, Israel Prewitt (BIO-WEST)
DATE:	**December 5, 2024**
SUBJECT:	2024 Annual Progress Report on the Native Riparian Restoration - Riffle Beetle Project

Hi Phillip,

Below is the annual (2024) summary of activities performed for the Native Riparian Restoration - Riffle Beetle project (BIO-WEST #2502) along Spring Run 2, Spring Run 3 and the Western shoreline in Landa Park. The newest addition to the project, Spring Run 2, has filled in nicely despite the dry conditions experienced this year. The following is a rundown of the work conducted over the course of 2024.

- ***January / February-*** The restoration team trimmed and utilized dead trees/branches for erosion control and wildlife snags for both spring runs. These were placed above coir logs to protect from herbivory and add organic matter over time. Heavy rains revealed weak points in erosion points which were subsequently repaired. We replaced and reinforced damaged coir logs, most caused by animal traffic. The restoration team created a new erosion structure, "Cage prism" incorporating coir logs, wood logs, rocks, and tree cages in a prism for a protected and more structurally sound erosion control feature.
- ***March-May-*** The restoration team added several "cage prisms' with new coir logs and recent deadfall. We trimmed old vegetative growth along Spring Run 3 to the ground to allow for new spring growth. We planted buttonbush, elderberry, Turks cap and spiderwort cuttings along both sides of Spring Run 3, some along Western shoreline and other riparian areas. Previously caged trees were checked and seeded if doing well.
- ***June – November-*** The team continued to maintain the restoration zones with occasional trimming, checking on fencing and enclosures and readjusting/mending as necessary. Older tree cages and fences in well-established areas were converted to additional Cage prisms or moved to needed areas. We added native seed to the Spring Run 2 slope including Red salvia and Inland seaoats,. Wild seeds were regularly collected from around Landa Lake and added to Spring Runs 2 and 3: including Turks cap, Beauty berry, Button bush, Blue curls, Ohio spiderwort Elderberry, Blue stem, Goldenrod, Mistflower, Frost weed, Emory sedge, Pecan, Oak, and Mountain Laurel. Additionally, we added 5 coir logs uphill of the start of Spring Run 1 and brushed piled them to prevent herbivory.
- ***Future work through years end*** – We will continue to maintain the water diversion barrier along the Spring Run 3 hillside. The diversion catchment area will be mended and aerated to prevent overflow. We will also selectively remove branches and shrubs to open up more canopy for sunlight and will leave brush piles along the slope of Spring Run 2 to discourage herbivory and human traffic. As needed, we will continue seeding Turks cap,

Frost weed, and Inland seaoats to both spring runs. With more trimming, we should also be able to create more Cage prisms as well. Finally, we will likely add a small rope fence to the stream buffer area again (if this is ok with the City) since that seemed to at least slow down human traffic last winter.

In summary, we continue to notice more vegetation establishment along the Spring Run 2 and 3 hillsides and buffer areas (**Figures 1 and 2**). Even during the drought, new vegetation has emerged. Some problematic points include continued undercutting along some stream edges and the rock wall along Spring Run 3 (**Figure 3**) and both sides of Spring Run 2. This can pose a future stream side erosion risk as these areas become more unstable, leading to potential bank collapses. The head of Spring Run 2 has been getting more scoured from Panther canyon, causing a deeper pool/ undercut and shallower riffle. We recommend shoring up these areas in some way, which would be easier during these times of low flow. Specific to Spring Run 3, there continues to be social trails cut across the vegetation buffer to access the water. We have tried various methods at discouraging these including brush piles (which were subsequently removed by another party), fenced cages and more plantings. It is likely it will take some continued effort to discourage foot traffic and repair damage. We also feel it is worth noting the decaying status of the Spring Run 3 Bridges.

We sincerely appreciate the continued opportunity to be involved in this project and the habitat restoration progress made these past several years has been exciting to see.

Sincerely,

BIO-WEST restoration team

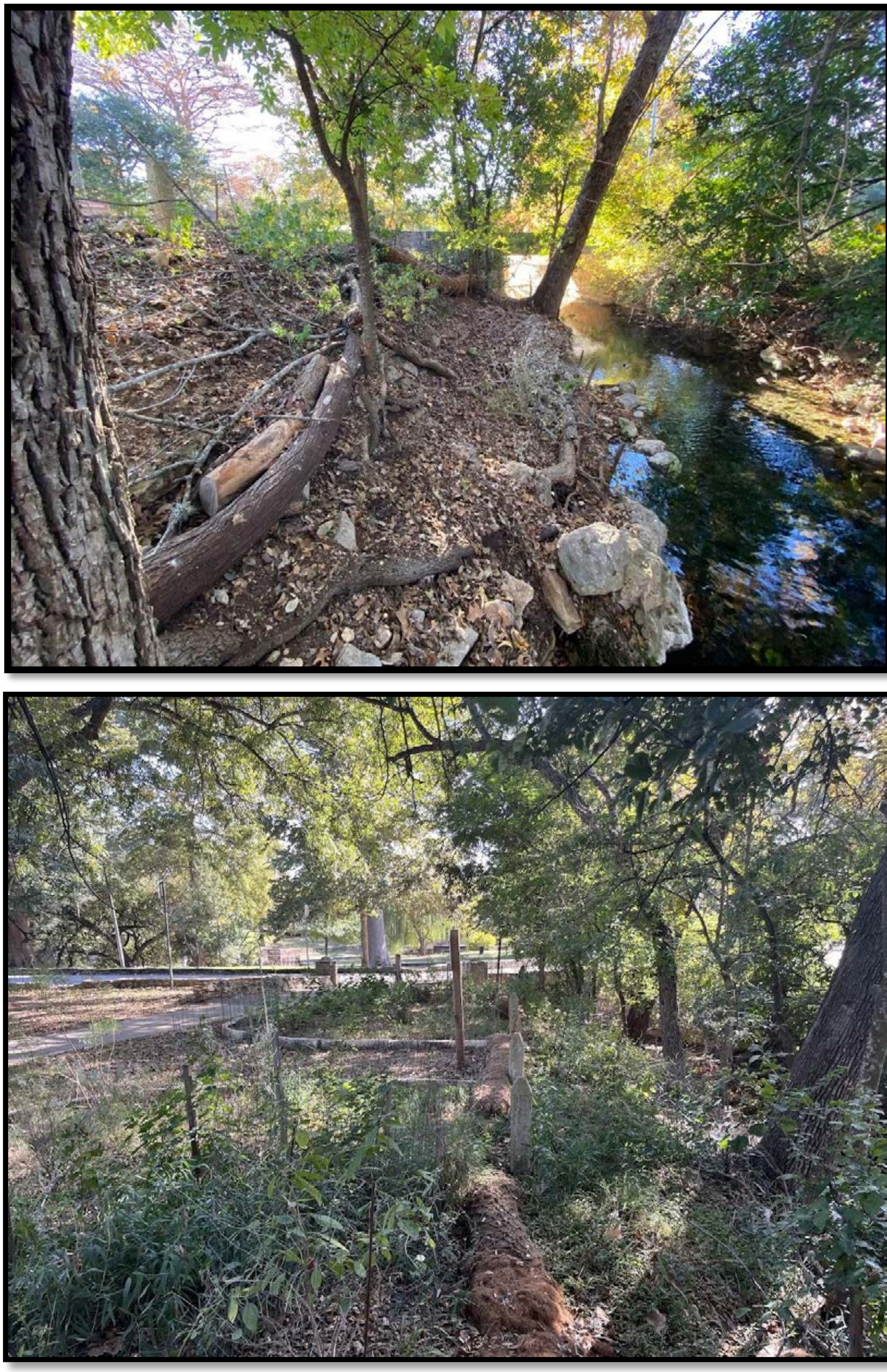
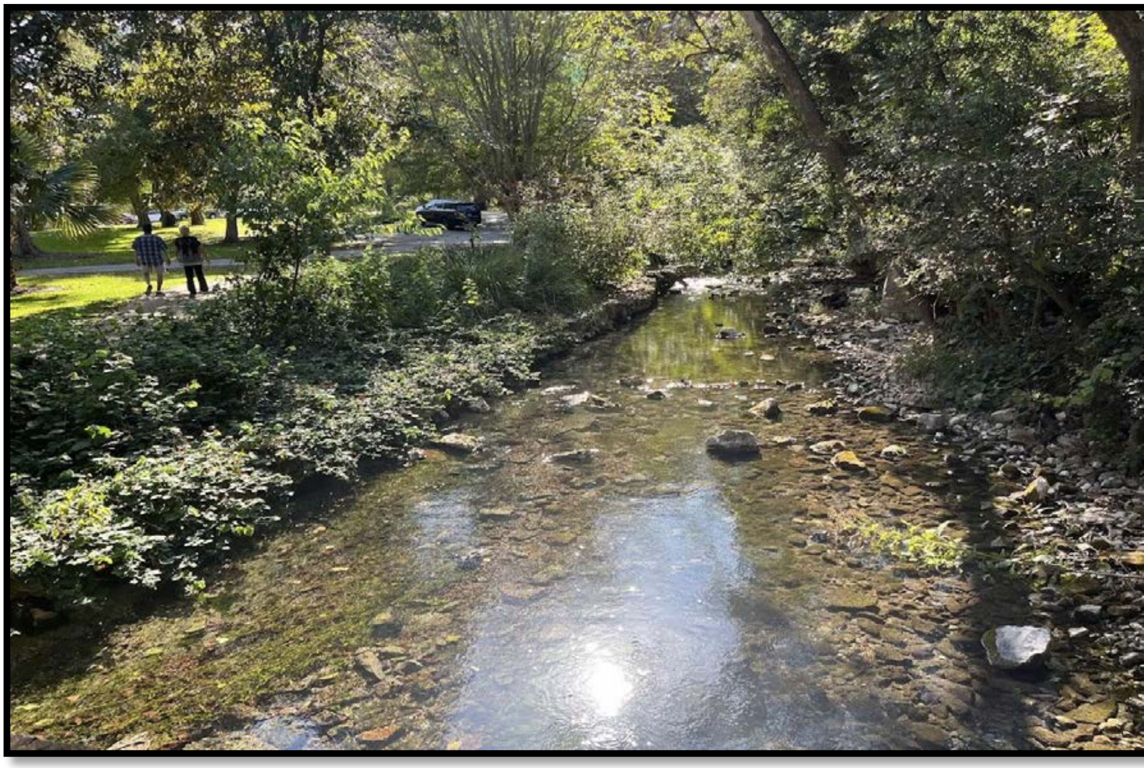


Figure 1. Spring Run 2 slope and beds in fall 2024.



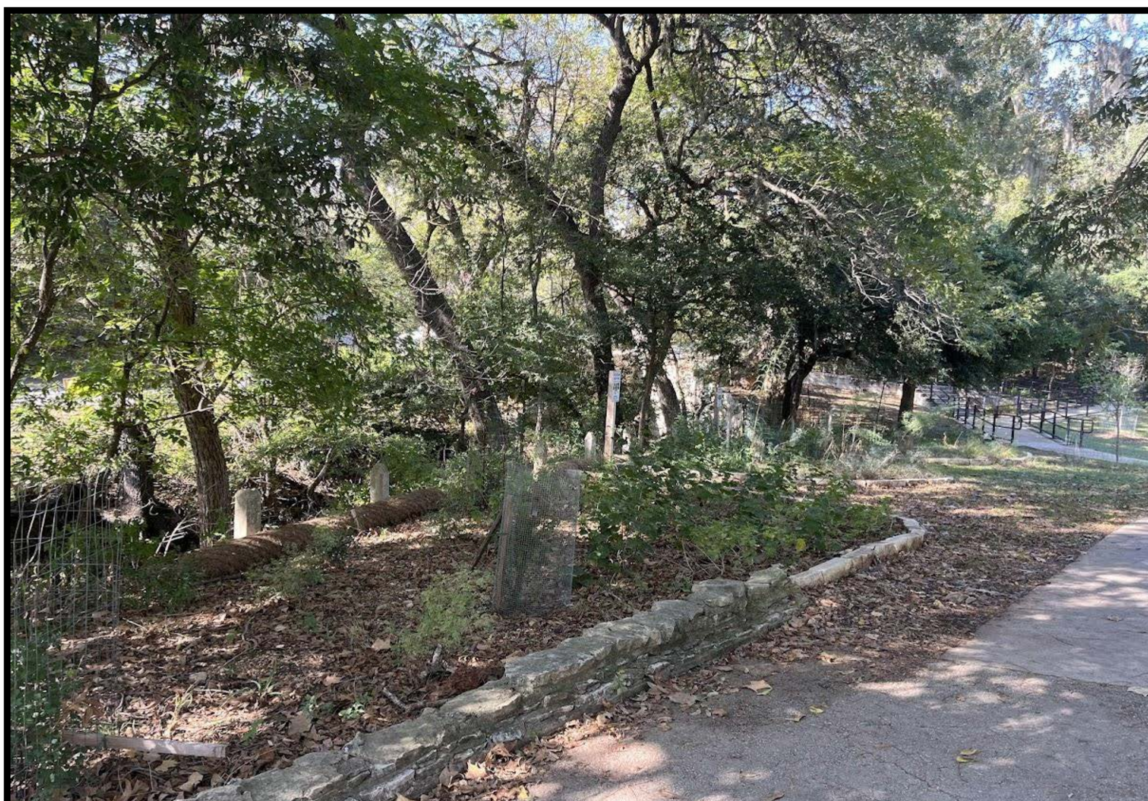


Figure 2. Vegetation buffer along Spring Run 3 during the current discharge rates for Comal Springs (top). Area along Spring Run 2 at the end of the season (bottom).

Figure 3. Low water levels have undermined several portions of the rock wall along Spring Run 3. Some areas of the wall have completely caved in undermining vegetation roots. Areas like this are susceptible to collapse and further erosion.

MEMORANDUM

TO:	Phillip Quast
FROM:	Casey Williams, Israel Prewitt (BIO-WEST)
DATE:	**December 5, 2024**
SUBJECT:	2024 Annual Progress Report on the Native Riparian Restoration - Riffle Beetle Project

Hi Phillip,

Below is the annual (2024) summary of activities performed for the Native Riparian Restoration - Riffle Beetle project (BIO-WEST #2502) along Spring Run 2, Spring Run 3 and the Western shoreline in Landa Park. The newest addition to the project, Spring Run 2, has filled in nicely despite the dry conditions experienced this year. The following is a rundown of the work conducted over the course of 2024.

- ***January / February-*** The restoration team trimmed and utilized dead trees/branches for erosion control and wildlife snags for both spring runs. These were placed above coir logs to protect from herbivory and add organic matter over time. Heavy rains revealed weak points in erosion points which were subsequently repaired. We replaced and reinforced damaged coir logs, most caused by animal traffic. The restoration team created a new erosion structure, "Cage prism" incorporating coir logs, wood logs, rocks, and tree cages in a prism for a protected and more structurally sound erosion control feature.
- ***March-May-*** The restoration team added several "cage prisms' with new coir logs and recent deadfall. We trimmed old vegetative growth along Spring Run 3 to the ground to allow for new spring growth. We planted buttonbush, elderberry, Turks cap and spiderwort cuttings along both sides of Spring Run 3, some along Western shoreline and other riparian areas. Previously caged trees were checked and seeded if doing well.
- ***June – November-*** The team continued to maintain the restoration zones with occasional trimming, checking on fencing and enclosures and readjusting/mending as necessary. Older tree cages and fences in well-established areas were converted to additional Cage prisms or moved to needed areas. We added native seed to the Spring Run 2 slope including Red salvia and Inland seaoats,. Wild seeds were regularly collected from around Landa Lake and added to Spring Runs 2 and 3: including Turks cap, Beauty berry, Button bush, Blue curls, Ohio spiderwort Elderberry, Blue stem, Goldenrod, Mistflower, Frost weed, Emory sedge, Pecan, Oak, and Mountain Laurel. Additionally, we added 5 coir logs uphill of the start of Spring Run 1 and brushed piled them to prevent herbivory.
- ***Future work through years end*** – We will continue to maintain the water diversion barrier along the Spring Run 3 hillside. The diversion catchment area will be mended and aerated to prevent overflow. We will also selectively remove branches and shrubs to open up more canopy for sunlight and will leave brush piles along the slope of Spring Run 2 to discourage herbivory and human traffic. As needed, we will continue seeding Turks cap,

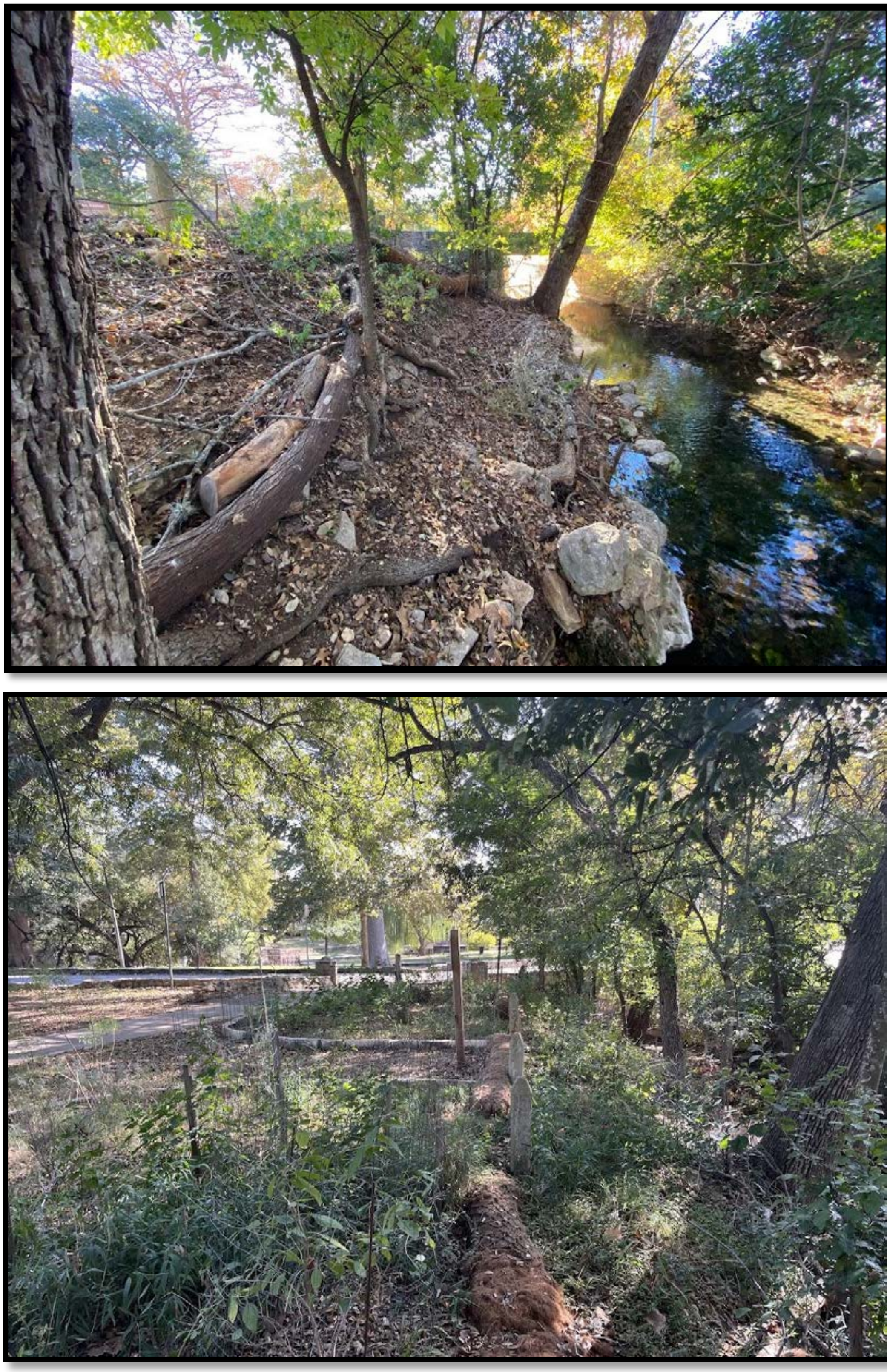
Frost weed, and Inland seaoats to both spring runs. With more trimming, we should also be able to create more Cage prisms as well. Finally, we will likely add a small rope fence to the stream buffer area again (if this is ok with the City) since that seemed to at least slow down human traffic last winter.

In summary, we continue to notice more vegetation establishment along the Spring Run 2 and 3 hillsides and buffer areas (**Figures 1 and 2**). Even during the drought, new vegetation has emerged. Some problematic points include continued undercutting along some stream edges and the rock wall along Spring Run 3 (**Figure 3**) and both sides of Spring Run 2. This can pose a future stream side erosion risk as these areas become more unstable, leading to potential bank collapses. The head of Spring Run 2 has been getting more scoured from Panther canyon, causing a deeper pool/ undercut and shallower riffle. We recommend shoring up these areas in some way, which would be easier during these times of low flow. Specific to Spring Run 3, there continues to be social trails cut across the vegetation buffer to access the water. We have tried various methods at discouraging these including brush piles (which were subsequently removed by another party), fenced cages and more plantings. It is likely it will take some continued effort to discourage foot traffic and repair damage. We also feel it is worth noting the decaying status of the Spring Run 3 Bridges.

We sincerely appreciate the continued opportunity to be involved in this project and the habitat restoration progress made these past several years has been exciting to see.

Sincerely,

BIO-WEST restoration team



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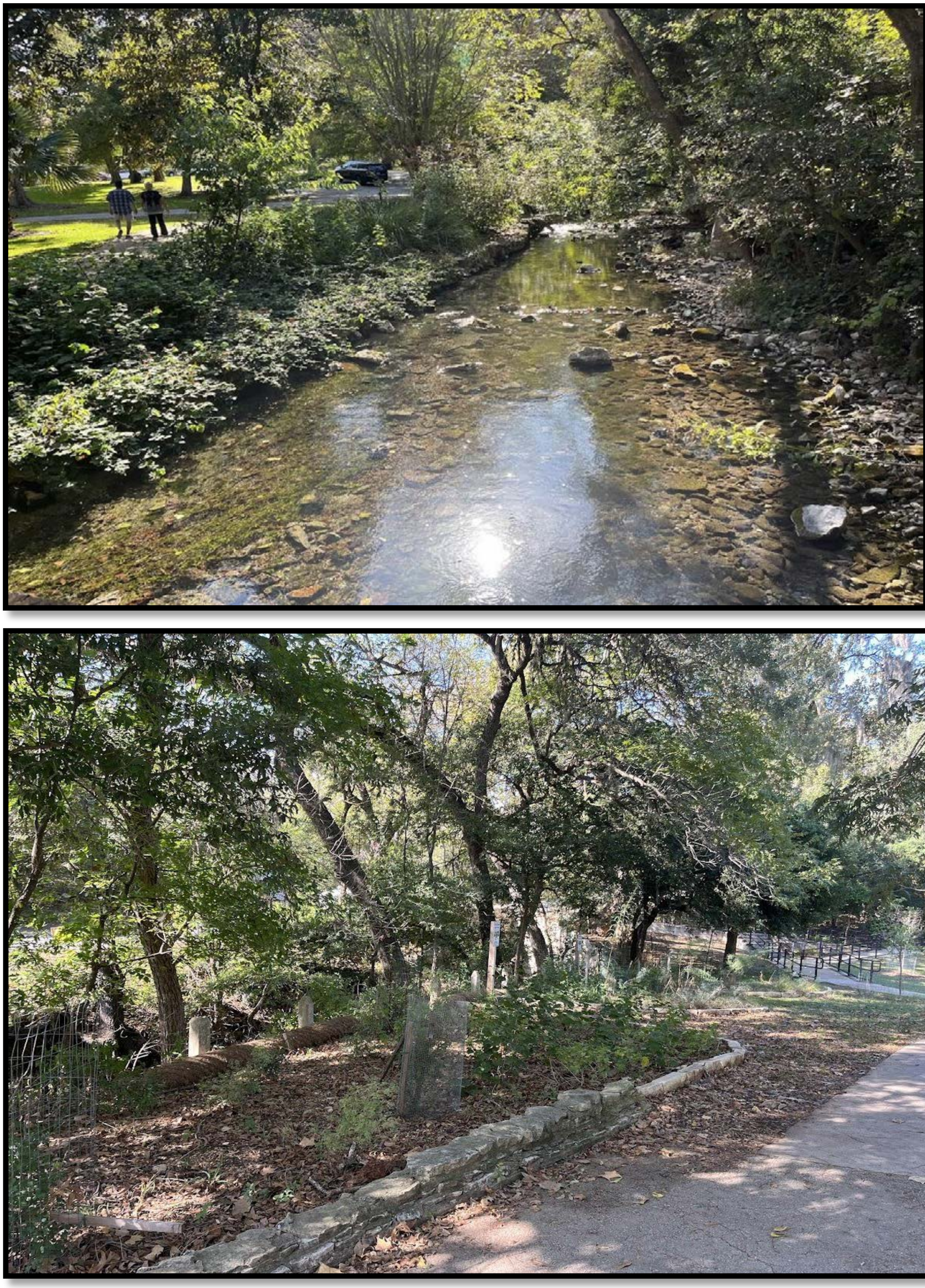

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Appendix H7 | **Native Riparian Habitat Restoration**

CoNB Native Riparian Habitat Restoration (EAHCP § 5.7.1)

The primary riparian restoration activities conducted in 2024 include: 1) removal and control of non-native riparian vegetation along Landa Lake on Comal County Water Recreation District property near Spring Island and Hinman Island Park 2) planting of native vegetation in areas where non-native vegetation was previously treated/ removed, 3) establishment of erosion/ sediment control berms and, 4) maintenance of previously restored areas within the riparian zone of Landa Lake and the Old Channel for the Comal River. **Figure 1 and Figure 2** illustrate the areas where riparian restoration activities occurred for the first time in 2024.

Figure 1. Location of 2024 riparian restoration along the banks of Landa Lake adjacent to the Spring Island which is owned by the Comal Country Water Recreation District #1. Restoration in these areas included removal of non-native vegetation and planting of native plants.

Figure 2. Location of 2024 riparian restoration in Hinman Island City Park along the Comal River. Restoration in this area to include removal of non-native vegetation, installation of erosion/ sediment control berms, and planting of native plants.

The non-native vegetation species targeted in 2024 include, but were not limited to, elephant ear (*Colocasia* sp.), privet (*Ligustrum* sp.), Chinese tallow (*Triadica sebifera*), giant cane (*Arundo donax*), and chinaberry (*Melia azedarach*). Approximately 110 Ligustrum (including 65 large trees and 45 small trees/ saplings), 94 Chinese tallow (including 17 large trees and 77 small trees/ saplings) and 243 Chinaberry (including 19 large trees and 224 small trees/ saplings) were removed/ treated throughout the riparian zone in 2024, primarily along the shores of Landa Lake and the bank of the Comal River.

Maintenance activities, including the re-treatment of re-emergent non-native vegetation and supplemental planting, occurred within previously restored areas extending from the upstream portion of Landa Lake through the Old Channel of the Comal River to the end of the Old Channel LTBG reach.

In 2024, approximately 267 native plants were planted and 2.5 lbs. of native grass and forb seed distributed within the riparian zone along Landa Lake primarily within the areas delineated in **Figure 1 and Figure 2**. The species and the total number of plants introduced into riparian areas in 2024 is shown in **Table 1**.

Table 1. Native Plants Planted within Riparian Zones Throughout the Comal River System in 2024	
Native Plants	
Bushy Bluestem	12
Canadian Wild Rye	9
Coralberry	7
Eastern Gamagrass	5
Elbow Bush	1
Green Texas Sage	3
Inland Sea Oats	88
Lindheimer Muhly	18
Lindheimer Senna	7
Mealy Blue Sage	60
Mexican Buckeye	2
Rockrose	2
Salvia greggii	6
Switchgrass	27
Texas Mountain Laurel	2
Texas Sage/ Cenizo	8
Turk's Cap	8
Yucca, Twist Leaf	2
Native Plant Seed Distributed	
Sideoats Grama	2 lbs.
Virginia Wildrye	2 lbs.
Inland Sea Oats	1 Large Pack

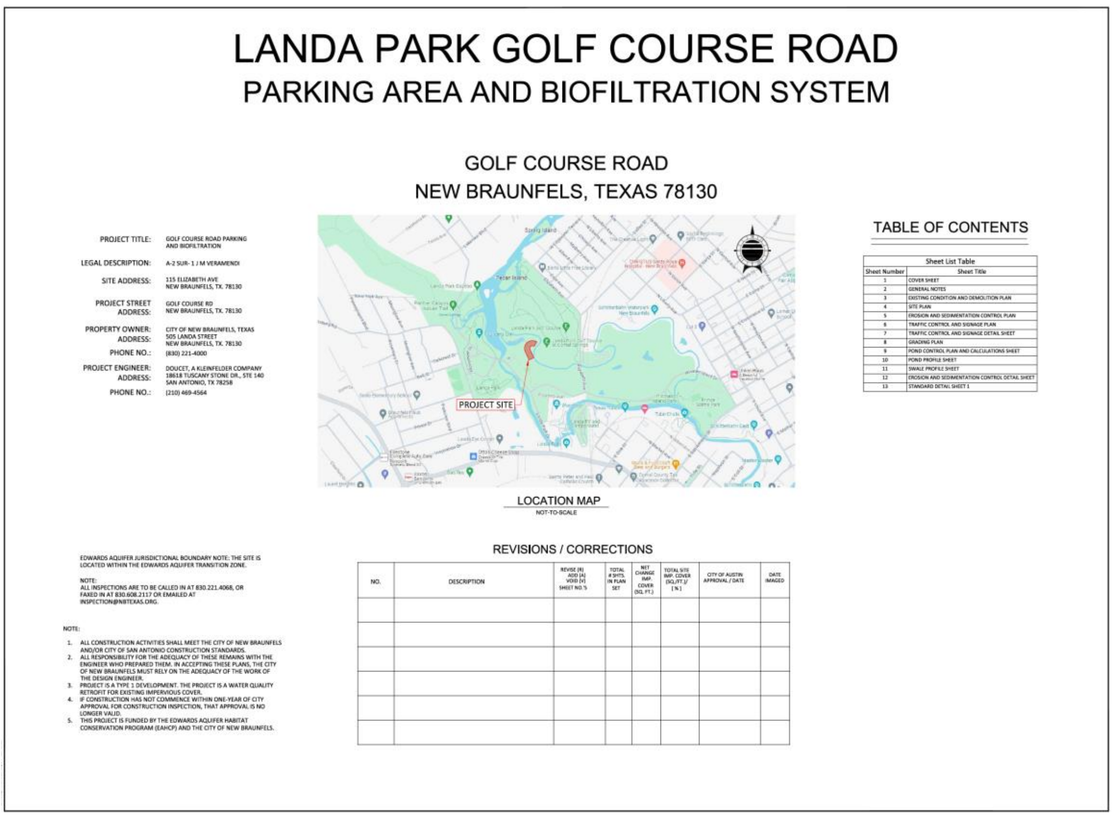
Purple Leatherflower	2 Large Packs
Scarlet Sage	1 Large Pack
Total # of native plantings: 267 (plus approx. 2.5 lbs. seed distributed)	

Appendix H8 | **Impervious Cover and Water Quality Protection**

City of New Braunfels

Landa Park Golf Course Road
Parking Area and Biofiltration System Design (December 2024)

In 2024, construction plans were designed for a 17-vehicle parking area on Golf Course Road in Landa Park with a bioretention basin adjacent to the parking area. The bioretention basin is designed to receive stormwater from Golf Course Road and the additional parking slots and allow the stormwater to slowly pass through the filtration medium in the biofiltration system. Once the stormwater has passed through the filtration medium, the stormwater is the directed to the Old Channel of the Comal River. This bioretention system helps to remove non-point source pollution from the stormwater passing through the system. This bioretention basin will be the fourth passive filtration system constructed in the Comal Springs area that has utilized EAHCP funding for the design and construction efforts. Construction of the new parking area and bioretention system is expected to occur in Q3 of 2025.


LANDA PARK GOLF COURSE ROAD
PARKING AREA AND BIOFILTRATION SYSTEM

GOLF COURSE ROAD
NEW BRAUNFELS, TEXAS 78130

PROJECT TITLE: GOLF COURSE ROAD PARKING AND BIOFILTRATION
LEGAL DESCRIPTION: A-2 SUR- 1 J M VERAMENDI
SITE ADDRESS: 115 ELIZABETH AVE NEW BRAUNFELS, TX. 78130
PROJECT STREET ADDRESS: GOLF COURSE RD NEW BRAUNFELS, TX. 78130
PROPERTY OWNER: CITY OF NEW BRAUNFELS, TEXAS
ADDRESS: 505 LANDA STREET NEW BRAUNFELS, TX. 78130
PHONE NO.: (830) 221-4000
PROJECT ENGINEER: DOUCET, A KLEINFELDER COMPANY
ADDRESS: 18618 TUSCANY STONE DR., STE 140 SAN ANTONIO, TX 78258
PHONE NO.: (210) 469-4564

PROJECT SITE

LOCATION MAP
NOT-TO-SCALE

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3	EXISTING CONDITION AND DEMOLITION PLAN
4	SITE PLAN
5	EROSION AND SEDIMENTATION CONTROL PLAN
6	TRAFFIC CONTROL AND SIGNAGE PLAN
7	TRAFFIC CONTROL AND SIGNAGE DETAIL SHEET
8	GRADING PLAN
9	POND CONTROL PLAN AND CALCULATIONS SHEET
10	POND PROFILE SHEET
11	SWALE PROFILE SHEET
12	EROSION AND SEDIMENTATION CONTROL DETAIL SHEET
13	STANDARD DETAIL SHEET 1

EDWARDS AQUIFER JURISDICTIONAL BOUNDARY NOTE: THE SITE IS LOCATED WITHIN THE EDWARDS AQUIFER TRANSITION ZONE.

NOTE:
ALL INSPECTIONS ARE TO BE CALLED IN AT 830.221.4068, OR FAXED IN AT 830.608.2117 OR EMAILED AT INSPECTION@NBTEXAS.ORG.

NOTE:

1. ALL CONSTRUCTION ACTIVITIES SHALL MEET THE CITY OF NEW BRAUNFELS AND/OR CITY OF SAN ANTONIO CONSTRUCTION STANDARDS.
2. ALL RESPONSIBILITY FOR THE ADEQUACY OF THESE REMAINS WITH THE ENGINEER WHO PREPARED THEM. IN ACCEPTING THESE PLANS, THE CITY OF NEW BRAUNFELS MUST RELY ON THE ADEQUACY OF THE WORK OF THE DESIGN ENGINEER.
3. PROJECT IS A TYPE 1 DEVELOPMENT. THE PROJECT IS A WATER QUALITY RETROFIT FOR EXISTING IMPERVIOUS COVER.
4. IF CONSTRUCTION HAS NOT COMMENCE WITHIN ONE-YEAR OF CITY APPROVAL FOR CONSTRUCTION INSPECTION, THAT APPROVAL IS NO LONGER VALID.
5. THIS PROJECT IS FUNDED BY THE EDWARDS AQUIFER HABITAT CONSERVATION PROGRAM (EAHCP) AND THE CITY OF NEW BRAUNFELS.

REVISIONS / CORRECTIONS

NO.	DESCRIPTION	REVISE (R) ADD (A) VOID (V) SHEET NO.'S	TOTAL # SHTS. IN PLAN SET	NET CHANGE IMP. COVER (SQ. FT.)	TOTAL SITE IMP. COVER (SQ./FT.)/ [%]	CITY OF AUSTIN APPROVAL / DATE	DATE IMAGED

LANDA PARK GOLF COURSE ROAD

PARKING AREA AND BIOFILTRATION SYSTEM

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PROPERTY OWNER: ADDRESS:	CITY OF NEW BRAUNFELS, TEXAS 505 LANDA STREET NEW BRAUNFELS, TX. 78130
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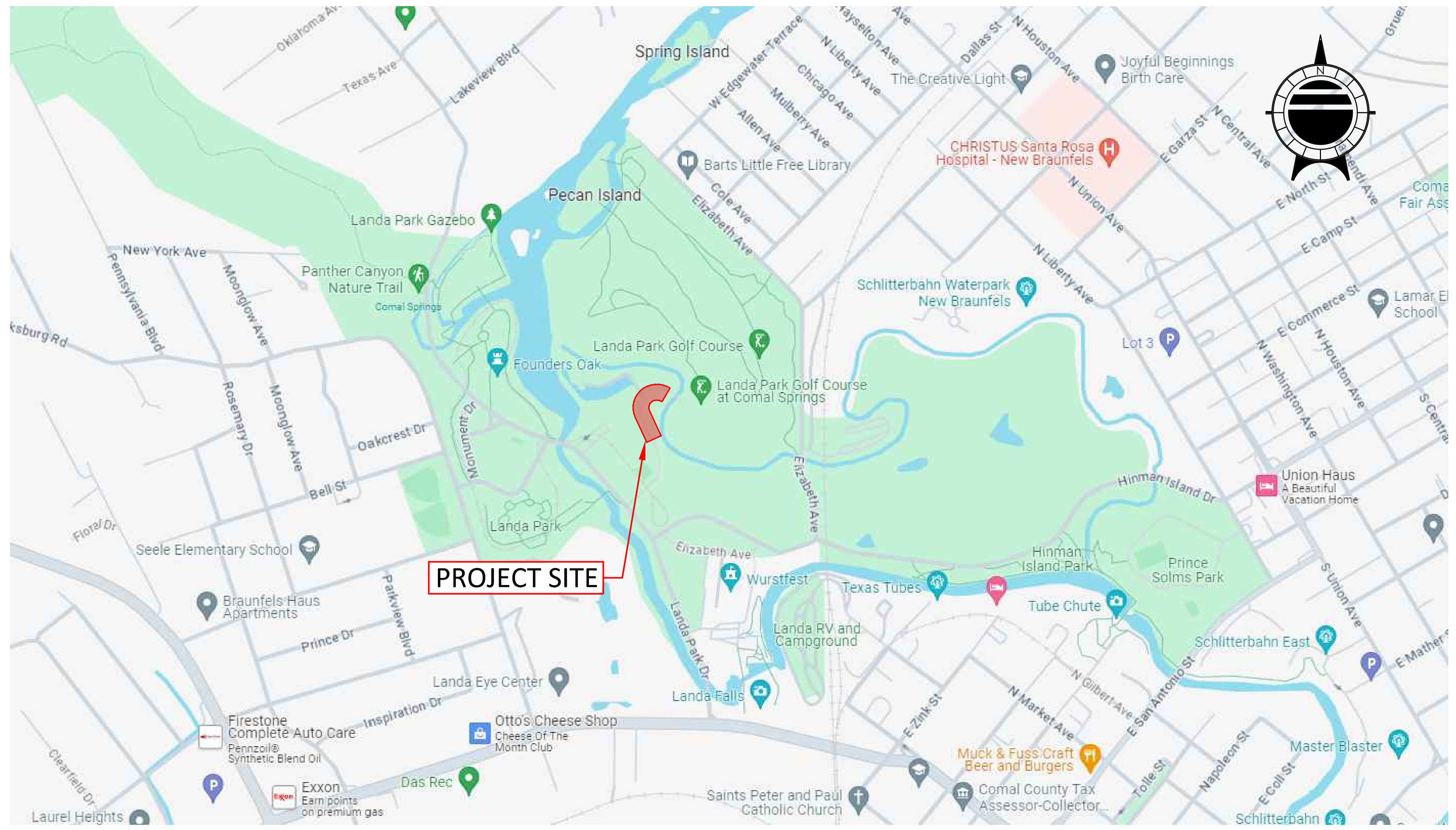

LOCATION MAP

NOT-TO-SCALE

TABLE OF CONTENTS

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IF THIS SHEET IS NOT 24" X 36", THEN IT IS A REDUCED PRINT.

Drawing: C:\pwworking\klf-dct-prod\zridge@kleinfelder.com\d0198322\24004114.001A SH CV.dwg
User: ZRIDGE
Last Modified: Dec. 20, 24 - 09:16
Plot Date/Time: Dec. 20, 24 - 09:45:12

THESE PLANS ARE RELEASED UNDER THE AUTHORITY OF JONATHAN CAREY, P.E., CFM TBPE# 131936, ON 12/20/24 FOR THE PURPOSES OF REVIEW AND ARE NOT TO BE USED FOR CONSTRUCTION PRIOR TO APPROVAL BY ALL GOVERNING JURISDICTIONS

STATE OF TEXAS
DAVID A. CLARK
123212
REGISTERED
PROFESSIONAL ENGINEER

12/20/2024

DOUCET ENGINEERS
TBPELS Firm No. F-3937

DOUCET
A Kleinfelder Company
Civil Engineering // Entitlements // Geospatial
7401 B. Highway 71 W, Ste. 160
Austin, TX 78735, Tel: (512)-583-2600
www.doucetengineers.com
TBPELS Engineering Firm No. F-3937
TBPELS Surveying Firm No. 10194551

GOLF COURSE ROAD PARKING AREA AND BIOFILTRATION SYSTEM
GOLF COURSE ROAD
NEW BRAUNFELS, TX. 78130

COVER SHEET

PLOTTED: Dec 20, 2024 - 9:45am
Designed: JC
Drawn: ZR
Reviewed: JC
Issue Date: 7/19/24

SHEET
1
OF 13

Project No.:
24004114.001A

IF THIS SHEET IS NOT 24" X 36", THEN IT IS A REDUCED PRINT.

CONSTRUCTION PLAN NOTES

IF CONSTRUCTION HAS NOT COMMENCED WITHIN ONE-YEAR OF CITY APPROVAL FOR CONSTRUCTION INSPECTION, THAT APPROVAL IS NO LONGER VALID.

THE MOST CURRENT EDITIONS OF THE CITY OF SAN ANTONIO STANDARD SPECIFICATIONS AND THE TEXAS DEPARTMENT OF TRANSPORTATION STANDARD SPECIFICATIONS FOR CONSTRUCTION OF HIGHWAYS, STREETS AND BRIDGES SHALL BE FOLLOWED FOR ALL CONSTRUCTION EXCEPT AS AMENDED BY THE CITY OF NEW BRAUNFELS STRANDARD DETAILS.

ALL RESPONSIBILITY FOR THE ADEQUACY OF THESE PLANS REMAINS WITH THE ENGINEER OF RECORD. IN ACCPETING THESE PLANS, THE CITY OF NEW BRAUNFELS MUST RELY UPON THE ADEQUACY OF THE WORK OF THE ENGINEER OF RECORD.

PRIOR TO THE START OF CONSTRUCTION, THE CONTRACTOR SHALL CONTACT THE CITY OF NEW BRAUNFELS TO SCHEDULE A PRECONSTRUCTION MEETING.

FOR PUBLIC INFRASTRUCTURE PERMIT OR GRADING PERMIT PROJECTS:

- FOR INSPECTIONS, YOU MUST CALL BEFORE 12:00 P.M., 48 HOURS PRIOR TO YOUR INSPECTION REQUEST.
- EACH INSPECTION WILL BE ALLOTTED 1 HOUR UNLESS YOU REQUEST FOR MORE TIME.
- ONCE YOUR REQUEST HAS BEEN ACCEPTED, YOU WILL RECEIVE A CALL FROM THE CITY OF NEW BRAUNFELS INSPECTOR.

FOR COMMERCIAL PERMIT (CP) PROJECTS:

- ALL INSPECTIONS ARE TO BE CALLED IN AT 830-221-4068 OR,
- FAXED IN AT 830-608-2117 OR,
- E-MAILED AT INSPECTIONS@NBTEXAS.ORG

IT IS THE CONTRACTOR'S RESPONSIBILITY TO SEE THAT ALL TEMPORARY AND PERMANENT TRAFFIC CONTROL DEVICES ARE PROPERLY INSTALLED AND MAINTAINED IN ACCORDANCE WITH THE PLANS AND LATEST EDITION OF THE TEXAS MANUAL ON UNIFORM TRAFFIC CONTROL DEVICES. IF, IN THE OPINION OF THE ENGINEERING REPRESENTATIVE AND THE CONSTRUCTION INSPECTOR, THE BARRICADES AND SIGNS DO NOT CONFORM TO ESTABLISHED STANDARDS OR ARE INCORRECTLY PLACED OR ARE INSUFFICIENT IN QUANTITY TO PROTECT THE GENERAL PUBLIC, THE CONSTRUCTION INSPECTOR SHALL HAVE THE OPTION TO STOP OPERATIONS UNTIL SUCH TIME AS THE CONDITIONS ARE CORRECTED. IF THE NEED ARISES, ADDITIONAL TEMPORARY CONSTRUCTION DEVICES MAY BE ORDERED BY THE ENGINEERING REPRESENTATIVE AT THE CONTRACTOR'S EXPENSE.

A TxDOT TYPE II B-B BLUE REFLECTIVE RAISED PAVEMENT MARKER SHALL BE INSTALLED IN THE CENTER OF THE ROADWAY ADJACENT TO ALL FIRE HYDRANTS. IN LOCATIONS WHERE HYDRANTS ARE SITUATED ON CORNERS, BLUE REFLECTIVE RAISED PAVEMENT MARKERS SHALL BE INSTALLED ON BOTH APPROACHES WHICH FRONT THE HYDRANT. THE RAISED PAVEMENT MARKER SHALL MEET TxDOT MATERIAL, EPOXY AND ADHESIVE SPECIFICATIONS.

GROUNDWATER

IT SHALL BE THE RESPONSIBILITY OF THE DEVELOPER, CONTRACTOR, SUBCONTRACTORS, BUILDERS, GEO-TECHNICAL ENGINEER, AND PROJECT ENGINEER TO IMMEDIATELY NOTIFY THE OFFICE OF THE CITY ENGINEER AND PROJECT ENGINEER IF THE PRESENCE OF GROUNDWATER WITHIN THE SITE IS EVIDENT. UPON NOTIFICATION THE PROJECT ENGINEER SHALL RESPOND WITH PLAN REVISIONS FOR THE MITIGATION OF THE GROUNDWATER ISSUE. THE CITY ENGINEER SHALL RESPOND WITHIN TWO (2) BUSINESS DAYS UPON RECEIPT OF THE MITIGATION PLAN. ALL CONSTRUCTION ACTIVITY, IMPACTED BY THE DISCOVERY OF GROUNDWATER, SHALL BE SUSPENDED UNTIL THE CITY ENGINEER GRANTS A WRITTEN APPROVAL OF THE GROUNDWATER MITIGATION PLAN.

RECORD DRAWINGS

AS PER PLATTING ORDINANCE SECTION 118-38M.: WHEN ALL OF THE IMPROVEMENTS ARE FOUND TO BE CONSTRUCTED AND COMPLETED IN ACCORDANCE WITH THE APPROVED PLANS AND SPECIFICATIONS AND WITH THE CITY'S STANDARDS, AND UPON RECEIPT OF ONE SET OF ''RECORD DRAWING'' PLANS, AND A DIGITAL COPY OF ALL PLANS (PDF COPY) THE CITY ENGINEER SHALL ACCEPT SUCH IMPROVEMENTS FOR THE CITY OF NEW BRAUNFELS, SUBJECT TO THE GUARANTY OF MATERIAL AND WORKMANSHIP PROVISIONS IN THIS SECTION.

CONSTRUCTION NOTE

ENGINEER OF RECORD IS RESPONSIBLE TO ENSURE THAT EROSION CONTROL MEASURES AND STORMWATER CONTROL SUFFICIENT TO MITIGATE OFF SITE IMPACTS ARE IN PLACE AT ALL STAGES OF CONSTRUCTION.

DRAINAGE NOTE

DRAINAGE IMPROVEMENTS SUFFICIENT TO MITIGATE THE IMPACT OF CONSTRUCTION SHALL BE INSTALLED PRIOR TO ADDING IMPERVIOUS COVER.

SOILS TESTING

PROCTORS SHALL BE SAMPLED FROM ON-SITE MATERIAL (ON-SITE IS DEFINED AS LIMITS OF CONSTRUCTION FOR THIS-PLAN SET) AND A COPY OF THE PROCTOR RESULTS SHALL BE DELIVERED TO THE CITY OF NEW BRAUNFELS STREET INSPECTOR PRIOR TO ANY DENSITY TESTS.

ROADWAY

ALL ROADWAY COMPACTION TESTS SHALL BE THE RESPONSIBILITY OF THE DEVELOPER'S GEOTECHNICAL ENGINEER. FLEXIBLE BASE OR FILL/EMBANKMENT MATERIAL SHALL BE PLACED IN UNIFORM LAYERS NOT TO EXCEED EIGHT INCHES (8'') LOOSE. THE REQUIRED DENSITY FOR THE FILL/EMBANKMENT MATERIAL SHALL MEET THE REQUIREMENTS OF TxDOT'S SPECIFICATION ITEM 132. THE REQUIRED DENSITY FOR THE FLEXIBLE BASE MATERIAL SHALL MEET THE REQUIREMENTS OF TxDOT'S SPECIFICATION ITEM 247. EACH LAYER OF MATERIAL, INCLUSIVE OF SUBGRADE, SHALL BE COMPACTED AS SPECIFIED AND TESTED FOR DENSITY AND MOISTURE IN ACCORDANCE WITH TEST METHODS TEX-113-E, TEX-114-E, TEX-115-E. THE NUMBER AND LOCATION OF THE REQUIRED TESTS SHALL BE DETERMINED BY THE GEOTECHNICAL ENGINEER AND APPROVED BY THE CITY OF NEW BRAUNFELS STREET INSPECTOR. AT A MINIMUM, TESTS SHALL BE TAKEN EVERY 200 LF FOR EACH LIFT. UPON COMPLETION OF TESTING, THE GEOTECHNICAL ENGINEER WILL PROVIDE THE CITY OF NEW BRAUNFELS STREET INSPECTOR WITH ALL TESTING DOCUMENTATION AND A CERTIFICATION STATING THAT THE PLACEMENT OF FLEXIBLE BASE, AND FILL MATERIAL, AND SUBGRADE, HAS BEEN COMPLETED IN ACCORDANCE WITH THE PLANS. ADDITIONAL DENSITY TESTS MAY BE REQUESTED BY THE CITY OF NEW BRAUNFELS INSPECTOR.

ITEM 340

ASPHALTIC CONCRETE PAVEMENT SHALL BE THE TYPE OF HOT MIX ASPHALT AS DEFINED IN THE CURRENT TxDOT STANDARD SPECIFICATIONS FOR CONSTRUCTION OF HIGHWAYS, STREETS AND BRIDGES.

THE CITY OF NEW BRAUNFELS WILL NOT ACCEPT THE USE OF RECYCLED ASPHALT PAVEMENT (RAP) OR RECYCLED ASPHALT SHINGLES (RAS) IN ASPHALT MIXTURES FOR NEW ROADWAYS. ANY DEBRIS INCLUSIONS WITHIN NEW ASPHALT PAVEMENTS WILL RESULT IN ASPHALT REMOVAL AND REPLACEMENT FROM CURB TO CURB FOR LIMITS TO BE DETERMINED BY THE CITY OF NEW BRAUNFELS.

THE ASPHALTIC CONCRETE PAVEMENT SURFACE COURSE SHALL BE PLANT MIXED, HOT LAID TYPE "D" MEETING THE SPECIFICATION REQUIREMENTS OF TXDOT ITEM 340. THE ASPHALTIC CONCRETE PAVEMENT SUB-SURFACE COURSES SHALL BE PLANT MIXED, HOT LAID TYPE "B" MEETING THE SPECIFICATION REQUIREMENTS OF TXDOT ITEM 340. THE MIXTURE SHALL BE DESIGNED PER THE DESIGN REQUIREMENTS SPECIFIED IN TXDOT ITEM 340 AND SHALL BE COMPACTED TO BETWEEN 91 AND 95 PERCENT OF THE MAXIMUM THEORETICAL DENSITY AS DETERMINED BY TXDOT TEST METHOD TEX-227-F. PLACE THE MIXTURE WHEN THE ROADWAY SURFACE TEMPERATURE IS AT OR ABOVE 60°F. COMPLETE ALL COMPACTION OPERATIONS BEFORE THE PAVEMENT TEMPERATURE DROPS BELOW 160°F. THE ASPHALT CEMENT CONTENT BY PERCENT OF TOTAL MIXTURE WEIGHT SHALL FALL WITHIN A TOLERANCE OF +0.5 PERCENT FROM A SPECIFIC MIX DESIGN.

UTILITY TRENCH COMPACTION (ADDED TO THE CONSTRUCTION PLANS ON ALL UTILITY PLAN SHEETS).

ALL UTILITY TRENCH COMPACTION TESTS WITHIN THE STREET PAVEMENT/SIDEWALK SECTION SHALL BE THE RESPONSIBILITY OF THE DEVELOPER'S GEOTECHNICAL ENGINEER. FILL MATERIAL SHALL BE PLACED IN UNIFORM LAYERS NOT TO EXCEED TWELVE INCHES (12") LOOSE. DETERMINE THE MAXIMUM LIFT THICKNESS BASED ON THE ABILITY OF THE COMPACTING OPERATION AND EQUIPMENT USED TO MEET THE REQUIRED DENSITY. EACH LAYER OF MATERIAL SHALL BE COMPACTED TO A MINIMUM 95% DENSITY AND TESTED FOR DENSITY AND MOISTURE IN ACCORDANCE WITH TEST METHODS TEX-113-E, TEX-114-E, TEX-115-E. THE NUMBER AND LOCATION OF REQUIRED TESTS SHALL BE DETERMINED BY THE GEOTECHNICAL ENGINEER AND APPROVED BY THE CITY OF NEW BRAUNFELS STREET INSPECTOR. AT A MINIMUM, TESTS SHALL BE TAKEN EVERY 200 LF FOR EACH LIFT AND EVERY OTHER SERVICE LINE. UPON COMPLETION OF TESTING THE GEOTECHNICAL ENGINEER SHALL PROVIDE THE CITY OF NEW BRAUNFELS STREET INSPECTOR WITH ALL TESTING DOCUMENTATION AND A CERTIFICATION STATING THAT THE PLACEMENT OF FILL MATERIAL HAS BEEN COMPLETED IN ACCORDANCE WITH THE PLANS. ADDITIONAL DENSITY TESTS MAY BE REQUESTED BY THE CITY OF NEW BRAUNFELS INSPECTOR.

CURB CUT DUE TO CONSTRUCTION OF NEW RIGHT-OF-WAY CONSTRUCTION

(INDICATE THE 2 OPTIONS ON THE CONSTRUCTION PLANS).

1. SAWCUT EXISTING STREET AND MATCH TO NEW CONSTRUCTION.
2. SAWCUT EXISTING CURB TO TIE INTO EXISTING CONSTRUCTION.

CONSTRUCTION STABILIZED ENTRANCE

SAWCUT CURB FOR CONSTRUCTION ENTRANCE.

STABILIZED CONSTRUCTION AREA SHALL BE CONSTRUCTED OF 3''x5'' ROCK TO BE PLACED A MINIMUM LENGTH OF 25-FT. AND MAINTAINED SO THAT CONSTRUCTION DEBRIS DOES NOT FALL WITHIN THE CITY RIGHT-OF-WAY. RIGHT-OF-WAY MUST BE CLEARED FROM MUD, ROCKS, ETC. AT ALL TIMES.

SIGNING AND PAVEMENT MARKING PLAN NOTES

THE CONTRACTOR SHALL FURNISH AND INSTALL ALL REGULATORY AND WARNING SIGNS, STREETS NAME SIGNS AND SIGN MOUNTS IN ACCORDANCE WITH APPROVED ENGINEERING PLANS. THE CITY WILL INSPECT ALL SIGNS AT FINAL INSPECTION. THE CONTRACTOR SHALL INSTALL ALL PAVEMENT MARKINGS IN ACCORDANCE WITH APPROVED ENGINEERING PLANS. THE CONTRACTOR SHALL NOTIFY THE CITY AT LEAST TWENTY-FOUR (24 HOURS) PRIOR TO THE INSTALLATION OF ALL SEALER AND FINAL MARKINGS. THE CITY WILL INSPECT ALL MARKINGS AT FINAL APPLICATION.

SEEDING AND ESTABLISHMENT OF VEGETATION WITHIN EARTHEN CHANNELS, STORMWATER BASINS AND DISTURBED AREAS

SEEDING FOR THE PURPOSE OF ESTABLISHING VEGETATION WITHIN CONSTRUCTED EARTHEN CHANNELS, BASINS AND DISTURBED AREAS SHALL BE CONDUCTED IN ACCORDANCE WITH ITEM 164 (SEEDING FOR EROSION CONTROL OF TXDOT'S STANDARD SPECIFICATIONS FOR CONSTRUCTION AND MAINTENANCE OF HIGHWAYS, STREETS AND BRIDGES MANUAL. ONLY SEED TYPES AND MIXES SPECIFIED FOR THE SAN ANTONIO DISTRICT (DISTRICT 15) IN TABLES 1 AND 2 UNDER ITEM 164 SHALL BE UTILIZED. DURING THE COOL SEASON (SEPT 1-NOV 30), CEREAL RYE AND SEED SPECIES SPECIFIED FOR THE SAN ANTONIO DISTRICT IN TABLE 3 MAY BE USED. FOR COOL SEASON SEEDING APPLICATIONS, COOL SEASON SEED MIXES SHALL BE USED IN CONJUNCTION WITH SEED MIXES FOR THE SAN ANTONIO DISTRICT AS SPECIFIED IN TABLE 1 AND 2 UNDER ITEM 164.

IT MAY BE DEEMED NECESSARY TO INCORPORATE TOPSOIL AND SOIL AMENDMENTS (I.E. COMPOST/ FERTILIZER INTO EXISTING SOIL IN ORDER TO FACILITATE VEGETATION GROWTH. TOPSOIL, COMPOST AND FERTILIZER ADDITIONS SHALL BE CONDUCTED ACCORDING TO ITEMS 160, 161 AND 166 OF TXDOT'S STANDARD SPECIFICATIONS MANUAL, RESPECTIVELY.

AREAS REQUIRING PERMANENT VEGETATION (EARTHEN CHANNELS, PONDS, ETC.) ARE REQUIRED TO MEET TXDOT SPECIFICATIONS FOR ITEM 160 TOPSOIL. TESTING PER TEX-128-E WILL BE REQUIRED AT THE CITY'S REQUEST.

WATERING MAY ALSO BE NECESSARY TO FACILITATE AND EXPEDITE THE SPROUTING AND GROWTH OF VEGETATION. ITEM 168 OF TXDOT'S STANDARD SPECIFICATIONS MANUAL SHALL BE ADHERED TO FOR VEGETATIVE WATERING.

IF EXTENDED DROUGHT CONDITIONS EXIST THAT HINDER OR PROHIBIT THE GROWTH AND ESTABLISHMENT OF VEGETATION, THE CONTRACTOR/ DEVELOPER SHALL PROVIDE A PLAN TO THE CITY OF NEW BRAUNFELS DESCRIBING THE MEASURES THAT WILL BE TAKEN TO STABILIZE EARTHEN DRAINAGE INFRASTRUCTURE UNTIL A TIME WHEN GROWING CONDITIONS BECOME MORE FAVORABLE.

THESE PLANS ARE RELEASED UNDER THE AUTHORITY OF JONATHAN CAREY, P.E., CFM TBPE# 131936, ON 12/20/24 FOR THE PURPOSES OF REVIEW AND ARE NOT TO BE USED FOR CONSTRUCTION PRIOR TO APPROVAL BY ALL GOVERNING JURISDICTIONS

STATE OF TEXAS
DAVID A. CLARK
123212
REGISTERED PROFESSIONAL ENGINEER

12/20/2024

DOUCET ENGINEERS
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GOLF COURSE ROAD PARKING AREA AND BIOFILTRATION SYSTEM
GOLF COURSE ROAD
NEW BRAUNFELS, TX. 78130

GENERAL NOTES

PLOTTED: Dec 20, 2024 - 9:45am

Designed:	JC
Drawn:	ZR
Reviewed:	JC
Issue Date:	7/19/24

SHEET 2 OF 13

Project No.: 24004114.001A

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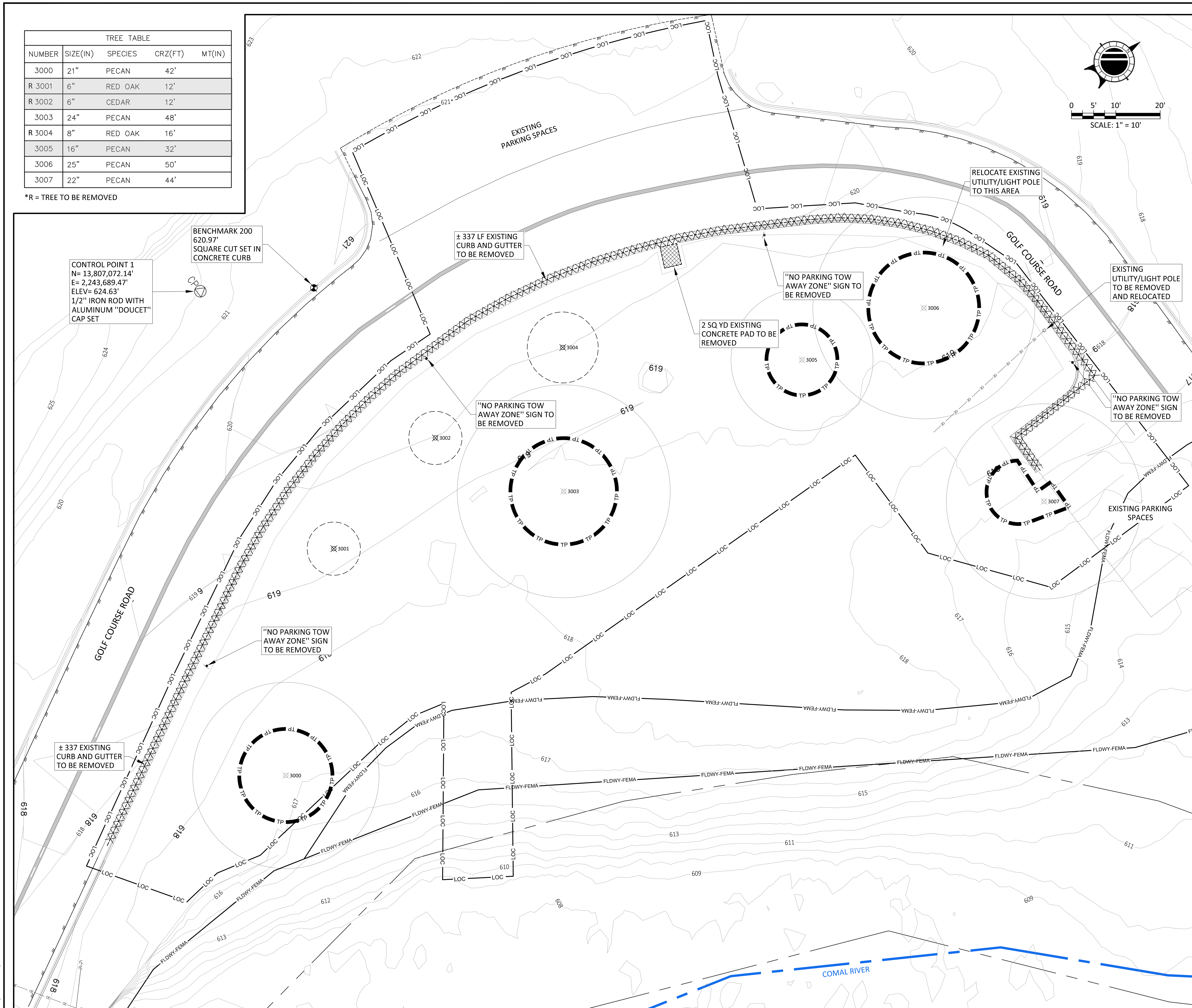
TREE TABLE				
NUMBER	SIZE(IN)	SPECIES	CRZ(FT)	MT(IN)
3000	21"	PECAN	42'	
R 3001	6"	RED OAK	12'	
R 3002	6"	CEDAR	12'	
3003	24"	PECAN	48'	
R 3004	8"	RED OAK	16'	
3005	16"	PECAN	32'	
3006	25"	PECAN	50'	
3007	22"	PECAN	44'	

*R = TREE TO BE REMOVED



CONTRACTOR NOTES:

EXISTING UNDERGROUND & OVERHEAD UTILITIES IN VICINITY. CONTRACTOR TO CONTACT UTILITY COMPANIES PRIOR TO CONSTRUCTION. CONTRACTOR TO CALL 811 FOR UTILITY LOCATES PRIOR TO EXCAVATION. CONTRACTOR TO FIELD VERIFY EXISTING UTILITY LOCATIONS & DEPTH PRIOR TO BEGINNING CONSTRUCTION.

CONTRACTOR SHALL CONSIDER PROPOSED UTILITY IMPROVEMENTS AND PROVIDE ADEQUATE HORIZONTAL AND VERTICAL CLEARANCE DURING INSTALLATION OF ALL UTILITY INFRASTRUCTURE.

LEGEND

EXISTING SITE

- EXISTING R.O.W./PROPERTY LINE
- EXISTING EASEMENT LINE
- EXISTING PAVEMENT
- 493 EX. CONTOURS
- W EX. WATER LINE
- WW EX. WASTEWATER
- SD EX. STORM DRAIN
- OHU EX. OVERHEAD UTILITIES
- OHE EX. OVERHEAD ELECTRIC
- UE EX. UNDERGROUND ELECTRIC
- TS EX. UNDERGROUND TRAFFIC SIGNAL
- UT EX. UNDERGROUND TELEPHONE
- FO EX. UNDERGROUND FIBEROPTICS
- G EX. GAS LINE
- OO EX. CHAINLINK FENCE
- X EX. WIRE FENCE
- // EX. WOOD FENCE
- EX. GUARD RAIL
- 100-YFP CITY OF AUSTIN FULLY DEVELOPED 100-YR FLOODPLAIN
- 100Y-FEMA 100-YR FEMA FLOODPLAIN
- CWQZ CRITICAL WATER QUALITY ZONE
- WQTZ WATER QUALITY TRANSITION ZONE
- 100 EXISTING TREE (TO REMAIN)
- EXISTING BUILDING
- LOC LIMITS OF CONSTRUCTION
- TP TREE PROTECTION
- TMH EX. TELEPHONE MANHOLE
- T EX. TELEPHONE MARKER
- FO EX. FIBER OPTICS MARKER
- TB EX. TELEPHONE BOX
- TSP EX. TRAFFIC SIGNAL POLE
- TSB EX. TRAFFIC SIGNAL BOX
- GV EX. GAS VALVE
- G EX. GAS METER
- G EX. GAS MARKER
- MB EX. MAIL BOX
- EX. PARKING METER
- EX. SIGN
- EX. POWER POLE
- EX. GUY WIRE
- LP EX. LIGHT POLE
- EMH EX. ELECTRIC MANHOLE
- EB EX. ELECTRIC BOX
- E EX. ELECTRIC BOX
- E EX. ELECTRIC MARKER
- SV EX. SPRINKLER VALVE
- EX. WATER VALVE
- EX. FIRE HYDRANT
- EX. WATER METER
- EX. STORM DRAIN INLET WITH LATERAL
- SDMH EX. STORM DRAIN MANHOLE
- WWMH EX. WASTEWATER MANHOLE
- CONTROL POINT
- 100 EXISTING TREE (TO BE REMOVED)
- HCRZ EXISTING TREE HALF CRITICAL ROOT ZONE

DEMOLITION LEGEND

OR

AREA(S) TO BE DEMOLISHED PER PLAN VIEW CALLOUT

CONTROL NOTE:
BASIS OF BEARING IS THE TEXAS COORDINATE SYSTEM, SOUTH CENTRAL ZONE [4204], NAD 83 (2011), EPOCH 2010. ALL DISTANCES SHOWN ARE LOCAL SURFACE VALUES AND MAY BE CONVERTED TO GRID BY DIVIDING BY THE SURFACE ADJUSTMENT FACTOR OF 1.00012 AND USING CONTROL POINT 1 AS THE POINT OF ORIGIN. UNITS: US SURVEY FEET.

BASE POINT INFORMATION
CONTROL POINT 1 (OPUS)
N= 13,807,072.14'
E= 2,243,689.47'
Z= 624.63'
DESCRIPTION: 1/2" IRON ROD SET WITH ALUMINUM "DOUCET CONTROL" CAP

BENCHMARK NOTE:
BENCHMARK #200
ELEVATION: 620.97'
DESCRIPTION: SQUARE CUT SET IN A CONCRETE CURB LOCATED APPROXIMATELY 350 FEET WEST OF THE OLD CHANNEL CROSSING OF THE COMAL RIVER, ON THE WEST SIDE OF GOLF COURSE ROAD.

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12/20/2024

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GOLF COURSE ROAD PARKING AREA AND BIOFILTRATION SYSTEM
GOLF COURSE ROAD
NEW BRAUNFELS, TX. 78130

EXISTING CONDITION AND DEMOLITION PLAN

PLOTTED: Dec 20, 2024 - 9:45am
Designed: JC
Drawn: ZR
Reviewed: JC
Issue Date: 7/19/24

SHEET
3
OF 13

Project No.:
24004114.001A

Drawing: C:\pwworking\klf-dct-prod\rdge@kleinfelder.com\d0198322\24004114.001A SH 3P.dwg
User: ZRIDGE
Last Modified: Dec. 20, 24 - 09:27
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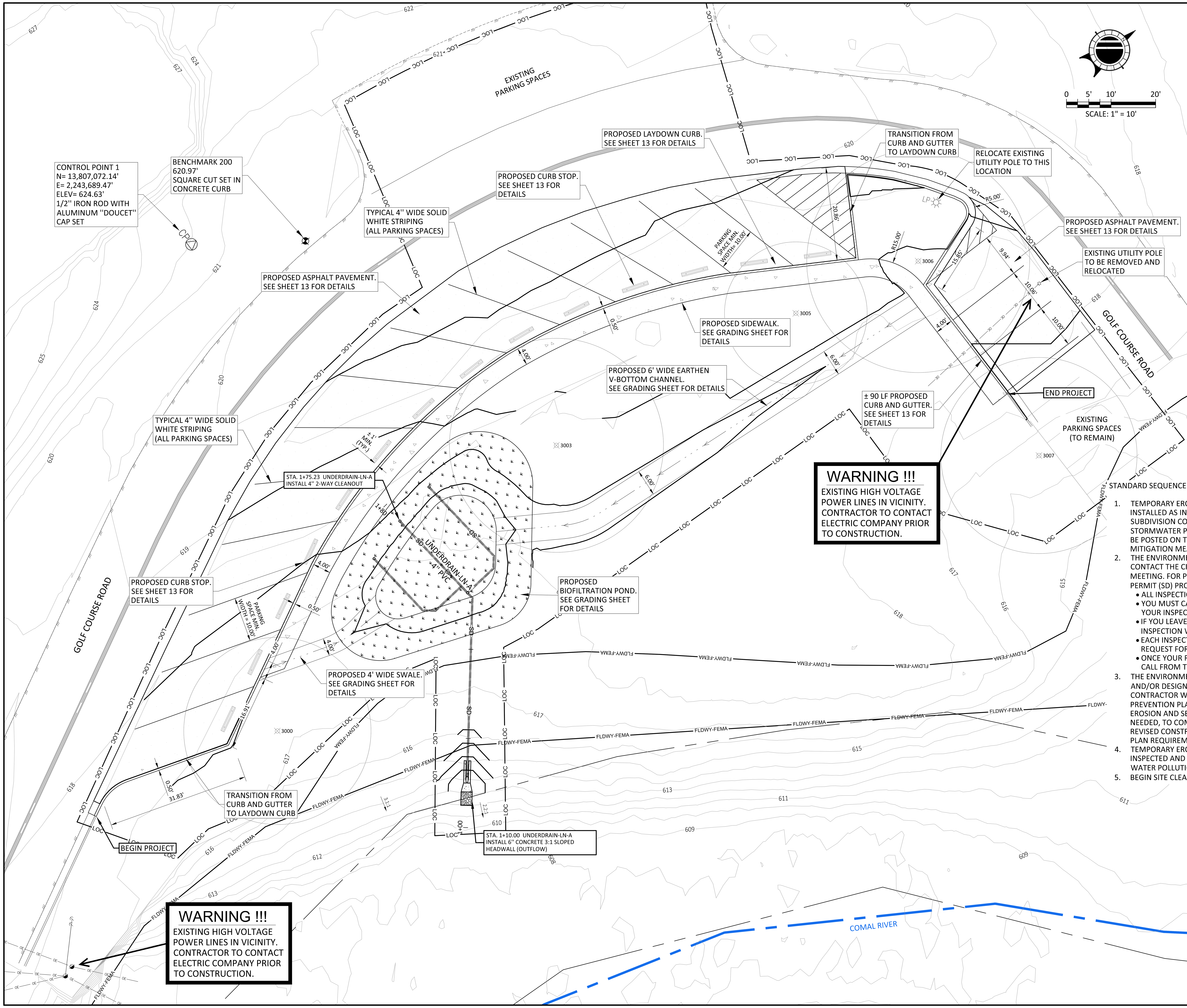

STANDARD SEQUENCE OF CONSTRUCTION

1. TEMPORARY EROSION AND SEDIMENTATION CONTROLS ARE TO BE INSTALLED AS INDICATED ON THE APPROVED SITE PLAN OR SUBDIVISION CONSTRUCTION PLAN AND IN ACCORDANCE WITH THE STORMWATER POLLUTION PREVENTION (SWPPP) THAT IS REQUIRED TO BE POSTED ON THE SITE. INSTALL TREE PROTECTION AND INITIATE TREE MITIGATION MEASURES.
2. THE ENVIRONMENTAL PROJECT MANAGER OR SITE SUPERVISOR MUST CONTACT THE CITY OF NEW BRAUNFELS TO SET A PRECONSTRUCTION MEETING. FOR PUBLIC INFRASTRUCTURE PERMIT (SC) OR SITE PREP PERMIT (SD) PROJECTS:
   - ALL INSPECTIONS ARE TO BE CALLED IN AT 830-221-4636.
   - YOU MUST CALL BEFORE 12:00 P.M., 24 TO 48 HOURS PRIOR TO YOUR INSPECTION REQUEST.
   - IF YOU LEAVE INCOMPLETE INFORMATION, YOUR REQUEST FOR INSPECTION WILL NOT BE ACCEPTED/SCHEDULED.
   - EACH INSPECTION WILL BE ALLOTTED 1 HOUR UNLESS YOUR REQUEST FOR MORE TIME.
   - ONCE YOUR REQUEST HAS BEEN ACCEPTED, YOU WILL RECEIVE A CALL FROM THE ENGINEERING INSPECTOR.
3. THE ENVIRONMENTAL PROJECT MANAGER, AND/OR SITE SUPERVISOR, AND/OR DESIGNATED RESPONSIBLE PARTY AND THE GENERAL CONTRACTOR WILL FOLLOW THE STORM WATER POLLUTION PREVENTION PLAN (SWPPP) POSTED ON THE SITE. TEMPORARY EROSION AND SEDIMENTATION CONTROLS WILL BE REVISED, IF NEEDED, TO COMPLY WITH CITY INSPECTORS' DIRECTIVES, AND REVISED CONSTRUCTION SCHEDULE RELATIVE TO THE WATER QUALITY PLAN REQUIREMENTS AND THE EROSION PLAN.
4. TEMPORARY EROSION AND SEDIMENTATION CONTROLS WILL BE INSPECTED AND MAINTAINED IN ACCORDANCE WITH THE STORM WATER POLLUTION PREVENTION PLAN (SWPPP) POSTED ON THE SITE.
5. BEGIN SITE CLEARING/CONSTRUCTION (OR DEMOLITION) ACTIVITIES.

CONTRACTOR NOTES:

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CONTRACTOR SHALL CONSIDER PROPOSED UTILITY IMPROVEMENTS AND PROVIDE ADEQUATE HORIZONTAL AND VERTICAL CLEARANCE DURING INSTALLATION OF ALL UTILITY INFRASTRUCTURE.

SITE LEGEND

EXISTING R.O.W./PROPERTY LINE
EXISTING EASEMENT LINE
EXISTING PAVEMENT
PROPOSED CURB & GUTTER
TAS ACCESSIBLE ROUTE
BUILDING LINE
493 EX. CONTOURS
493 PROP. CONTOURS

FIRE ZONE MARKINGS:
FIRE LANES TO BE MARKED BY PAINTING THE CURB RED WITH WHITE STENCILING READING "FIRE ZONE/TOW-AWAY ZONE" WITH LETTERING AT LEAST 3 INCHES IN HEIGHT. SUCH STENCILING SHALL BE AT INTERVALS OF 35 FEET OR LESS. IN ADDITION, SIGNS SHALL BE POSTED AT BOTH ENDS OF A FIRE ZONE, REFER TO C.O.A. STANDARD DETAILS 901S-5 & 901S-6.

RESTRICTED PARKING MARKINGS:
RESTRICTED PARKING LANES TO BE MARKED BY YELLOW PAINTED CURB WITH BLACK STENCILING READING "NO PARKING 7-8 AM AND 2-3 PM" WITH LETTERING AT LEAST 3 INCHES IN HEIGHT. SUCH STENCILING SHALL BE AT INTERVALS OF 35 FEET OR LESS.

NOTES:

1. DIMENSIONS ARE SHOWN ON THE DIMENSIONAL CONTROL PLAN. FOR PRECISE DIMENSIONS AND LOCATION OF SITE IMPROVEMENTS, ELECTRONIC FILES OF THE SITE LAYOUT WILL BE MADE AVAILABLE TO THE CONTRACTOR AND HIS SURVEYOR UPON REQUEST. FOR BUILDING DIMENSIONS, CONTRACTOR SHALL USE ARCHITECTURAL AND STRUCTURAL PLANS.
2. EXISTING UTILITIES ARE SHOWN PER SURVEY DRAWINGS.

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12/20/2024
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GOLF COURSE ROAD PARKING AREA AND BIOFILTRATION SYSTEM
GOLF COURSE ROAD
NEW BRAUNFELS, TX. 78130

SITE PLAN

PLOTTED: Dec 20, 2024 - 9:45am

Designed:	JC
Drawn:	ZR
Reviewed:	JC
Issue Date:	7/19/24

SHEET
4
OF 13

Project No.:
24004114.001A

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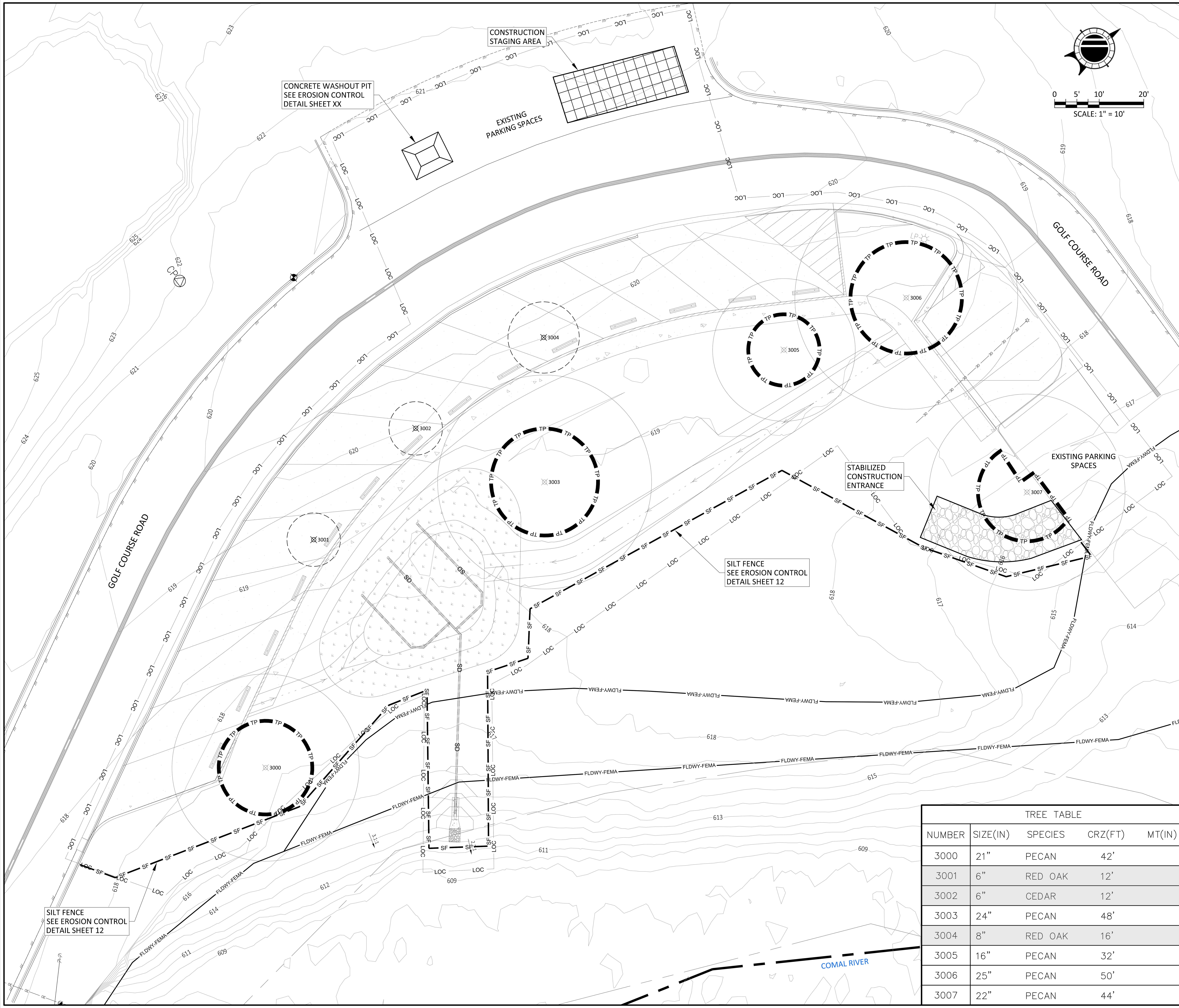

TREE TABLE					
NUMBER	SIZE(IN)	SPECIES	CRZ(FT)	MT(IN)	
3000	21"	PECAN	42'		
3001	6"	RED OAK	12'		REMOVE
3002	6"	CEDAR	12'		REMOVE
3003	24"	PECAN	48'		
3004	8"	RED OAK	16'		REMOVE
3005	16"	PECAN	32'		
3006	25"	PECAN	50'		
3007	22"	PECAN	44'		

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EROSION / SEDIMENTATION AND TREE PROTECTION LEGEND

- LOC — LIMITS OF CONSTRUCTION
- DRAINAGE FLOW DIRECTION
- OMF — ORANGE MESH SAFETY FENCE
- TP — TREE PROTECTION FENCE (C.O.A. DETAIL 610S-1 - 610S-5)
- ROCK BERM (C.O.A. DETAIL 639S-1)
- MS — MULCH SOCK (C.O.A. DETAIL 648S-1)
- SF — SILT FENCE (C.O.A. DETAIL 642S-1)
- TFD — TRIANGULAR SEDIMENT FILTER DIKE (C.O.A. DETAIL 628S)
- STABILIZED CONSTRUCTION ENTRANCE (SCE) (C.O.A. DETAIL 641S-1)
- TEMPORARY SPOILS SITE
- CONSTRUCTION STAGING AREA
- EROSION CONTROL BLANKET
- CONCRETE WASHOUT AREA
- HALF CRITICAL ROOT ZONE
- 1000 — EXISTING TREES (TO REMAIN)
- 1000 — EXISTING TREES (TO BE REMOVED)

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GOLF COURSE ROAD PARKING AREA AND BIOFILTRATION SYSTEM
GOLF COURSE ROAD
NEW BRAUNFELS, TX. 78130

EROSION AND SEDIMENTATION CONTROL PLAN

PLOTTED: Dec 20, 2024 - 9:45am

Designed:	JC
Drawn:	ZR
Reviewed:	JC
Issue Date:	7/19/24

Project No.: 24004114.001A

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TRAFFIC CONTROL LEGEND

- SIGN
- TYPE III BARRICADE
- WORK ZONE/SEGMENT
- LANE CLOSED TO TRAFFIC
- FLAGGER
- **CHANNELIZING DEVICES** (DRUMS)

DETAIL NUMBER — X — DETAIL
SHEET NUMBER — XX — NAME
DETAIL CALLOUT REFERENCE

POSTED SPEED LIMITS:

STREET NAME	SPEED(MPH)
XX	XX

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GOLF COURSE ROAD PARKING AREA AND BIOFILTRATION SYSTEM
GOLF COURSE ROAD
NEW BRAUNFELS, TX. 78130

TRAFFIC CONTROL AND SIGNAGE PLAN

PLOTTED: Dec 20, 2024 - 9:54am

Designed:	JC
Drawn:	ZR
Reviewed:	JC
Issue Date:	7/19/24

SHEET 6 OF 13

Project No.: 24004114.001A

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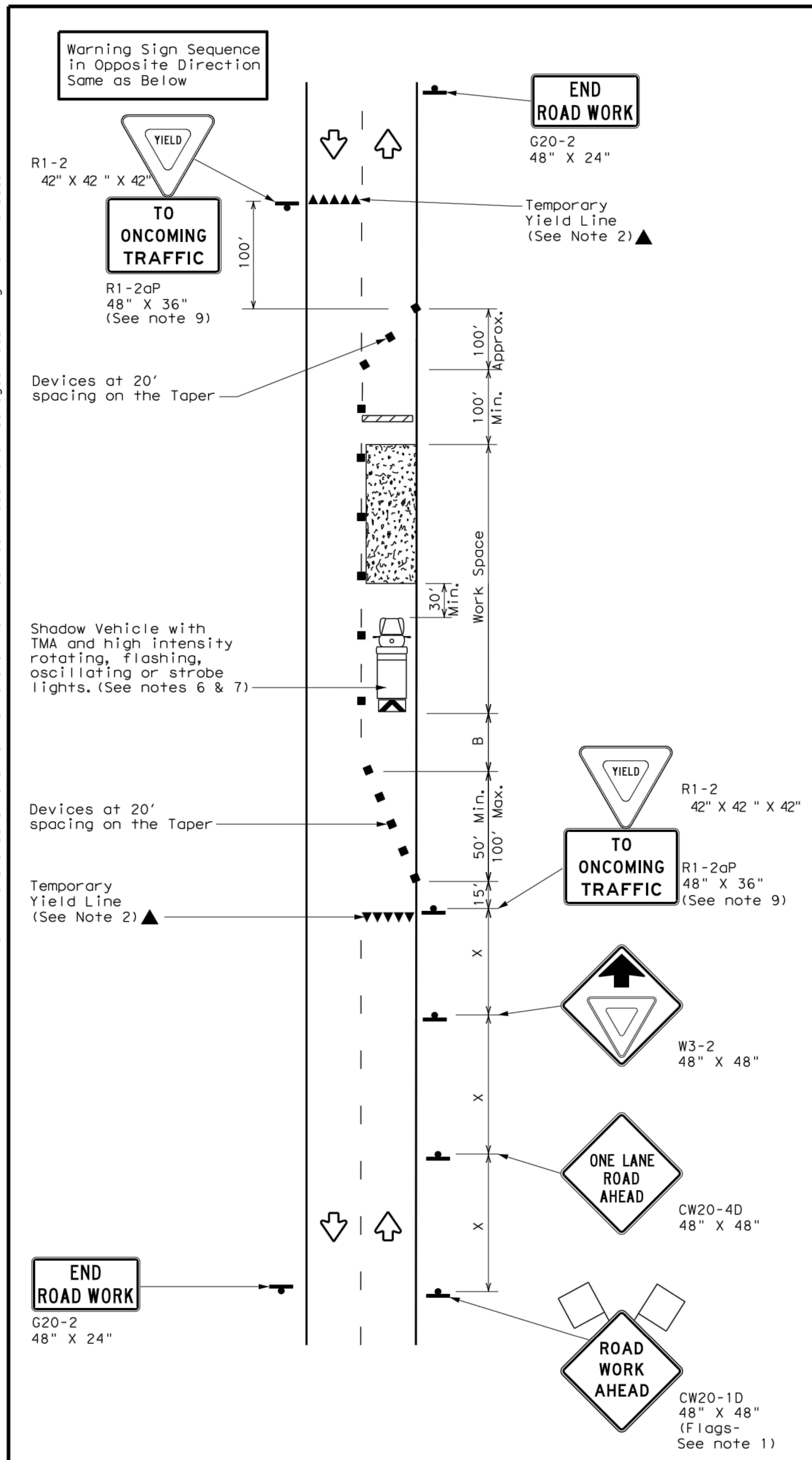


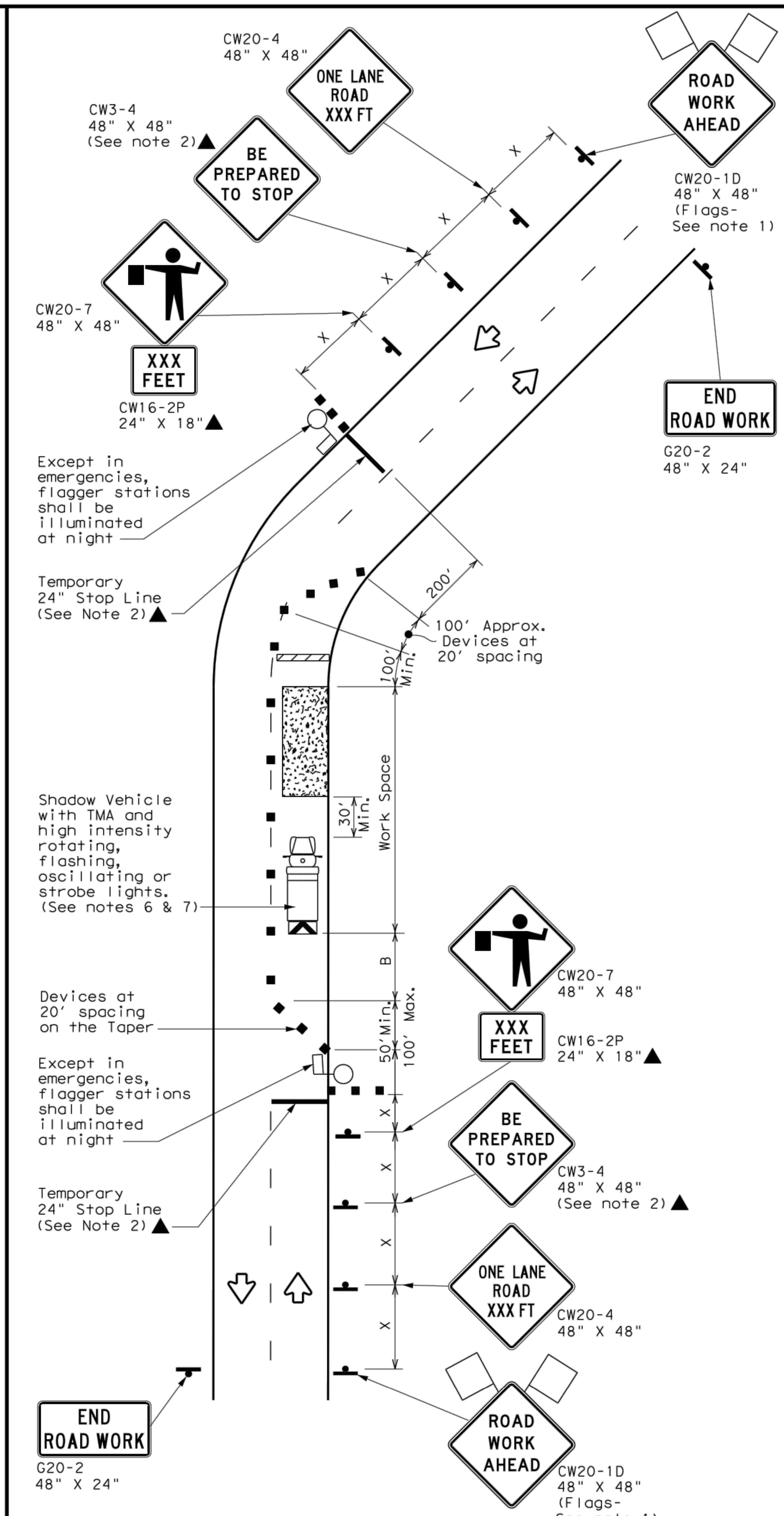
TCP (2-2a)

2-LANE ROADWAY WITHOUT PAVED SHOULDERS

ONE LANE TWO-WAY

CONTROL WITH YIELD SIGNS

(Less than 2000 ADT - See Note 9)



TCP (2-2b)

2-LANE ROADWAY WITHOUT PAVED SHOULDERS

ONE LANE TWO-WAY

CONTROL WITH FLAGGERS

LEGEND

Symbol	Description	Symbol	Description
	Type 3 Barricade		Channelizing Devices
	Heavy Work Vehicle		Truck Mounted Attenuator (TMA)
	Trailer Mounted Flashing Arrow Board		Portable Changeable Message Sign (PCMS)
	Sign		Traffic Flow
	Flag		Flagger

Posted Speed *	Formula	Minimum Desirable Taper Lengths **			Suggested Maximum Spacing of Channelizing Devices		Minimum Sign Spacing "X" Distance	Suggested Longitudinal Buffer Space "B"	Stopping Sight Distance
		10' Offset	11' Offset	12' Offset	On a Taper	On a Tangent			
30	$L = \frac{WS^2}{60}$	150'	165'	180'	30'	60'	120'	90'	200'
35		205'	225'	245'	35'	70'	160'	120'	250'
40		265'	295'	320'	40'	80'	240'	155'	305'
45	L = WS	450'	495'	540'	45'	90'	320'	195'	360'
50		500'	550'	600'	50'	100'	400'	240'	425'
55		550'	605'	660'	55'	110'	500'	295'	495'
60		600'	660'	720'	60'	120'	600'	350'	570'
65		650'	715'	780'	65'	130'	700'	410'	645'
70		700'	770'	840'	70'	140'	800'	475'	730'
75		750'	825'	900'	75'	150'	900'	540'	820'

* Conventional Roads Only

** Taper lengths have been rounded off.

L=Length of Taper(FT) W=Width of Offset(FT) S=Posted Speed(MPH)

TYPICAL USAGE				
MOBILE	SHORT DURATION	SHORT TERM STATIONARY	INTERMEDIATE TERM STATIONARY	LONG TERM STATIONARY
	✓	✓	✓	

GENERAL NOTES

1. Flags attached to signs where shown, are REQUIRED.
2. All traffic control devices illustrated are REQUIRED, except those denoted with the triangle symbol may be omitted when stated elsewhere in the plans, or for routine maintenance work, when approved by the Engineer.
3. The CW3-4 "BE PREPARED TO STOP" sign may be installed after the CW20-4 "ONE LANE ROAD XXX FT" sign, but proper sign spacing shall be maintained.
4. Flaggers should use two-way radios or other methods of communication to control traffic.
5. Length of work space should be based on the ability of flaggers to communicate.
6. A Shadow Vehicle with a TMA should be used anytime it can be positioned 30 to 100 feet in advance of the area of crew exposure without adversely affecting the performance or quality of the work. If workers are no longer present but road or work conditions require the traffic control to remain in place, Type 3 Barricades or other channelizing devices may be substituted for the Shadow Vehicle and TMA.
7. Additional Shadow Vehicles with TMAs may be positioned off the paved surface, next to those shown in order to protect a wider work space.

TCP (2-2a)

8. The R1-2 "YIELD" sign traffic control may be used on projects with approaches that have adequate sight distance. For projects in urban areas, work space should be no longer than one half city block. In rural areas, roadways with less than 2000 ADT, work space should be no longer than 400 feet.
9. The R1-2aP "YIELD TO ONCOMING TRAFFIC" sign shall be placed on a support at a 7 foot minimum mounting height.

TCP (2-2b)

10. Channelizing devices on the center line may be omitted when a pilot car is leading traffic and approved by the Engineer.
11. If the work space is located near a horizontal or vertical curve, the buffer distances should be increased in order to maintain stopping sight distance to the flagger and a queue of stopped vehicles. (See table above).
12. Flaggers should use 24" STOP/SLOW paddles to control traffic. Flags should be limited to emergency situtations.

Texas Department of Transportation — Traffic Operations Division Standard

TRAFFIC CONTROL PLAN ONE-LANE TWO-WAY TRAFFIC CONTROL

TCP(2-2)-18

FILE: tcp2-2-18.dgn | DN: | CK: | DW: | CK:

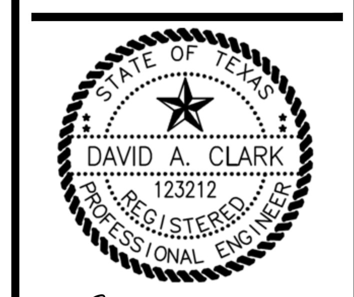
© TxDOT December 1985 | CONT | SECT | JOB | HIGHWAY

REVISIONS: 8-95 3-03; 1-97 2-12; 4-98 2-18

DIST | COUNTY | SHEET NO.

162

THESE PLANS ARE RELEASED UNDER THE AUTHORITY OF JONATHAN CAREY, P.E., CFM TBPE# 131936, ON 12/20/24 FOR THE PURPOSES OF REVIEW AND ARE NOT TO BE USED FOR CONSTRUCTION PRIOR TO APPROVAL BY ALL GOVERNING JURISDICTIONS



12/20/2024

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TBPELS Firm No. F-3937

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GOLF COURSE ROAD PARKING AREA AND BIOFILTRATION SYSTEM
GOLF COURSE ROAD
NEW BRAUNFELS, TX. 78130

TRAFFIC CONTROL AND SIGNAGE DETAIL SHEET

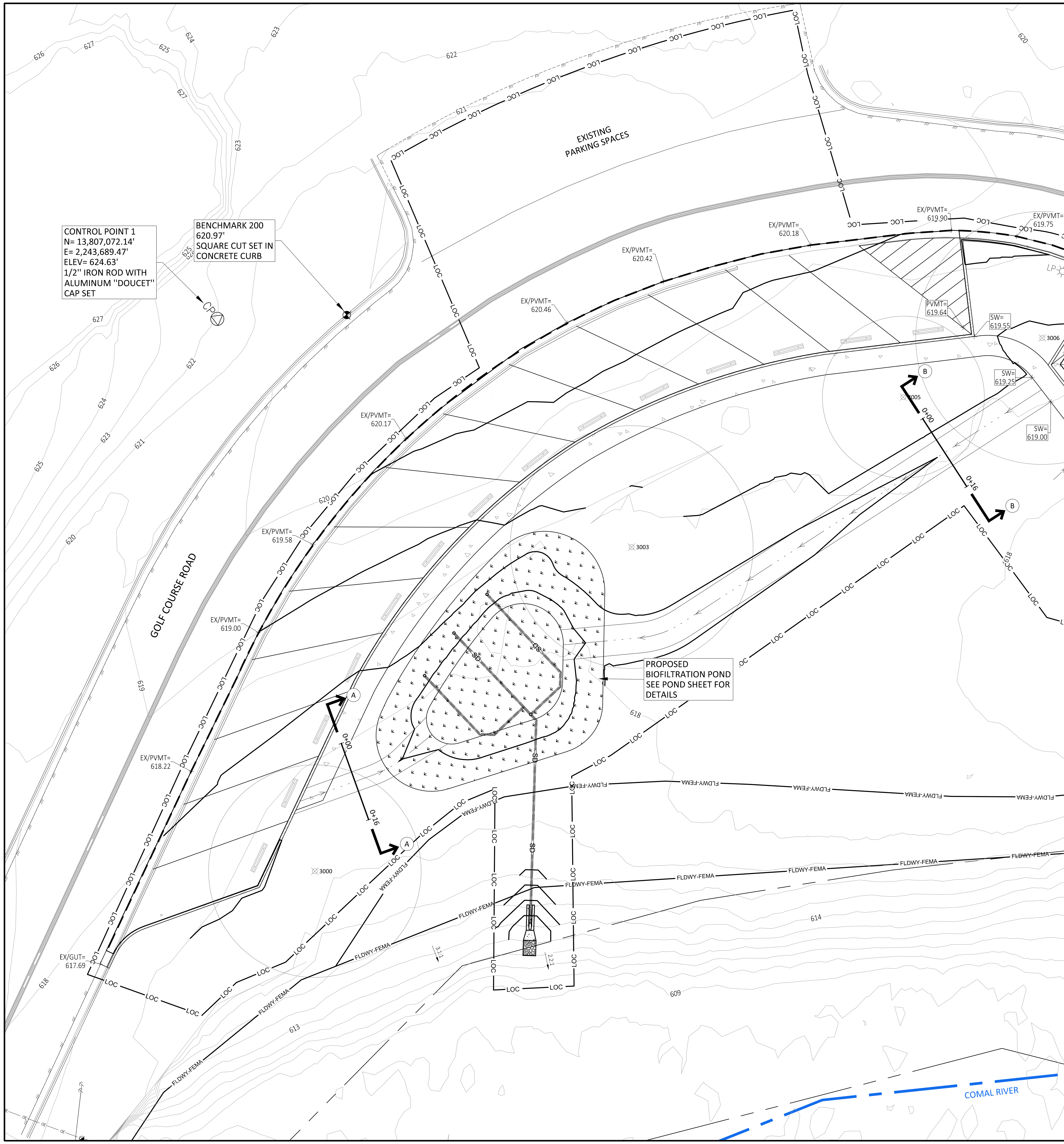
PLOTTED: Dec 20, 2024 - 9:45am
Designed: JC
Drawn: ZR
Reviewed: JC
Issue Date: 7/19/24

SHEET 7 OF 13

Project No.: 24004114.001A

DATE:
FILE:

Drawing: C:\pwworking\kf-dct-prof\rudge@kleinfelder.com\d0198322\24004114.001A SH TCP.dwg
User: ZRUDGE
Last Modified: Dec. 20, 24 - 09:20
Plot Date/Time: Dec. 20, 24 - 09:45:31



CONTRACTOR NOTES:

EXISTING UNDERGROUND & OVERHEAD UTILITIES IN VICINITY. CONTRACTOR TO CONTACT UTILITY COMPANIES PRIOR TO CONSTRUCTION. CONTRACTOR TO CALL 811 FOR UTILITY LOCATES PRIOR TO EXCAVATION. CONTRACTOR TO FIELD VERIFY EXISTING UTILITY LOCATIONS & DEPTH PRIOR TO BEGINNING CONSTRUCTION.

CONTRACTOR SHALL CONSIDER PROPOSED UTILITY IMPROVEMENTS AND PROVIDE ADEQUATE HORIZONTAL AND VERTICAL CLEARANCE DURING INSTALLATION OF ALL UTILITY INFRASTRUCTURE.

GRADING LEGEND

EXISTING R.O.W./PROPERTY LINE
EXISTING EASEMENT LINE
EXISTING PAVEMENT
PROPOSED CURB & GUTTER
PROPOSED LAYDOWN CURB
493 — EX. CONTOURS
493 — PROP. CONTOURS
SD — EX. STORM DRAIN
SD — PROP. STORM DRAIN
EX. STORM DRAIN INLET WITH LATERAL
PROP. STORM DRAIN INLET WITH LATERAL
EXISTING TREE (TO REMAIN)
EXISTING TREE (TO BE REMOVED)
NG= 493.00 EXISTING GROUND ELEVATION
PAV= 493.00 PROPOSED PAVEMENT ELEVATION
EX/PAV= 493.00 EXISTING EDGE OF PAVEMENT
GUT= 493.00 PROPOSED GUTTER ELEVATION
EX/GUT= 493.00 EXISTING GUTTER
TC= 493.00 PROPOSED TOP OF CURB
EX/SW= 493.00 EXISTING SIDEWALK
TW= 493.00 PROPOSED TOP OF WALL
FF= 493.00 PROPOSED FINISH FLOOR ELEVATION
SW= 493.00 PROPOSED TOP OF SIDEWALK
FG= 493.00 PROPOSED FINISH GRADE
FL= 493.00 PROPOSED FLOW LINE
1.00% PROPOSED SLOPE (SLOPE DOWN)
G.B. OR GRADE BREAK — PROPOSED GRADE BREAK ON SURFACE (CNC., PVMT., GRASS, ETC.)
SPILL — SPILL — DENOTES THE CURB & GUTTER SHALL BE A SPILL CURB.

NOTE: FINISHED GROUND (FG=) SPOT ELEVATION CALLOUTS INDICATE THE ELEVATION OF FINAL GRADING INCLUDING THE INSTALLATION OF GRASS AND/OR REVEGETATION. IF THE CONTRACTOR INSTALLS GRASS SOD AND / OR TOP SOIL, THE THICKNESS OF THE MATERIAL SHOULD BE SUBTRACTED FROM THE FINISHED GROUND ELEVATIONS CALLOUTS.

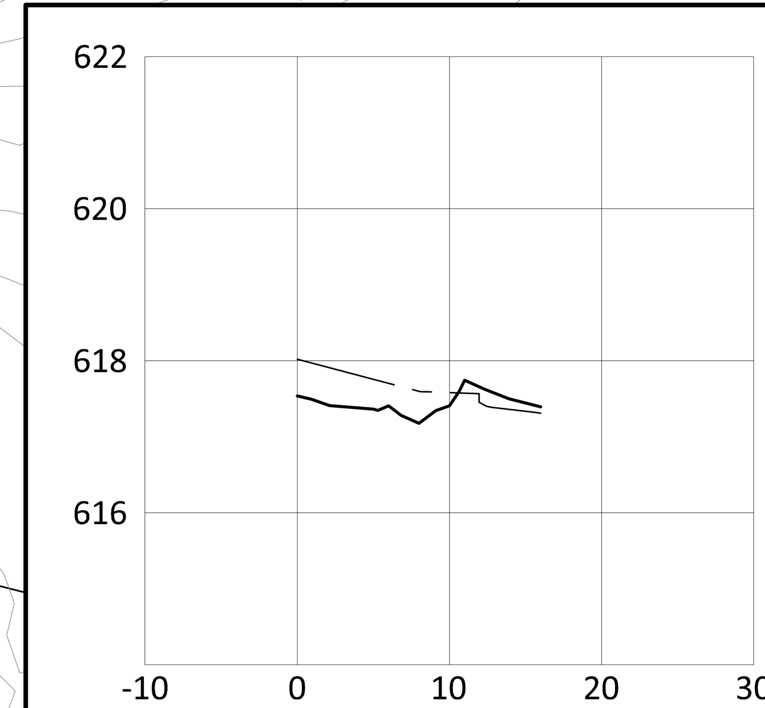
NOTE: CONTRACTOR SHALL CONSTRUCT ALL TAS ACCESSIBLE ROUTES SIDEWALK, RAMP AND DRIVEWAY CROSSING GRADES AND DIMENSIONS IN ACCORDANCE WITH THE TEXAS ACCESSIBILITY STANDARDS, ARCHITECTURAL BARRIERS GOVERNMENT CODE, ARCHITECTURAL BARRIERS ADMINISTRATIVE RULES AND TECHNICAL MEMORANDUM, LATEST EDITION. THE GRADES SHOWN ON THESE DRAWINGS WERE ESTABLISHED USING THE BEST AVAILABLE EXISTING GROUND INFORMATION AND ARE FOR GENERAL CONSTRUCTION AND BIDDING PURPOSES ONLY. CONTRACTOR SHALL ADJUST GRADES AND DIMENSIONS TO FIELD CONDITIONS AND TO COMPLY WITH TEXAS ACCESSIBILITY STANDARDS.

CONTROL NOTE:

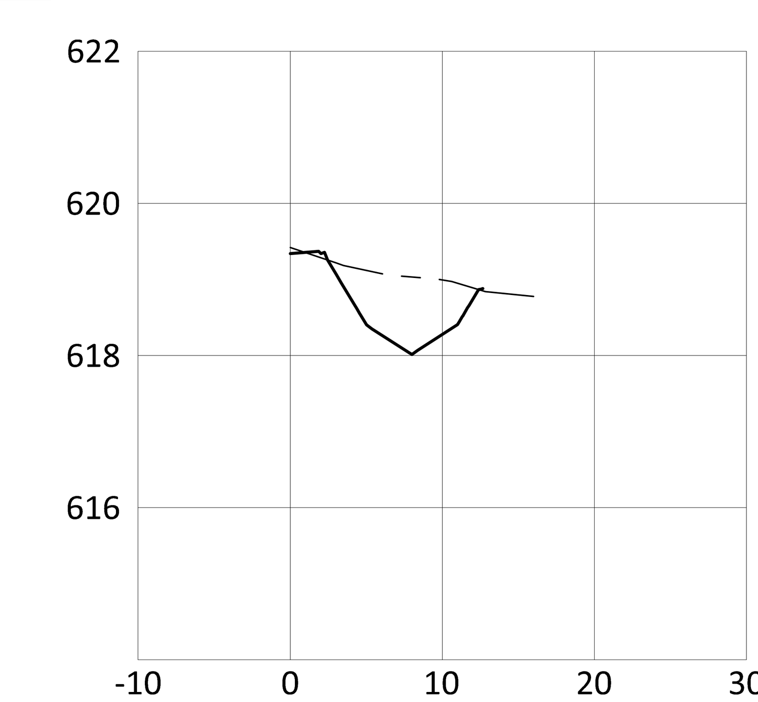
BASIS OF BEARING IS THE TEXAS COORDINATE SYSTEM, SOUTH CENTRAL ZONE [4204], NAD 83 (2011), EPOCH 2010. ALL DISTANCES SHOWN ARE LOCAL SURFACE VALUES AND MAY BE CONVERTED TO GRID BY DIVIDING BY THE SURFACE ADJUSTMENT FACTOR OF 1.00012 AND USING CONTROL POINT 1 AS THE POINT OF ORIGIN.
UNITS: US SURVEY FEET.

BASE POINT INFORMATION
CONTROL POINT 1 (OPUS)
N= 13,807,072.14'
E= 2,243,689.47'
Z= 624.63'
DESCRIPTION: 1/2" IRON ROD SET WITH ALUMINUM "DOUCET CONTROL" CAP

BENCHMARK NOTE:
BENCHMARK #200
ELEVATION: 620.97'
DESCRIPTION: SQUARE CUT SET IN A CONCRETE CURB LOCATED APPROXIMATELY 350 FEET WEST OF THE OLD CHANNEL CROSSING OF THE COMAL RIVER, ON THE WEST SIDE OF GOLF COURSE ROAD.



SECTION A-A
1" = 10' HORZ. - 1" = 2' VERT.



SECTION B-B
1" = 10' HORZ. - 1" = 2' VERT.

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STATE OF TEXAS
DAVID A. CLARK
123212
REGISTERED
PROFESSIONAL ENGINEER
12/20/2024

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GOLF COURSE ROAD PARKING AREA AND BIOFILTRATION SYSTEM
GOLF COURSE ROAD
NEW BRAUNFELS, TX. 78130

GRADING PLAN

PLOTTED: Dec 20, 2024 - 9:45am
Designed: JC
Drawn: ZR
Reviewed: JC
Issue Date: 7/19/24

SHEET
8
OF 13

Project No.:
24004114.001A

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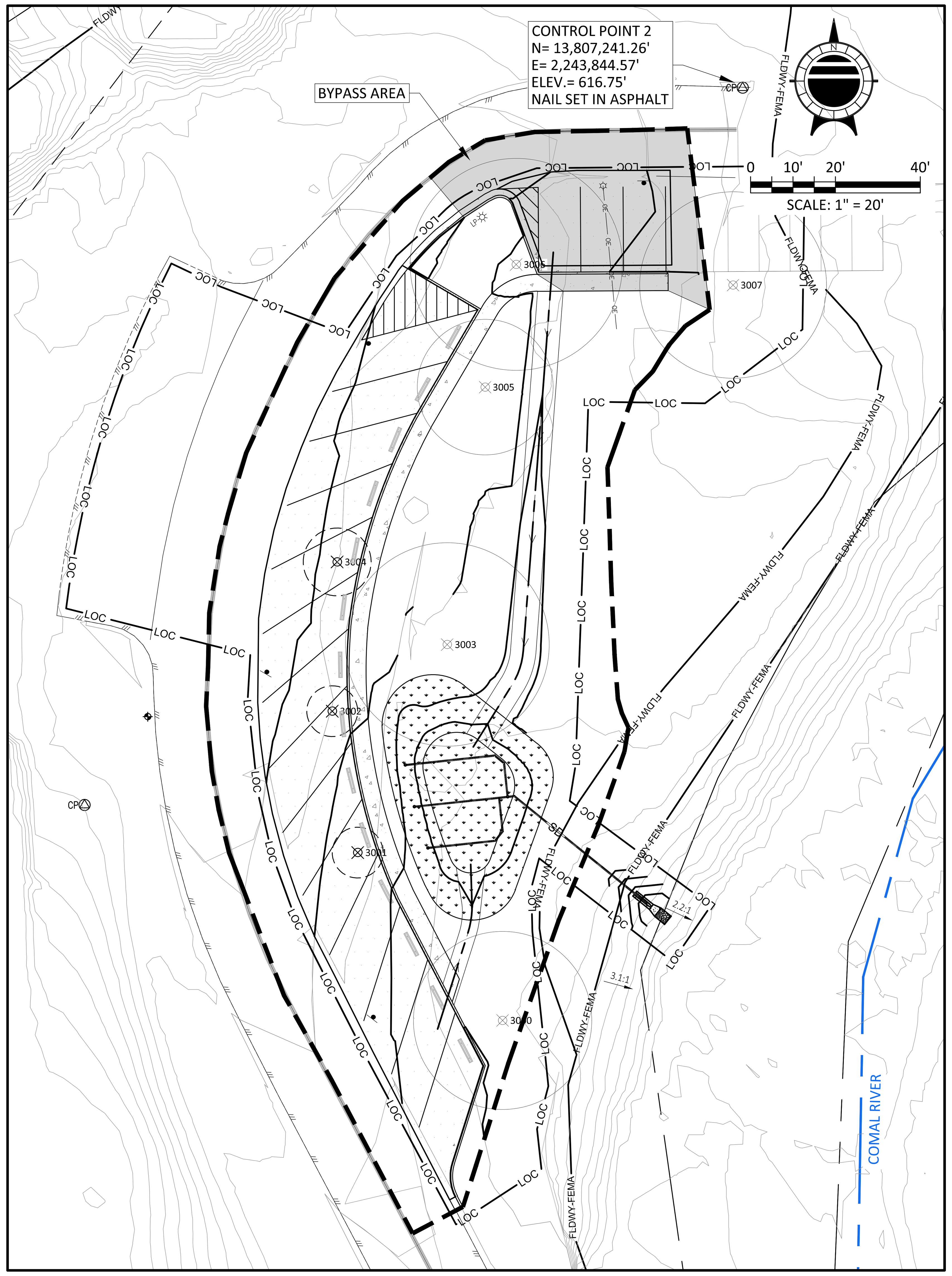
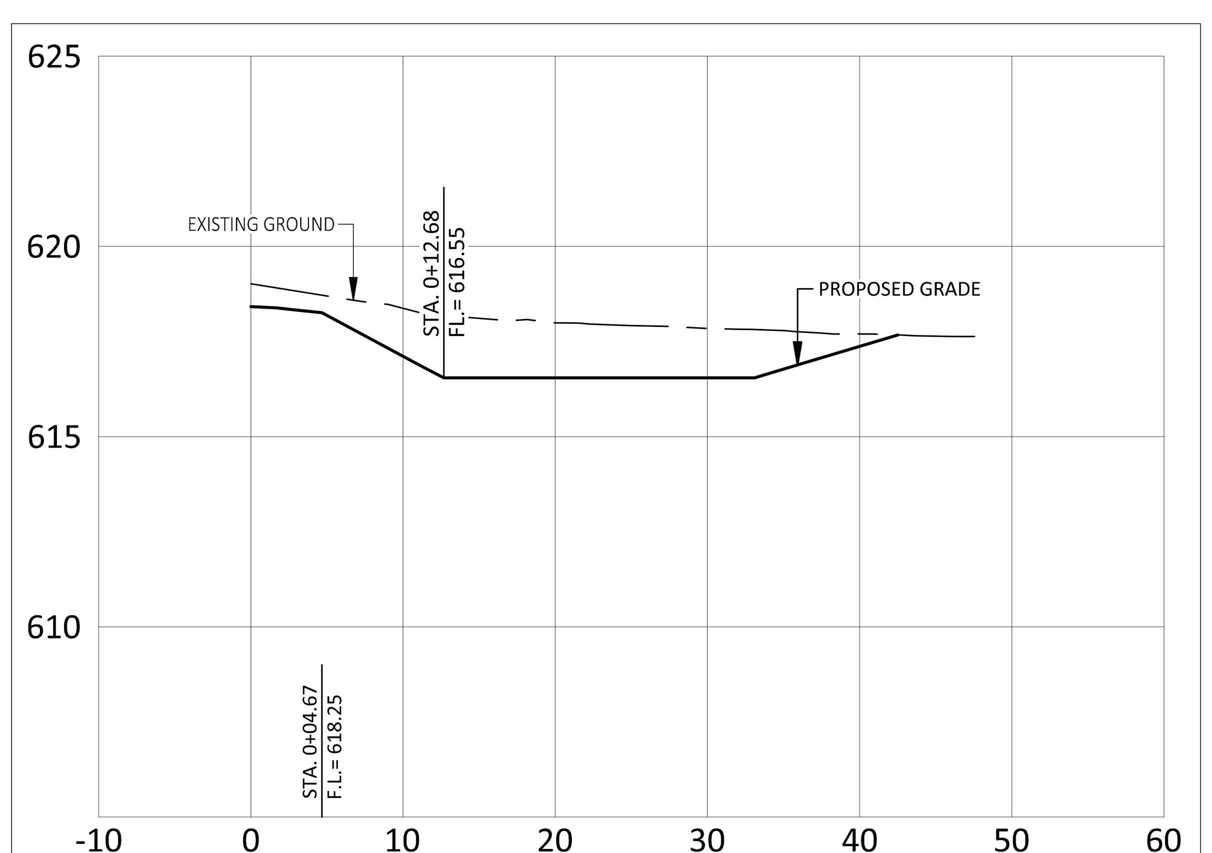


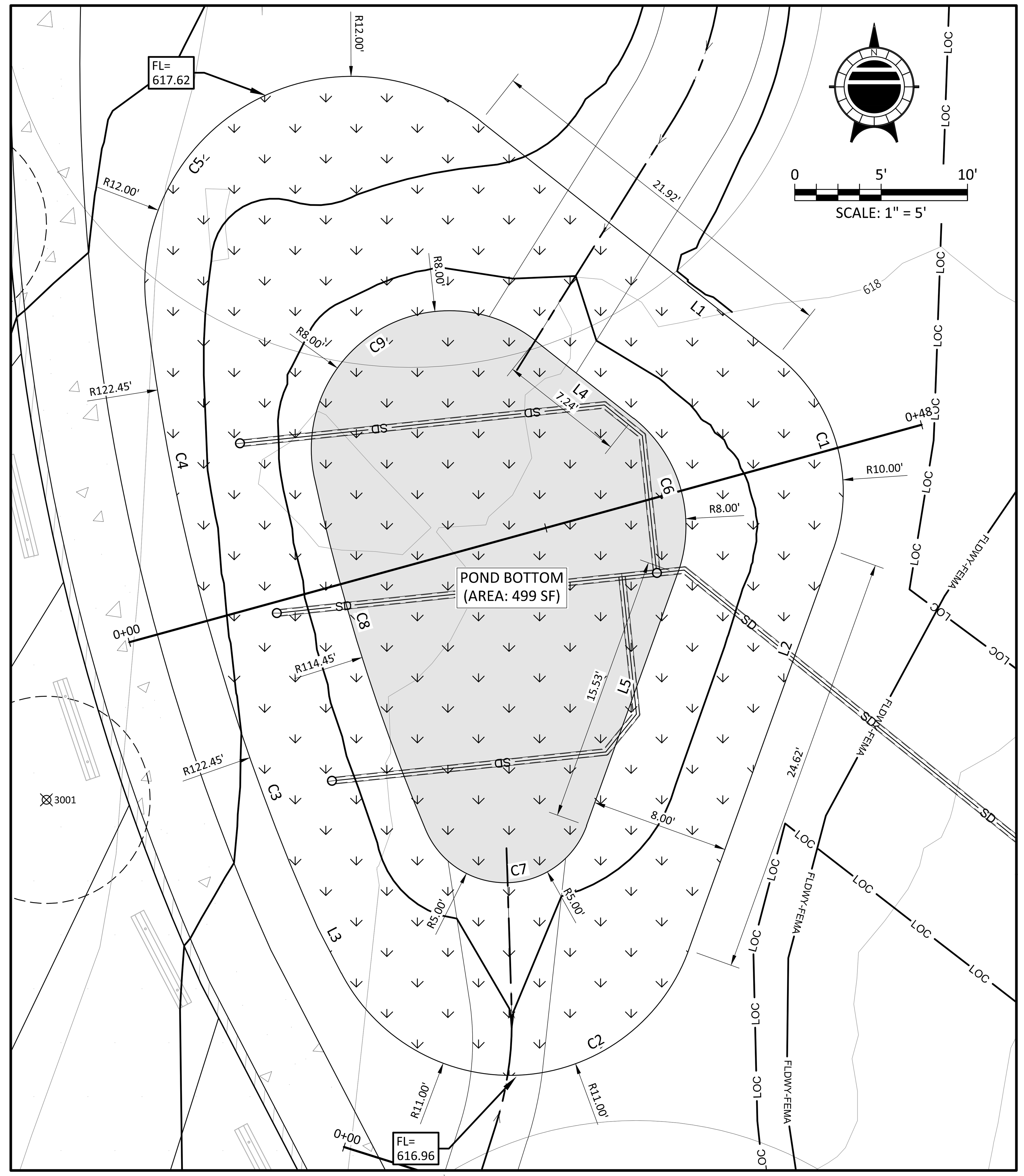
NOTE:
THE TOTAL PROJECT AREA IS 0.43 ACRES AND INCLUDES THE ADDITION OF 0.14 ACRES OF NEW IMPERVIOUS COVER. DUE TO EXISTING TOPOGRAPHY, 0.04 ACRES OF THE PROJECT AREA, WHICH INCLUDES 0.02 ACRES OF NEW IMPERVIOUS COVER, WILL BYPASS THE BIORETENTION POND. HOWEVER, THE POND HAS BEEN SIZED BASED ON THE TOTAL 0.14 ACRES OF ADDED IMPERVIOUS COVER WITHIN THE OVERALL PROJECT AREA.

DRAINAGE AREA BOUNDARY



POND SECTION

1" = 10' HORZ. - 1" = 4' VERT.



POND OUTER POND INNER			
Number	Radius	Length	Line/Chord Direction
L1		21.92	N51° 37' 02.94"W
L2		24.62	N19° 49' 41.10"E
L3		2.98	S27° 27' 50.16"E
C1	10.00	12.47	N15° 53' 40.92"W
C2	11.00	25.48	N86° 10' 55.47"E
C3	122.45	37.38	S15° 26' 56.58"E
C4	122.45	37.38	S15° 26' 56.58"E
C5	12.00	28.29	S60° 50' 19.57"W
L4		7.24	N51° 37' 02.94"W
L5		15.53	N19° 49' 41.10"E
C6	8.00	9.98	N15° 53' 40.92"W
C7	5.00	11.98	N88° 27' 47.73"E
C8	114.45	21.41	S17° 32' 35.28"E
C9	8.00	19.63	S58° 05' 56.07"W

CONTRACTOR NOTES:

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ELEVATION	AREA (SF)	INCREMENTAL VOL. (CF)	CUMULATIVE VOL. (CF)
616.55	498.86	0.00	0
616.60	525.94	25.62	25.62
616.70	581.27	55.36	80.98
616.80	640.10	61.07	142.05
616.90	702.81	67.15	209.19
617.00	768.00	73.54	282.74
617.10	844.81	80.64	363.38
617.20	935.34	89.01	452.38
617.30	1031.57	98.35	550.73
617.40	1134.38	108.30	659.03

Bioretention Pond

1. Required Load Reduction for the total project:

Lm = 27.2(An x P)

Lm = Required TSS removal resulting from proposed development = 80% of increased load
An = Net increase in impervious area for the project
P = Average annual precipitation

County = Comal
Total Project area = 0.43 acres
Pre-development impervious area within the limits of the plan = 0.10 acres
Post-development impervious area within drainage basin = 0.24 acres
Total post-development impervious cover fraction = 0.56
P = 33 inches

Lm total project (TCEQ Required 80%)= 126 lbs.

2. Drainage Basin Parameters:
Total drainage basin = 0.43 acres
Predevelopment impervious area within drainage basin = 0.10 acres
Post-development impervious area within drainage basin = 0.24 acres
Post-development impervious fraction within drainage basin = 0.56
Lm (TCEQ Required 80%)= 126 lbs.

3. Indicate the proposed BMP Code for this basin:
Proposed BMP = Bioretention
Removal efficiency = 89 percent

4. Calculate Maximum TSS Load Removed (Lr) for this Drainage Basin by the selected BMP Type.

Lr = (BMP efficiency) x P x (AI x 34.6 + Ap x 0.54)

Ac = Total On-site drainage area in the BMP catchment area
AI = Impervious area proposed in the BMP catchment area
Ap = Pervious area remaining in the BMP catchment area
Lr = TSS Load removed from this catchment area by the proposed BMP

Ac = 0.43
AI = 0.24
Ap = 0.19
Lr = 247

5. Calculate Fraction of Annual Runoff to Treat the drainage basin:

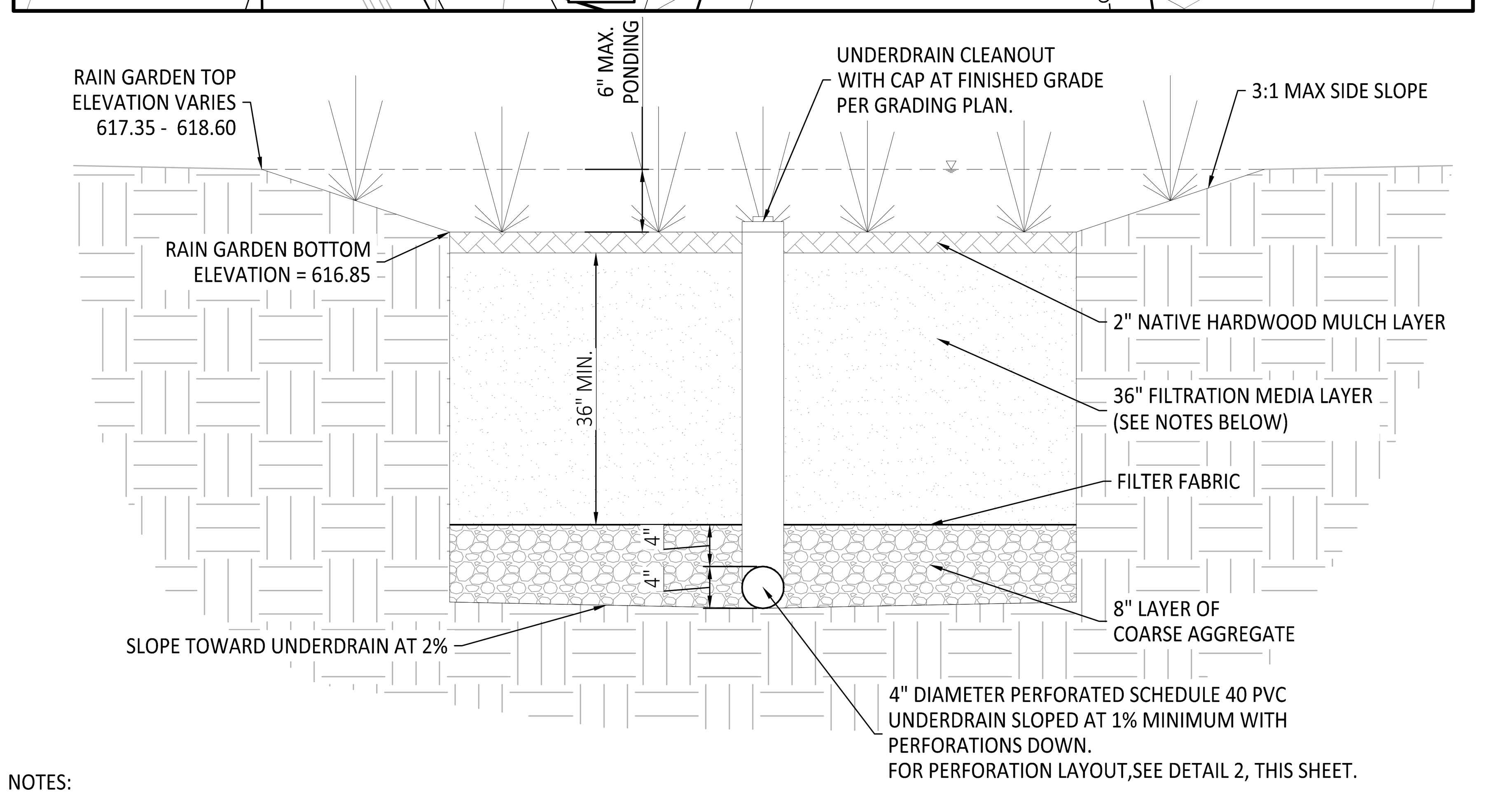
Desired Lm this basin = 126 lbs.
F = 0.51

6. Calculate Capture Volume required by the BMP Type for this drainage basin:

Rainfall Depth = 0.44 inches
Post Development Runoff Coefficient = 0.39
On-site Water Quality Volume = 268 cubic feet

Off-site area draining to BMP = 0 acres
Off-Site Impervious cover draining to BMP = 0 acres
Impervious fraction of off-site area = 0
Off-site Runoff Coefficient = 0
Off-site Water Quality Volume = 0 cubic feet

Storage for sediment =
Total Capture Volume (required water quality volume x 1.20) = 321 cubic feet
0.007 acre-ft
Volume Provided = 376 cubic feet
0.009 acre-ft

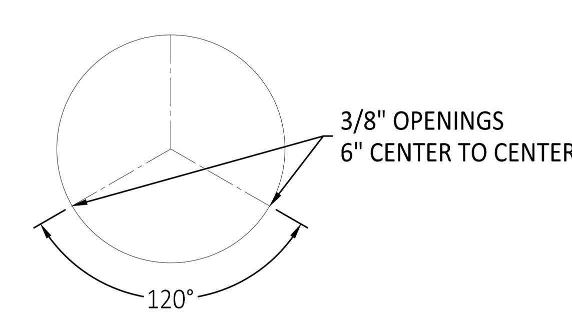


NOTES:

1. FILTRATION MEDIA SHOULD HAVE A MAXIMUM CLAY CONTENT OF LESS THAN 5%. SOIL MIXTURE SHOULD BE 50-60% SAND, 20-30% COMPOST, AND 20-30% TOPSOIL. SOIL SHOULD BE A UNIFORM MIX, FREE OF STONES, STUMPS, ROOTS, OR OTHER SIMILAR OBJECTS LARGER THAN 2 INCHES. NO OTHER MATERIALS OR SUBSTANCES SHOULD BE MIXED OR DUMPED WITHIN THE BIORETENTION THAT MAY BE HARMFUL TO PLANT GROWTH OR PROVE A HINDRANCE TO THE PLANTING OR MAINTENANCE OPERATIONS. PROVIDE CLEAN SAND, FREE OF DELETERIOUS MATERIALS. SAND SHOULD BE ASTM C33 WITH GRAIN SIZE OF 0.02-0.04 INCHES.
2. INSTALLATION OF FILTER MEDIA MUST BE DONE IN A MANNER THAT WILL ENSURE ADEQUATE FILTRATION. AFTER SCARIFYING THE INVERT AREA, PLACE SOIL IN 8"-12" LIFTS. LIFTS ARE NOT TO BE COMPACTED BUT ARE PERFORMED IN ORDER TO REDUCE THE POSSIBILITY OF EXCESSIVE SETTLEMENT. LIFTS MAY BE LIGHTLY WATERED TO ENCOURAGE NATURAL COMPACTION. AVOID OVER COMPACTION BY ALLOWING TIME FOR NATURAL COMPACTION AND SETTLEMENT. NO ADDITIONAL MANUAL COMPACTION OF SOIL IS NECESSARY. RAKE SOIL MATERIAL AS NEEDED TO LEVEL OUT. OVERFILL ABOVE THE SURFACE INVERT TO ACCOMMODATE NATURAL SETTLEMENT TO PROPER GRADE.

BIOFILTRATION POND DETAIL

NOT TO SCALE CUST-043



UNDERDRAIN PERFORATION LAYOUT DETAIL

NOT TO SCALE CUST-043

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GOLF COURSE ROAD PARKING AREA AND BIOFILTRATION SYSTEM
GOLF COURSE ROAD
NEW BRAUNFELS, TX. 78130

POND CONTROL PLAN AND CALCULATIONS SHEET

PLOTTED: Dec 20, 2024 - 9:45am
Designed: JC
Drawn: ZR
Reviewed: JC
Issue Date: 7/19/24

SHEET
9
OF 13

Project No.:
24004114.001A

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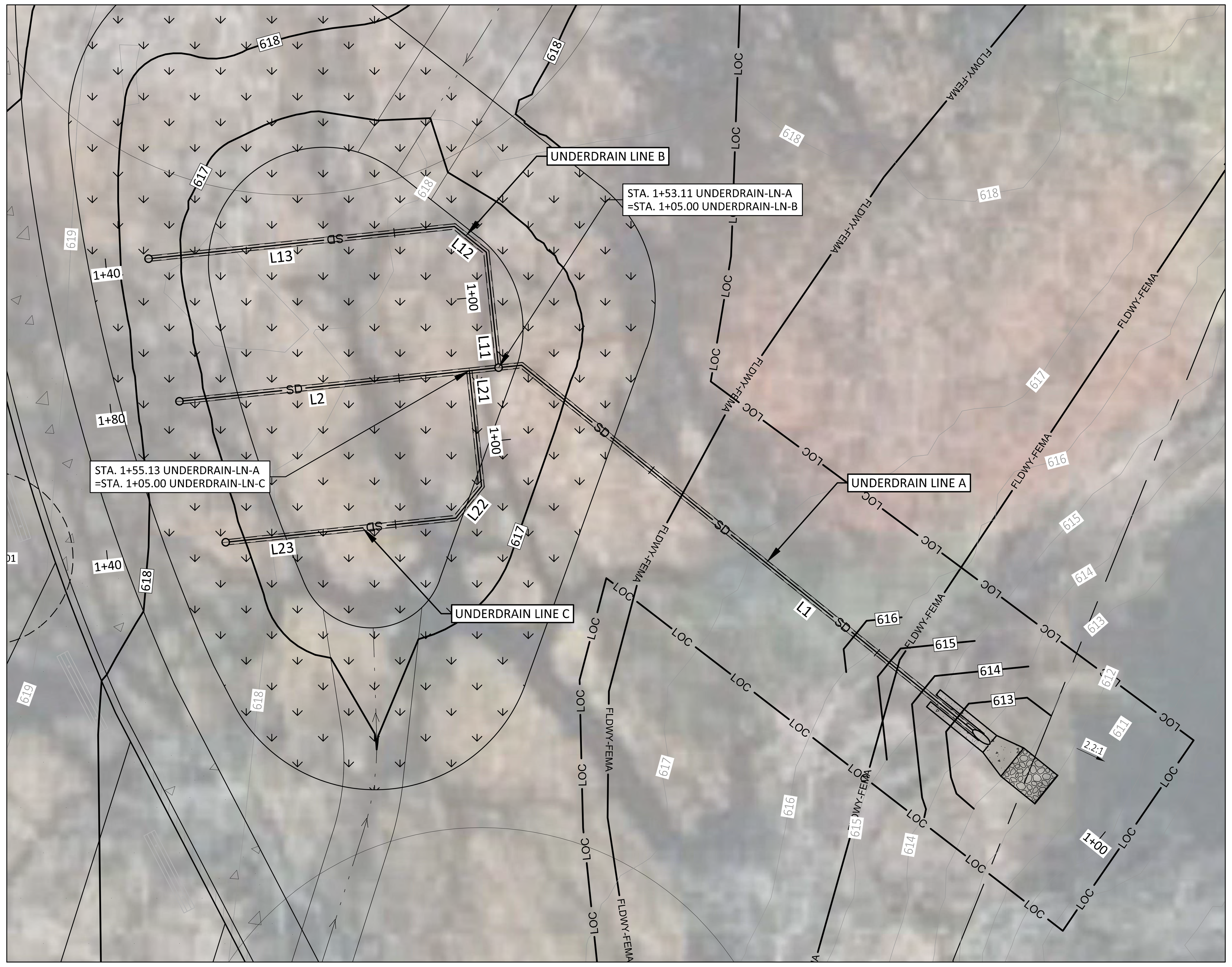
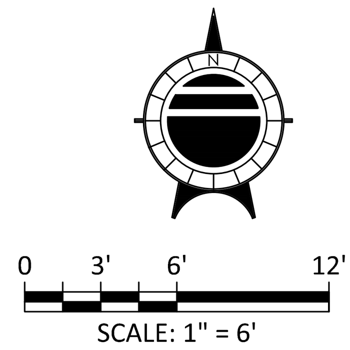
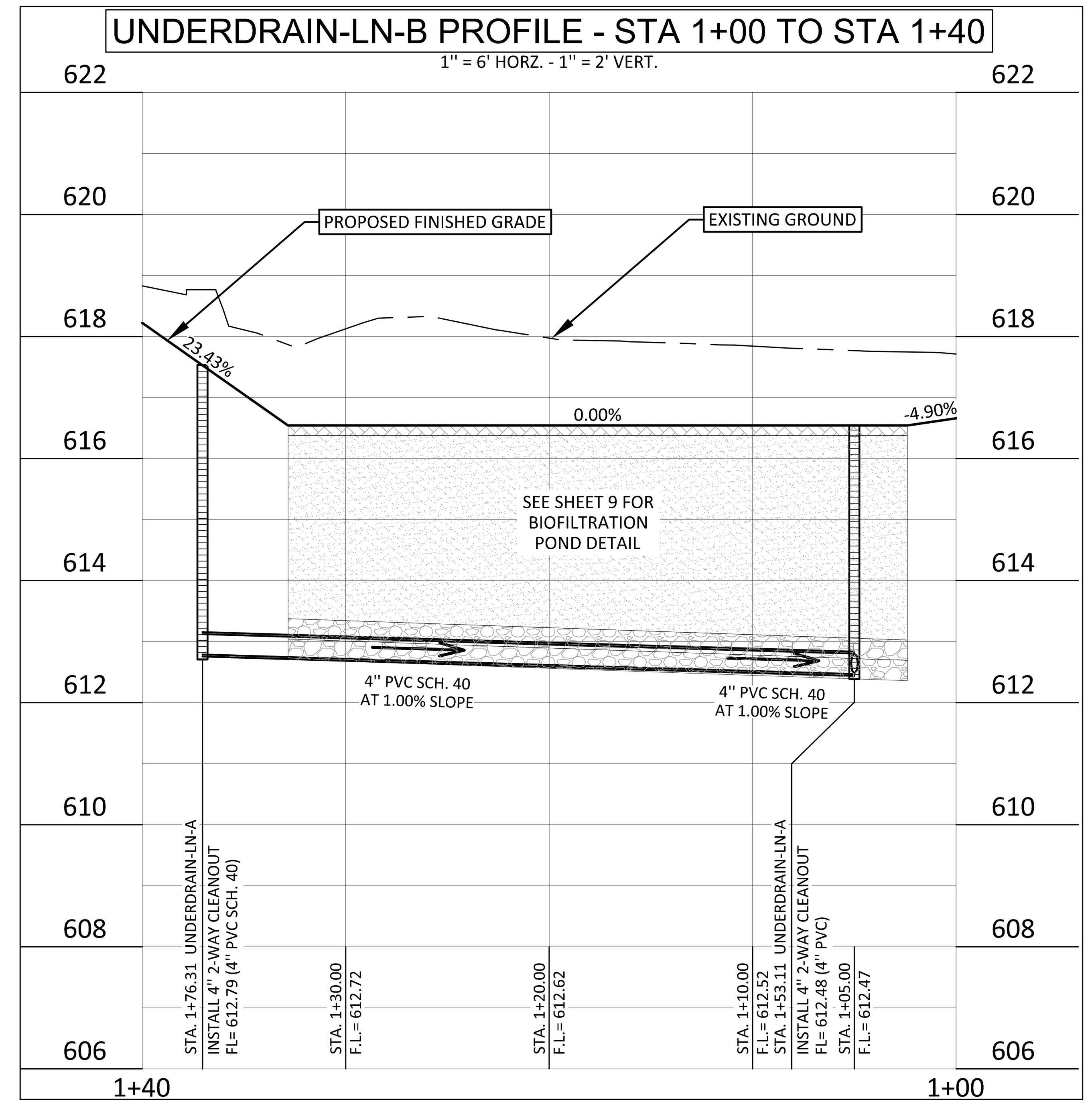
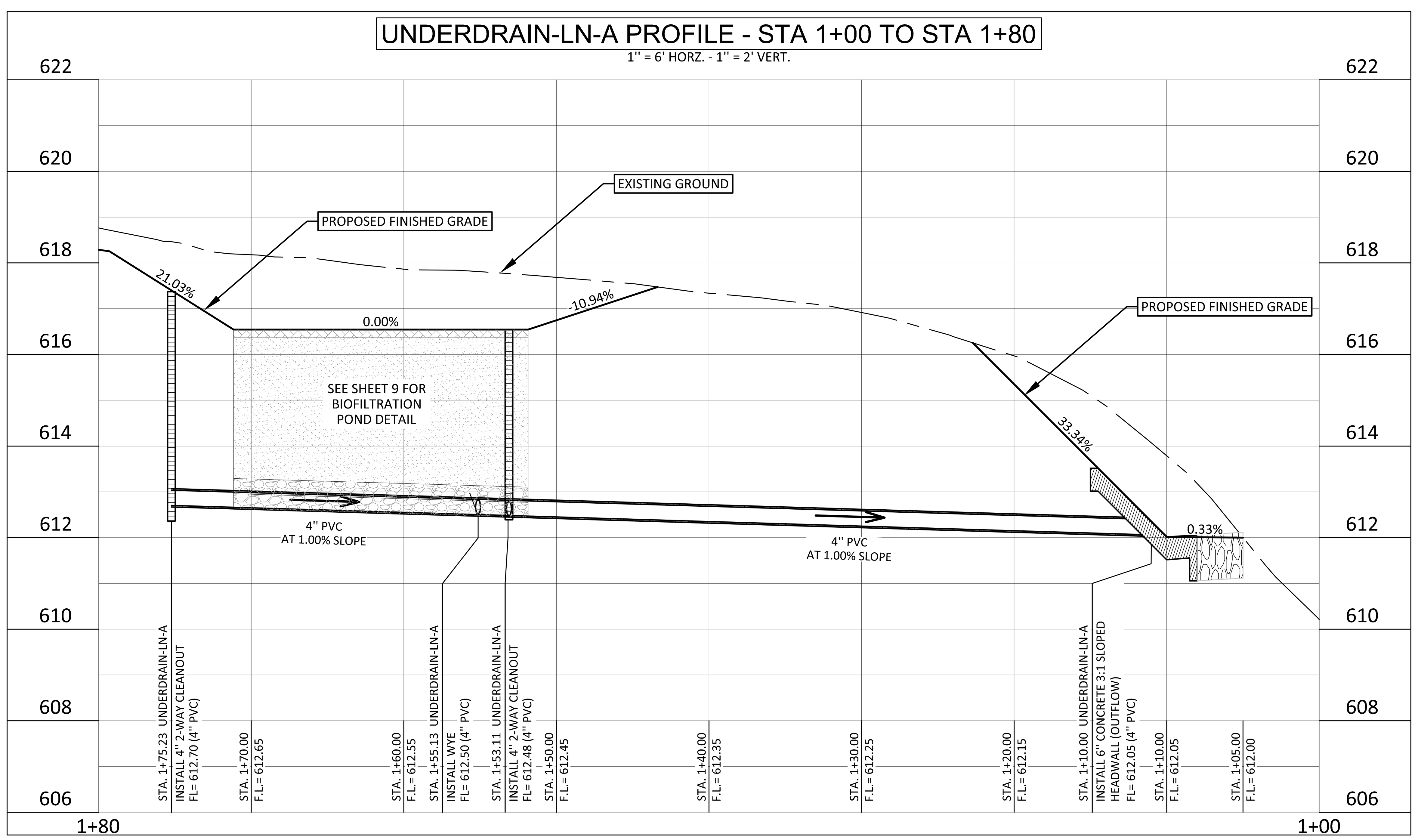






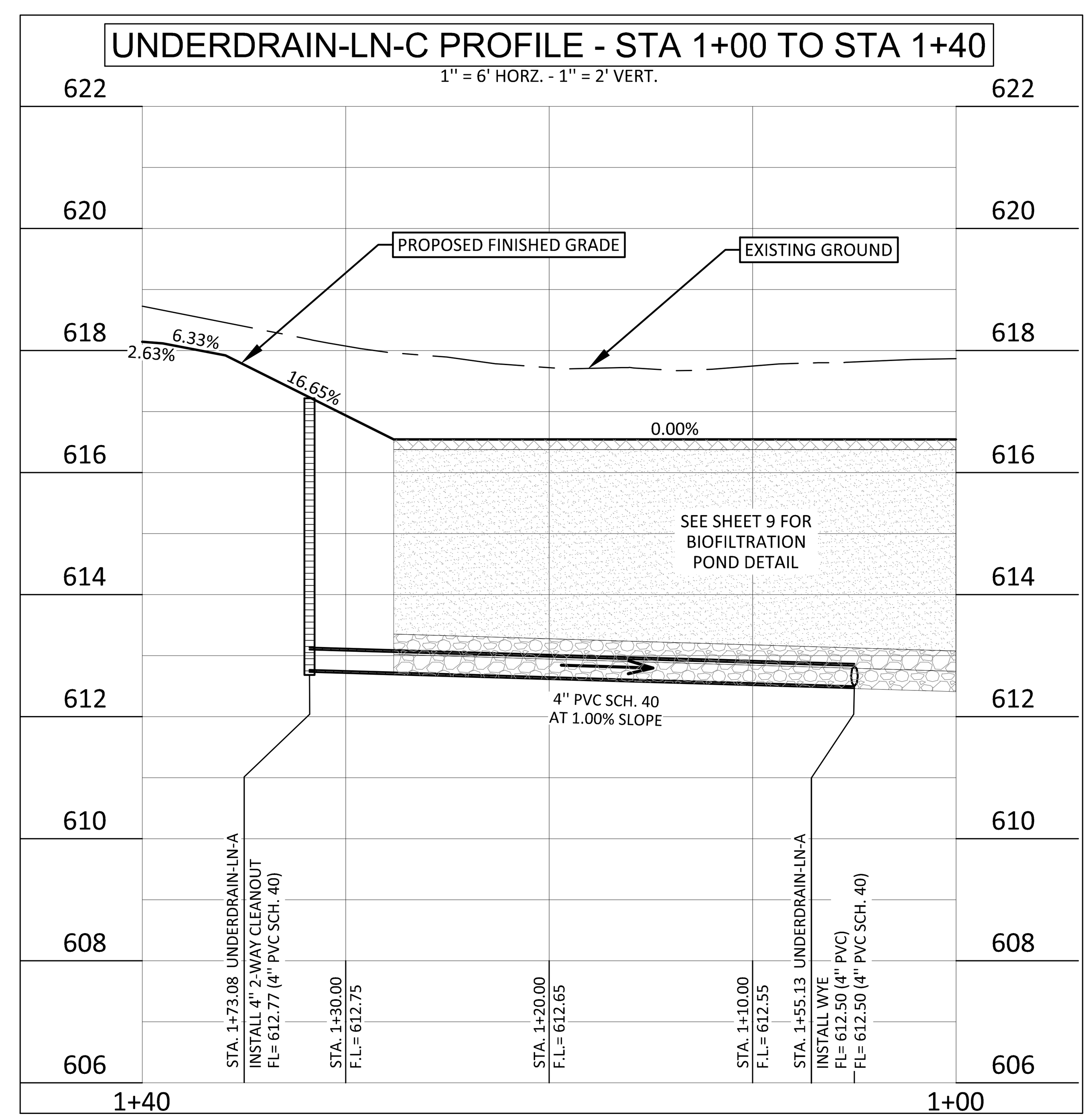
UNDERDRAIN-LN-B

NUMBER	LENGTH	LINE DIRECTION	START	END
L11	13.00	N6° 01' 36.38"W	STA 1+00.00 X: 2243789.71 Y: 13807069.10	STA 1+13.00 X: 2243788.35 Y: 13807082.03
L12	2.83	N51° 01' 36.38"W	STA 1+13.00 X: 2243788.35 Y: 13807082.03	STA 1+15.83 X: 2243786.15 Y: 13807083.81
L13	24.17	S83° 58' 23.62"W	STA 1+15.83 X: 2243786.15 Y: 13807083.81	STA 1+40.00 X: 2243762.11 Y: 13807081.27



UNDERDRAIN-LN-A

NUMBER	LENGTH	LINE DIRECTION	START	END
L1	51.51	N51° 01' 36.38"W	STA 1+00.00 X: 2243830.82 Y: 13807041.85	STA 1+51.51 X: 2243790.78 Y: 13807074.24
L2	28.49	S83° 58' 23.62"W	STA 1+51.51 X: 2243790.78 Y: 13807074.24	STA 1+80.00 X: 2243762.44 Y: 13807071.25



UNDERDRAIN-LN-C

NUMBER	LENGTH	LINE DIRECTION	START	END
L21	13.00	S6° 01' 36.38"E	STA 1+00.00 X: 2243786.65 Y: 13807078.84	STA 1+13.00 X: 2243788.01 Y: 13807065.91
L22	2.83	S38° 58' 23.62"W	STA 1+13.00 X: 2243788.01 Y: 13807065.91	STA 1+15.83 X: 2243786.23 Y: 13807063.71
L23	24.17	S83° 58' 23.62"W	STA 1+15.83 X: 2243786.23 Y: 13807063.71	STA 1+40.00 X: 2243762.19 Y: 13807061.17

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GOLF COURSE ROAD PARKING AREA AND BIOFILTRATION SYSTEM
GOLF COURSE ROAD
NEW BRAUNFELS, TX. 78130

POND PROFILE SHEET

PLOTTED: Dec 20, 2024 - 9:45am

Designed:	JC
Drawn:	ZR
Reviewed:	JC
Issue Date:	7/19/24

SHEET 10 OF 13

Project No.: 24004114.001A

Drawing: C:\pwworking\klf-dct-prod\zridge@kleinfelder.com\d0198322\24004114.001A SH PROF.dwg
User: ZRIDGE
Last Modified: Dec. 20, 24 - 09:16
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0 5' 10' 20'
SCALE: 1" = 10'

CONTROL NOTE:
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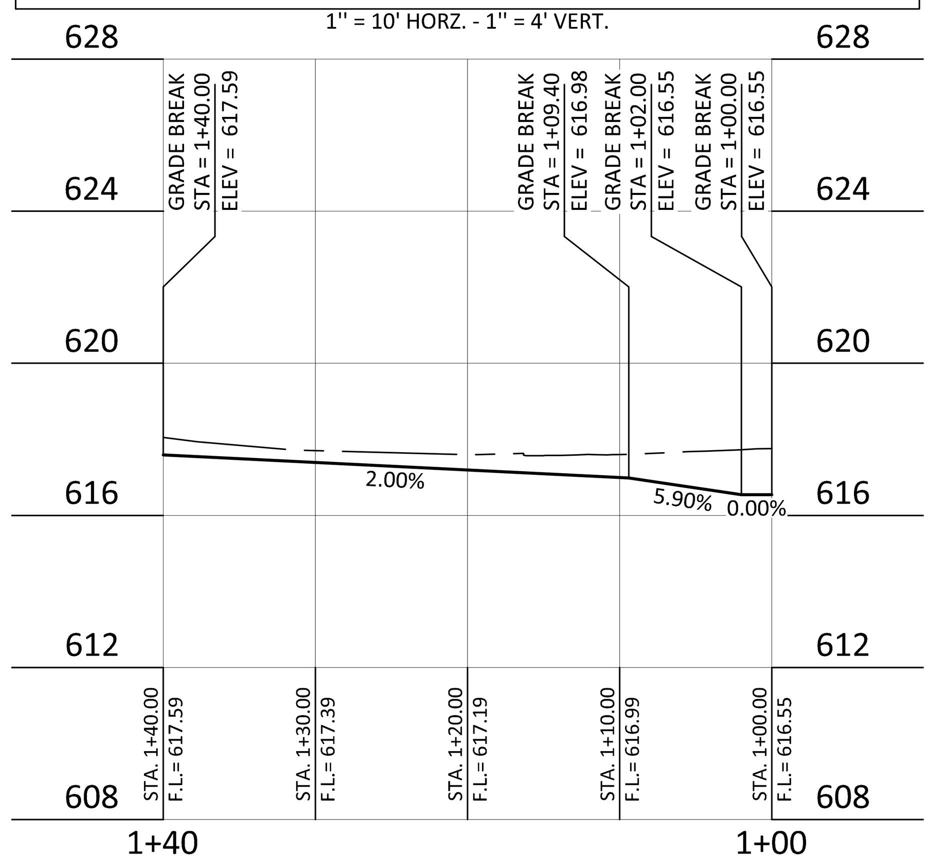
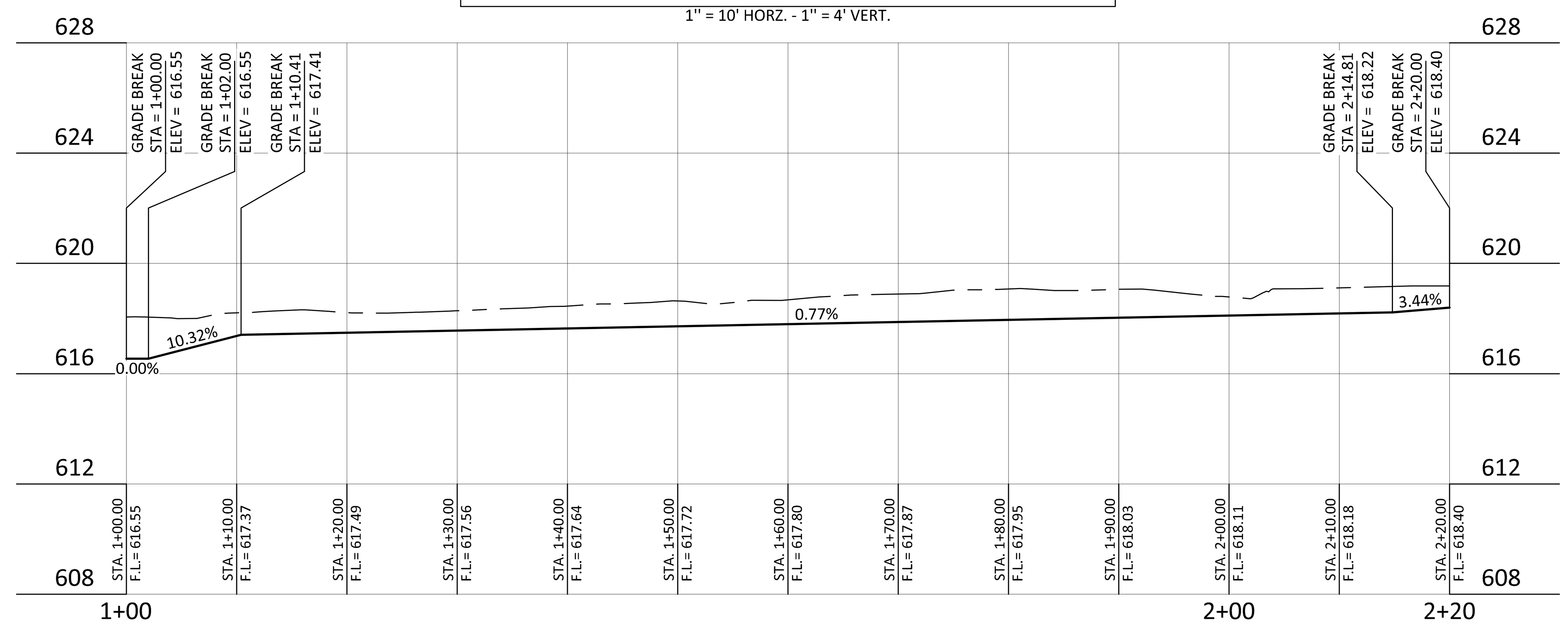
DESCRIPTION: SQUARE CUT SET IN A CONCRETE CURB LOCATED APPROXIMATELY 350 FEET WEST OF THE OLD CHANNEL CROSSING OF THE COMAL RIVER, ON THE WEST SIDE OF GOLF COURSE ROAD.

SWALE-B PROFILE - STA 1+00 TO STA 1+40
1" = 10' HORZ. - 1" = 4' VERT.



SWALE-A PROFILE - STA 1+00 TO STA 2+20
1" = 10' HORZ. - 1" = 4' VERT.



SWALE-B					
NUMBER	LENGTH	RADIUS	Line/Chord Direction	START	END
L201	9.40		S1° 49' 35.65"E	STA 1+00.00 X: 2243780.49 Y: 13807058.14	STA 1+09.40 X: 2243780.79 Y: 13807048.75
C201	6.76	20.00	S7° 51' 17.09"W	STA 1+09.40 X: 2243780.79 Y: 13807048.75	STA 1+16.16 X: 2243779.87 Y: 13807042.09
L202	23.84		S17° 32' 09.84"W	STA 1+16.16 X: 2243779.87 Y: 13807042.09	STA 1+40.00 X: 2243772.68 Y: 13807019.35

SWALE-A					
NUMBER	LENGTH	RADIUS	Line/Chord Direction	START	END
L101	17.22		N31° 58' 01.60"E	STA 1+00.00 X: 2243781.09 Y: 13807085.84	STA 1+17.22 X: 2243790.21 Y: 13807100.45
C101	8.69	18.00	N18° 08' 17.23"E	STA 1+17.22 X: 2243790.21 Y: 13807100.45	STA 1+25.91 X: 2243792.89 Y: 13807108.63
L102	94.09		N4° 18' 32.86"E	STA 1+25.91 X: 2243792.89 Y: 13807108.63	STA 2+20.00 X: 2243799.96 Y: 13807202.45

THESE PLANS ARE RELEASED UNDER THE AUTHORITY OF JONATHAN CAREY, P.E., CFM TBPE# 131936, ON 12/20/24 FOR THE PURPOSES OF REVIEW AND ARE NOT TO BE USED FOR CONSTRUCTION PRIOR TO APPROVAL BY ALL GOVERNING JURISDICTIONS

STATE OF TEXAS
DAVID A. CLARK
123212
REGISTERED PROFESSIONAL ENGINEER
12/20/2024

DOUCET ENGINEERS
TBPELS Firm No. F-3937

DOUCET
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www.douceteengineers.com
TBPELS Engineering Firm No. F-3937
TBPELS Surveying Firm No. 10194551

GOLF COURSE ROAD PARKING AREA AND BIOFILTRATION SYSTEM
GOLF COURSE ROAD
NEW BRAUNFELS, TX. 78130

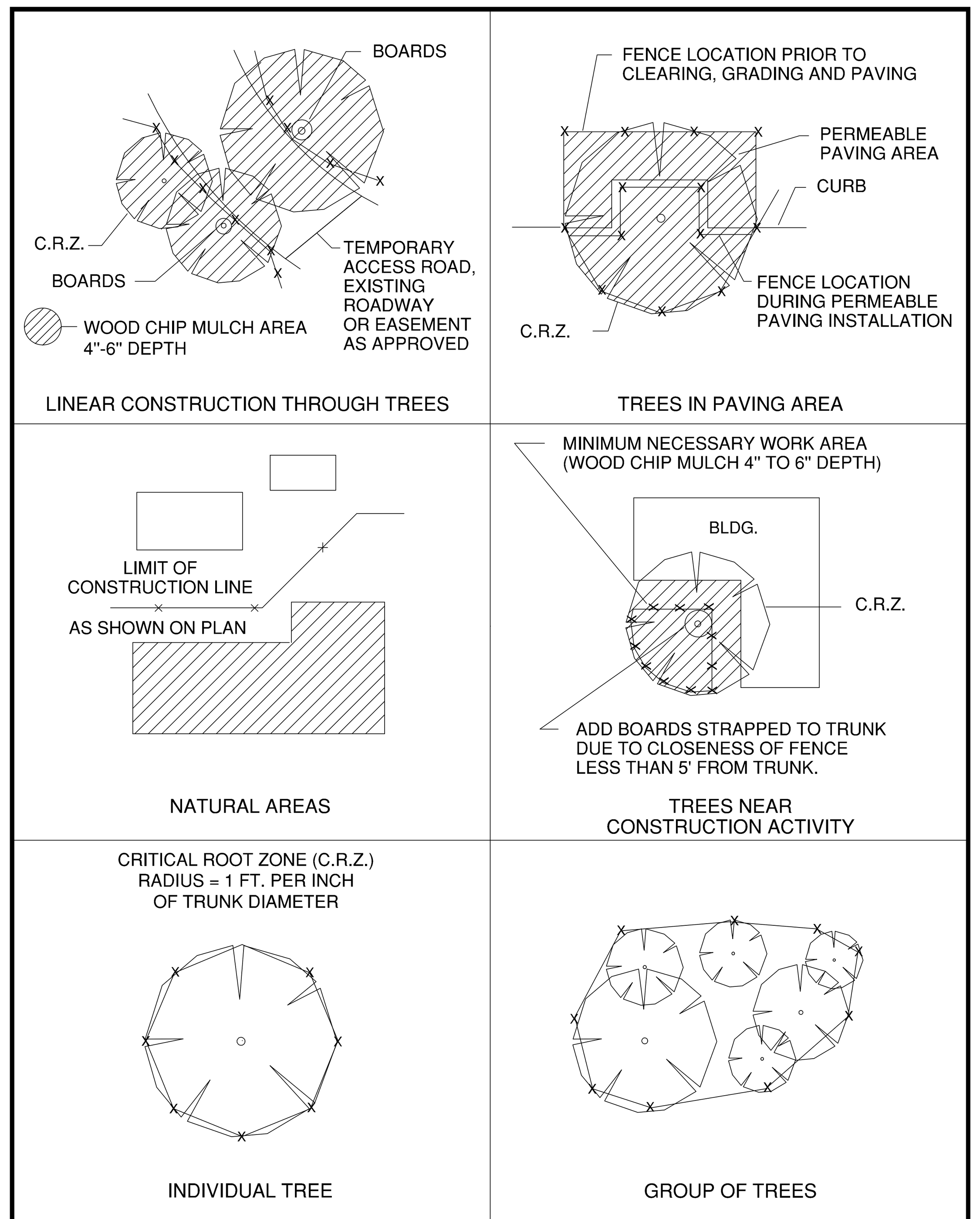
SWALE PROFILE SHEET

PLOTTED: Dec 20, 2024 - 9:46am
Designed: JC
Drawn: ZR
Reviewed: JC
Issue Date: 7/19/24

SHEET 11 OF 13

Project No.: 24004114.001A

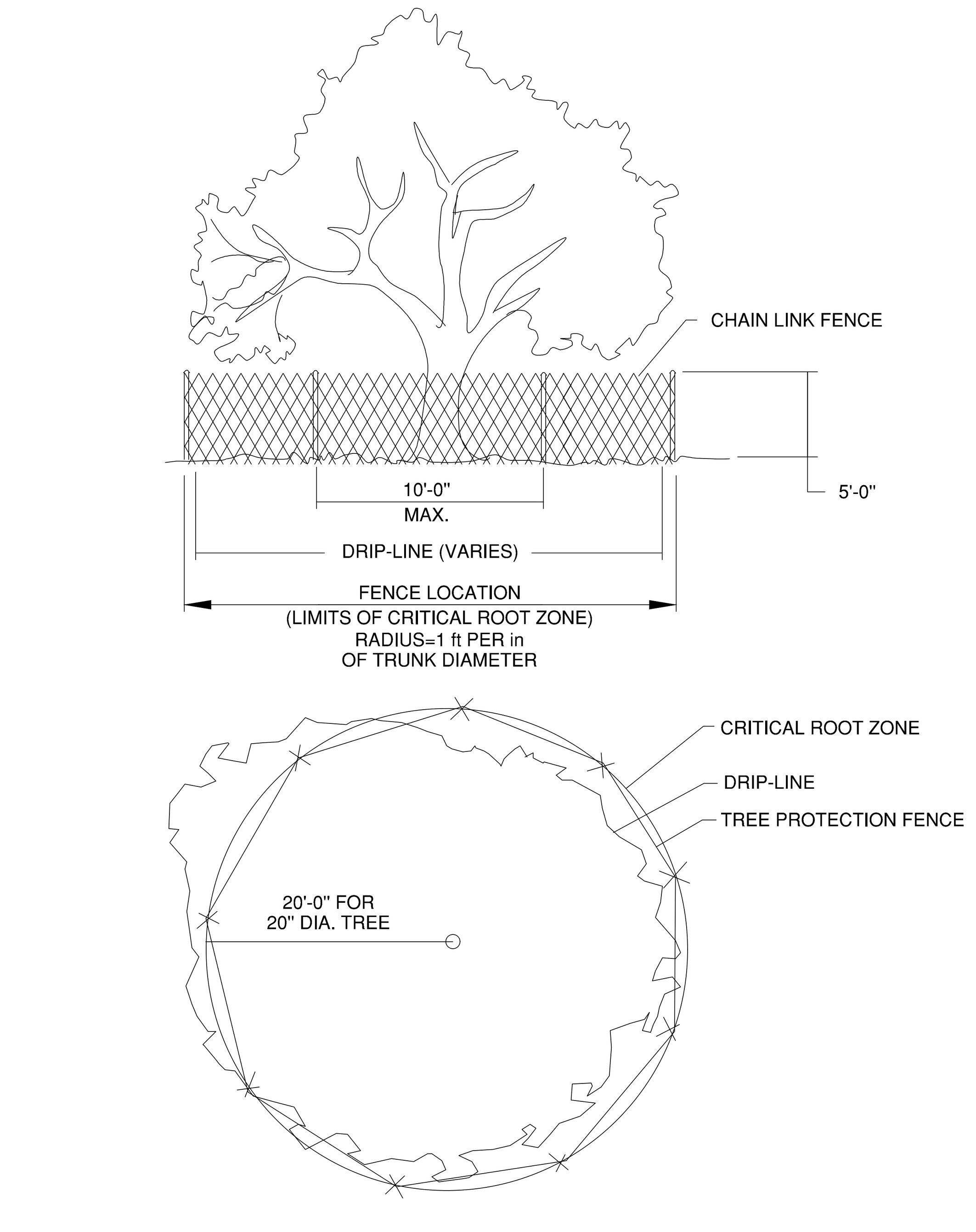
IF THIS SHEET IS NOT 24" X 36", THEN IT IS A REDUCED PRINT.



NBU — NEW BRAUNFELS UTILITIES WATER SYSTEMS ENGINEERING

DRAWN BY: H Shadrock	STANDARD DRAWING: TREE PROTECTION FENCE LOCATIONS		
APPROVED BY:	UPDATED: 4-29-03	SCALE: N.T.S.	SHEET: 1 OF 1	DRAWING NO. 510

1/12



NBU — NEW BRAUNFELS UTILITIES WATER SYSTEMS ENGINEERING

DRAWN BY: H Shadrock	STANDARD DRAWING: TREE PROTECTION FENCE TYPE A - CHAIN LINK		
APPROVED BY:	UPDATED: 4-29-03	SCALE: N.T.S.	SHEET: 1 OF 1	DRAWING NO. 511

2/12

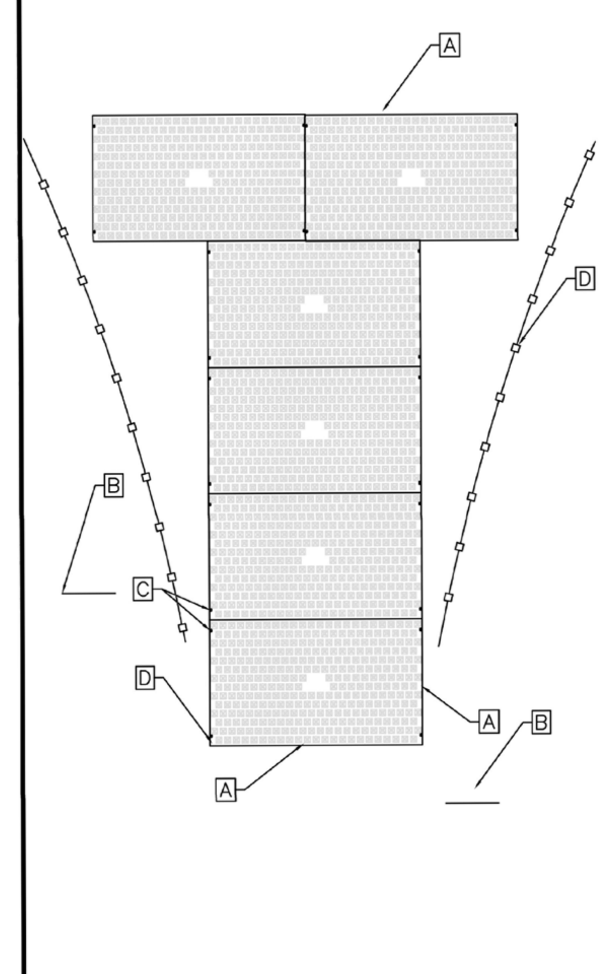
FODS TRACKOUT CONTROL SYSTEM

THE PURPOSE AND DESIGN OF THE FODS TRACKOUT CONTROL SYSTEM IS TO EFFECTIVELY REMOVE MOST SEDIMENT FROM VEHICLE TIRES AS THEY EXIT A DISTURBED LAND AREA ONTO A PAVED STREET. THIS A GENERAL GUIDE FROM WHICH TO INSTALL A FODS TRACKOUT CONTROL SYSTEM. (NOTE: THIS IS NOT A ONE SIZE FITS ALL GUIDE.) THE INSTALLATION MAY NEED TO BE MODIFIED TO MEET THE EXISTING CONDITIONS, EXPECTATIONS, OR DEMANDS OF A PARTICULAR SITE. THIS IS A GUIDELINE. ULTIMATELY THE FODS TRACKOUT CONTROL SYSTEM SHOULD BE INSTALLED SAFELY WITH PROPER ANCHORING AND SIGNS PLACED AROUND THE ENTRANCE AND EXIT TO CAUTION USERS AND OTHERS.

KEY NOTES:

A. FODS TRACKOUT CONTROL SYSTEM MAT.
B. FODS SAFETY SIGN.
C. ANCHOR POINT.
D. SILT OR ORANGE CONSTRUCTION FENCE.

CALL UTILITY NOTIFICATION CENTER
811
CALL 3-BUSINESS DAYS IN ADVANCE BEFORE YOU DIG, GRADE, OR EXCAVATE FOR THE MARKING OF UNDERGROUND MEMBER UTILITIES.



TYPICAL ONE-LANE LAYOUT

FIG. 1

INSTALLATION:

1. THE SITE WHERE THE FODS TRACKOUT CONTROL SYSTEM IS TO BE PLACED SHOULD CORRESPOND TO BEST MANAGEMENT PRACTICES AS MUCH AS POSSIBLE. THE SITE WHERE FODS TRACKOUT CONTROL SYSTEM SHOULD ALSO MEET OR EXCEED THE LOCAL JURISDICTION OR STORM WATER POLLUTION PREVENTION PLAN (SWPPP) REQUIREMENTS.
2. CALL FOR UTILITY LOCATES 3 BUSINESS DAYS IN ADVANCE OF THE FODS TRACKOUT CONTROL SYSTEM INSTALLATION FOR THE MARKING OF UNDERGROUND MEMBER UTILITIES. CALL THE UTILITY NOTIFICATION CENTER AT 811.
3. ONCE THE SITE IS ESTABLISHED WHERE FODS TRACKOUT CONTROL SYSTEM IS TO BE PLACED, ANY EXCESSIVE UNEVEN TERRAIN SHOULD BE LEVELED OUT OR REMOVED SUCH AS LARGE ROCKS, LANDSCAPING MATERIALS, SUDDEN ABRUPT CHANGES IN ELEVATION, AND SIMILAR. FODS WILL SPAN AND SUPPORT OVER MOST OBSTACLES, BUT THE FLATTER AND SMOOTHER THE TERRAIN UNDER THE FODS TRACKOUT CONTROL SYSTEM WILL BE MORE EFFICIENT AND SAFER.
4. NEXT THE INDIVIDUAL MATS CAN START TO BE PLACED IN POSITION. THE FIRST MAT SHOULD BE PLACED NEXT TO THE PAVED SURFACE AND/OR CURB AT THE CLOSEST POINT OF EGRESS. THIS WILL ENSURE THAT THE VEHICLE WILL EXIT STRAIGHT FROM THE SITE TO THE PAVED SURFACE. FROM THE SITE TO THE PAVED SURFACE.
5. AFTER THE FIRST MAT IS PLACED DOWN IN ITS PROPER LOCATION, AN H BRACKET SHOULD BE PLACED AT THE END OF THE FIRST MAT, BEFORE ANOTHER MAT IS POSITIONED ADJACENT TO THE FIRST MAT.
6. ONCE THE SECOND MAT IS PLACED ADJACENT TO THE FIRST MAT, MAKE SURE THE H BRACKET IS CORRECTLY SITUATED BETWEEN THE TWO MATS.
7. NEXT, THE CONNECTOR STRAP SHOULD BE INSTALLED TO CONNECT THE TWO MATS TOGETHER.
8. AFTER THE FIRST MAT IS PLACED DOWN IN ITS PROPER LOCATION, IT SHOULD BE ANCHORED TO PREVENT THE POTENTIAL MOVEMENT WHILE THE ADJOINING MATS ARE INSTALLED NEXT. ANCHORS SHOULD BE PLACED AT EVERY ANCHOR POINT (IF FEASIBLE) TO HELP MAINTAIN THE MAT IN ITS CURRENT POSITION.
9. ONCE THE FIRST MAT IS ANCHORED DOWN, THE SUCCESSIVE MATS CAN THEN BE PLACED TO CREATE THE FODS® TRACKOUT CONTROL SYSTEM.
10. UPON PLACEMENT OF EACH NEW MAT IN THE SYSTEM, THAT MAT SHOULD BE ANCHORED AT EVERY ANCHOR POINT TO HELP STABILIZE THE MAT AND ENSURE THE SYSTEM IS CONTINUOUS WITH NO GAPS IN BETWEEN THE MATS.
11. AFTER INSTALLATION OF THE FODS TRACKOUT CONTROL SYSTEM, FODS SAFETY SIGNS SHOULD BE PLACED AT THE ENTRANCE AND EXIT SIDES OF THE FODS TRACKOUT CONTROL SYSTEM.
12. A SILT FENCE OR ORANGE CONSTRUCTION FENCE SHOULD ALSO BE INSTALLED ON THE SIDES OF THE FODS TRACKOUT CONTROL SYSTEM TO DIRECT VEHICLES DOWN THE MATS AND BARRICADE PEDESTRIANS FROM CROSSING THE MATS. PEDESTRIANS SHOULD ALSO USE EXTREME CAUTION WHEN CROSSING THE MATS AS THE SURFACE IS UNEVEN AND MAY BE DIFFICULT TO WALK ON.

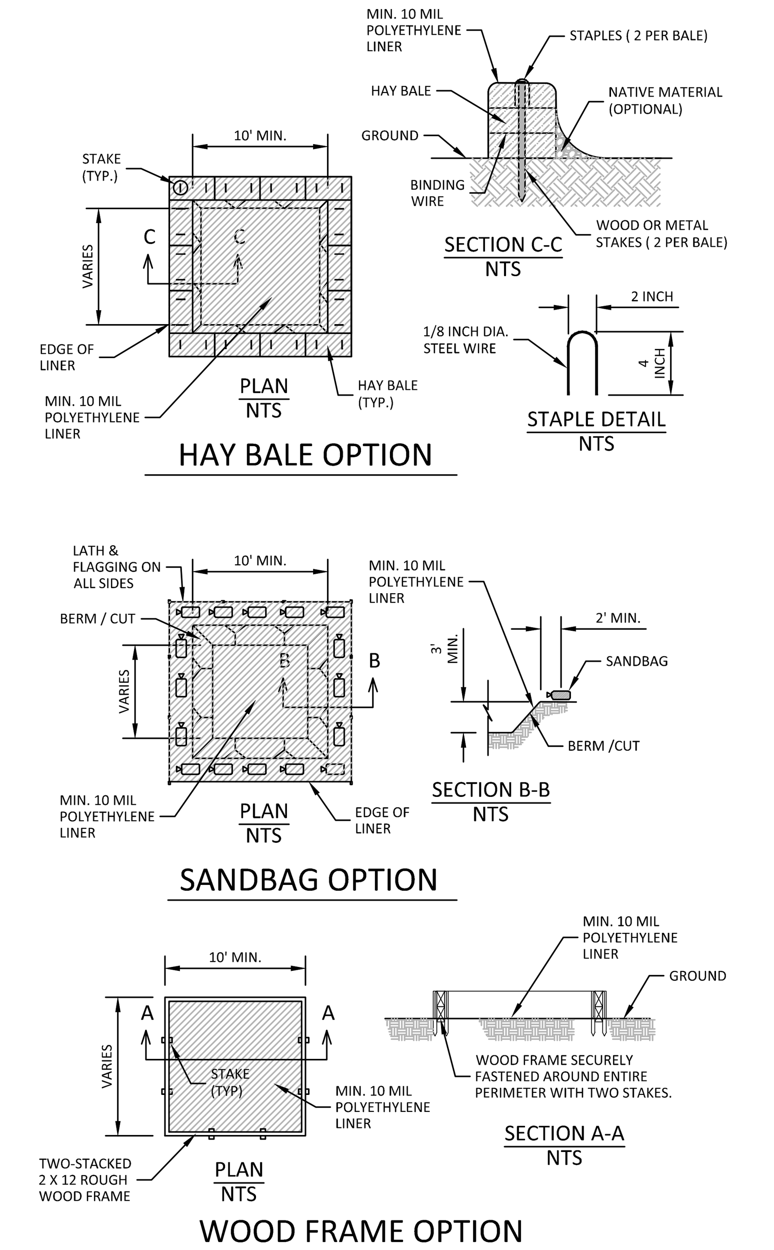
USE AND MAINTENANCE

1. VEHICLES SHOULD TRAVEL DOWN THE LENGTH OF THE FODS TRACKOUT CONTROL SYSTEM AND NOT CUT ACROSS THE MATS.
2. DRIVERS SHOULD TURN THE WHEEL OF THEIR VEHICLES SUCH THAT THE VEHICLE WILL TAKE A SERPENTINE ROUTE DOWN THE LENGTH OF THE FODS TRACKOUT CONTROL SYSTEM.
3. MATS SHOULD BE CLEANED ONCE THE VOIDS BETWEEN THE PYRAMIDS BECOME FULL OF SEDIMENT. TYPICALLY THIS TASK WILL NEED TO BE PERFORMED WITHIN TWO WEEKS AFTER A STORM EVENT. BRUSHING IS THE PREFERRED METHOD OF CLEANING, EITHER MANUALLY OR MECHANICALLY.
4. THE USE OF ICE MELT, ROCK SALT, SNOW MELT, DEICER, ETC. SHOULD BE UTILIZED AS NECESSARY DURING THE WINTER MONTHS AND AFTER A SNOW EVENT.

REMOVAL

1. REMOVAL OF FODS TRACKOUT CONTROL SYSTEM IS THE REVERSE ORDER OF THE INSTALLATION.
2. STARTING WITH THE LAST MAT, THE MAT THAT IS PLACED AT THE INNERMOST POINT OF THE SITE OR THE MAT FURTHEST FROM THE EXIT OR PAVED SURFACE SHOULD BE REMOVED FIRST.
3. THE CABLE ANCHORS SHOULD BE CUT WITH WIRE ROPE CUTTERS.
4. THE CONNECTOR STRAPS SHOULD BE UNBOLTED AT ALL LOCATIONS IN THE FODS TRACKOUT CONTROL SYSTEM.
5. STARTING WITH THE LAST MAT IN THE SYSTEM, EACH SUCCESSIVE MAT SHOULD THEN BE MOVED AND STACKED FOR LOADING BY FORKLIFT OR EXCAVATOR ON TO A TRUCK FOR REMOVAL FROM THE SITE.

3/12



PORTABLE, PREFABRICATED, CONCRETE WASHOUT CONTAINERS ARE COMMERCIALLY AVAILABLE AND ARE AN ACCEPTABLE ALTERNATIVE TO ABOVE GRADE AND BELOW GRADE WASHOUT AREAS DEPICTED ABOVE.

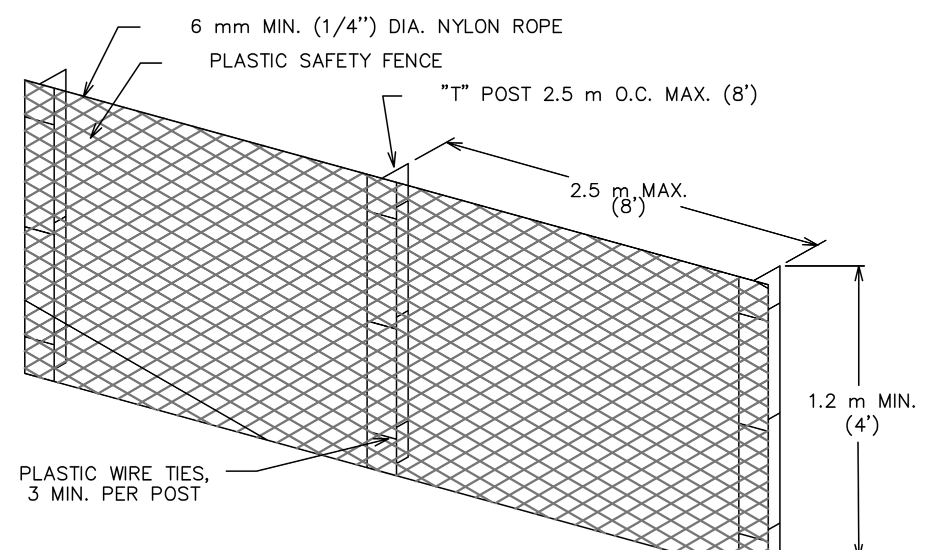
PREFAB CONTAINER OPTION

NOTES:

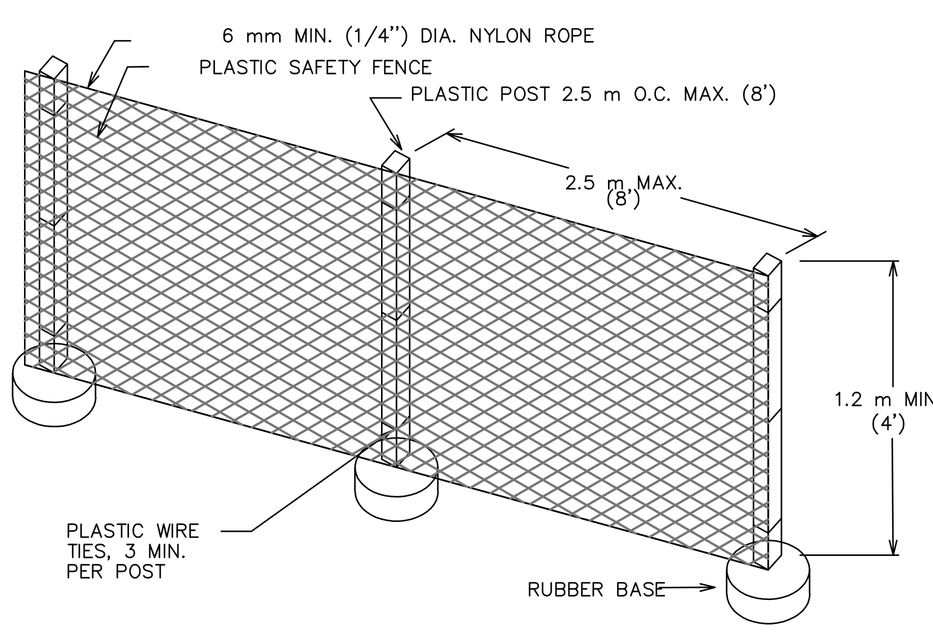
1. WASHOUT AREA MUST BE CLEARLY MARKED WITH SIGNAGE NOTING THE WASHOUT AREA AND BE IDENTIFIED ON SWPPP MAP.
2. THE CONCRETE WASHOUT SIGN SHALL BE INSTALLED WITHIN 30 FEET OF THE TEMPORARY CONCRETE WASHOUT FACILITY.
3. A CONCRETE WASHOUT PIT OR OTHER CONTAINMENT SHALL BE INSTALLED A MINIMUM OF 50 FEET AWAY FROM INLETS, SWALES, DRAINAGE WAYS, CHANNELS, AND OTHER WATERS, IF THE SITE CONFIGURATION PROVIDES SUFFICIENT SPACE TO DO SO. IN NO CASE SHALL CONCRETE WASHOUT OCCUR CLOSER THAN 20 FEET FROM INLETS, SWALES, DRAINAGE WAYS, CHANNELS AND OTHER WATERS.
4. WASHOUT AREAS MUST ALLOW FOR 6 CUBIC FEET OF CONTAINMENT VOLUME FOR EVERY 10 CUBIC YARDS OF CONCRETE PLACED.
5. THE CONTAINMENT SHALL BE LINED WITH POLYETHYLENE (MINIMUM 10 MILLIMETERS THICK) OR AN EQUIVALENT MEASURE TO PREVENT SEEPAGE TO GROUNDWATER.
6. WASHOUT STRUCTURES SHALL BE CLEANED OUT WHEN THE STRUCTURE IS 75% FULL. TEMPORARY CONCRETE WASHOUT FACILITY SHOULD BE MAINTAINED TO PROVIDE ADEQUATE HOLDING CAPACITY.
7. ANY DAMAGE TO THE POLYETHYLENE LINER MUST BE IMMEDIATELY REPAIRED.

4/12 CONCRETE WASHOUT DETAIL

SCALE: NONE CUST- 360



TEMPORARY SAFETY FENCE



PORTABLE SAFETY FENCE

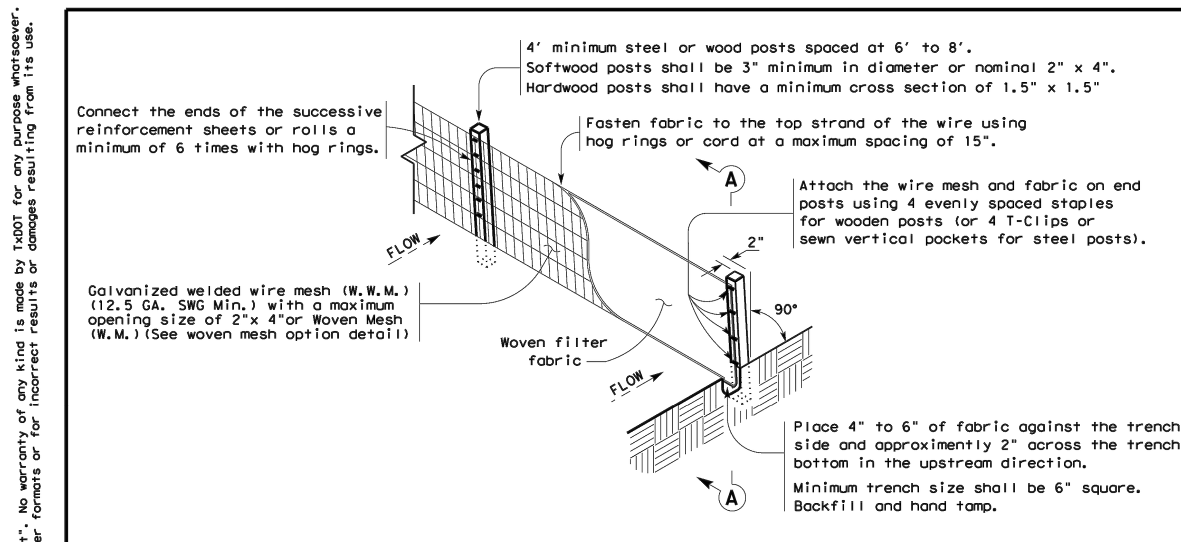
CITY OF AUSTIN DEPARTMENT OF PUBLIC WORKS	SAFETY FENCE	
RECORD COPY SIGNED BY SAM ANGOORI — 04/03/09 ADOPTED	THE ARCHITECT/ENGINEER ASSUMES RESPONSIBILITY FOR APPROPRIATE USE OF THIS STANDARD.	STANDARD NO. 804S-4 1 OF 9

5/12

1. SAFETY FENCE SHALL BE USED TO PROTECT ALL EXCAVATIONS IN THE RIGHT-OF-WAY.
2. SAFETY FENCES SHALL BE USED TO SEPARATE CONSTRUCTION ACTIVITIES FROM PEDESTRIAN.
3. ALL SAFETY FENCING SHALL BE PLASTIC, 1,200 mm (48") MINIMUM HEIGHT AND ORANGE IN COLOR.
4. SAFETY FENCE USED WITHIN THE ROADWAY SHALL BE REFLECTORIZED WITH A MINIMUM OF TWO (2) STRIPS OF RETROREFLECTIVE MATERIAL, A MINIMUM OF 25 mm (1") WIDE, THE LENGTH OF THE FENCE OR DELINEATED BY CHANNELIZING DEVICES.
5. SAFETY FENCE USED TO SEPARATE SIDEWALKS FROM CONSTRUCTION ACTIVITIES SHALL HAVE MINIMUM ENCROACHMENT TO THE SIDEWALK.
6. AS A MINIMUM, SAFETY FENCING IS REQUIRED IN AREAS ADJACENT TO EXCAVATIONS GREATER THAN OR EQUAL TO 150 mm (6").
7. SAFETY FENCING SHALL BE PAID FOR UNDER ITEM 803S, "BARRICADES, SIGNS AND TRAFFIC HANDLING", PAY ITEM NO. 803S-SF.
8. PORTABLE SAFETY FENCE MOUNTS SHALL BE APPROVED BY THE TRANSPORTATION DIVISION PRIOR TO CONSTRUCTION.

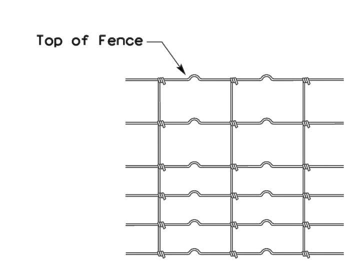
CITY OF AUSTIN DEPARTMENT OF PUBLIC WORKS	SAFETY FENCE	
RECORD COPY SIGNED BY SAM ANGOORI — 04/03/09 ADOPTED	THE ARCHITECT/ENGINEER ASSUMES RESPONSIBILITY FOR APPROPRIATE USE OF THIS STANDARD.	STANDARD NO. 804S-4 2 OF 9

5/12



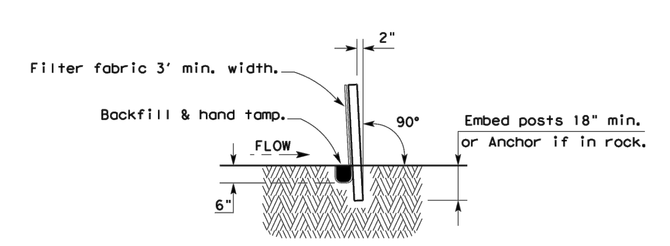
TEMPORARY SEDIMENT CONTROL FENCE

SCF



HINGE JOINT KNOT WOVEN MESH (OPTION) DETAIL

Galvanized hinge joint knot woven mesh (12.5 GA.SWG Min.) requires a minimum of five horizontal wires spaced at a maximum of 12 inches apart and all vertical wires spaced at a maximum of 12 inches apart.



SECTION A-A

SEDIMENT CONTROL FENCE USAGE GUIDELINES

A sediment control fence may be constructed near the downstream perimeter of a disturbed area along a contour to intercept sediment from overland runoff. A 2 year storm frequency may be used to calculate the flow rate to be filtered.

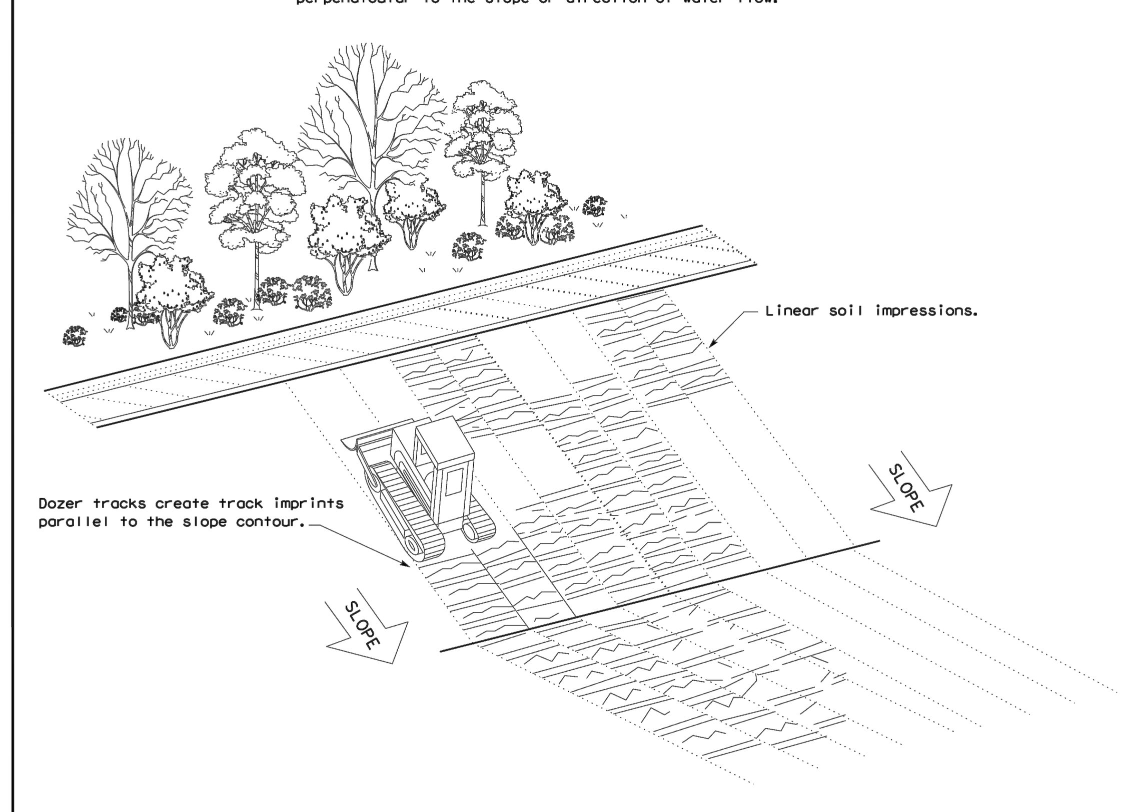
Sediment control fence should be sized to filter a maximum flow through rate of 100 GPM/FT^2. Sediment control fence is not recommended to control erosion from a drainage area larger than 2 acres.

LEGEND

Sediment Control Fence — SCF

GENERAL NOTES

1. Vertical tracking is required on projects where soil distributing activities have occurred unless otherwise approved.
2. Perform vertical tracking on slopes to temporarily stabilize soil.
3. Provide equipment with a track undercarriage capable of producing linear soil impressions measuring a minimum of 12" in length by 2" to 4" in width by 1/2" to 2" in depth.
4. Do not exceed 12" between track impressions.
5. Install continous linear track impressions where the minimum 12" length impressions are perpendicular to the slope or direction of water flow.



VERTICAL TRACKING

Texas Department of Transportation — Design Division Standard

TEMPORARY EROSION, SEDIMENT AND WATER POLLUTION CONTROL MEASURES

FENCE & VERTICAL TRACKING

EC(1)-16

FILE: ec116	DN: TxDOT	CK: KM	DW: VP	DN/CK: LS
© TxDOT: JULY 2016	CONT	SECT	JOB	HIGHWAY
REVISIONS	DIST	COUNTY		SHEET NO.

DATE
FILE

6/12

THESE PLANS ARE RELEASED UNDER THE AUTHORITY OF JONATHAN CAREY, P.E., CFM TBPE# 131936, ON 12/20/24 FOR THE PURPOSES OF REVIEW AND ARE NOT TO BE USED FOR CONSTRUCTION PRIOR TO APPROVAL BY ALL GOVERNING JURISDICTIONS

STATE OF TEXAS — DAVID A. CLARK — 123212 — REGISTERED PROFESSIONAL ENGINEER

12/20/2024

DOUCET ENGINEERS
TBPELS Firm No. F-3937

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TBPELS Surveying Firm No. 10194551

GOLF COURSE ROAD PARKING AREA AND BIOFILTRATION SYSTEM
GOLF COURSE ROAD
NEW BRAUNFELS, TX. 78130

EROSION AND SEDIMENTATION CONTROL DETAIL SHEET

PLOTTED: Dec 20, 2024 - 9:46am

Designed:	JC
Drawn:	ZR
Reviewed:	JC
Issue Date:	7/19/24

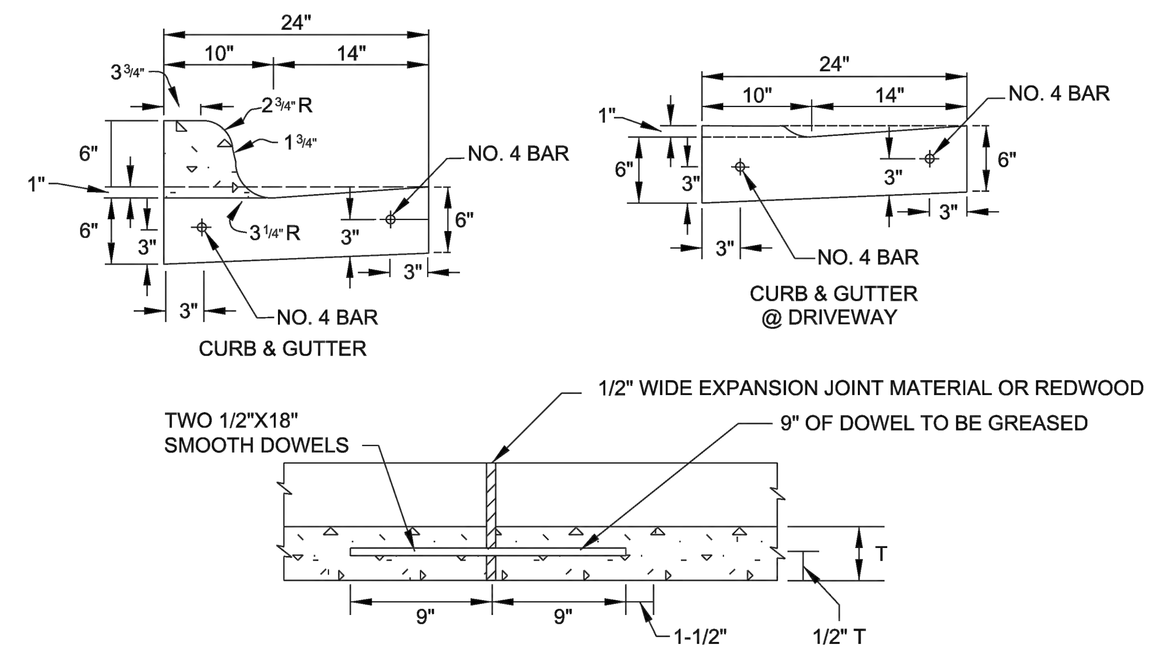
SHEET
12
OF 13

Project No.:
24004114.001A

Drawing: C:\pwworking\kif-dct-prod\zridge@kleinfelder.com\d0198322\24004114.001A SH ES.dwg
User: ZRidge
Last Modified: Dec. 20, 24 - 09:36
Plot Date/Time: Dec. 20, 24 - 09:46:03

IF THIS SHEET IS NOT 24" X 36", THEN IT IS A REDUCED PRINT.

CURB AND GUTTER



LONGITUDINAL SECTION THRU CURB AND GUTTER
SHOWING TYPICAL EXPANSION JOINT DETAILS.
REINFORCING STEEL SHALL NOT CROSS EXPANSION JOINTS.
STEEL SHALL BE TERMINATED 3" (+ OR -) 1" FROM FACE OF THE JOINT.

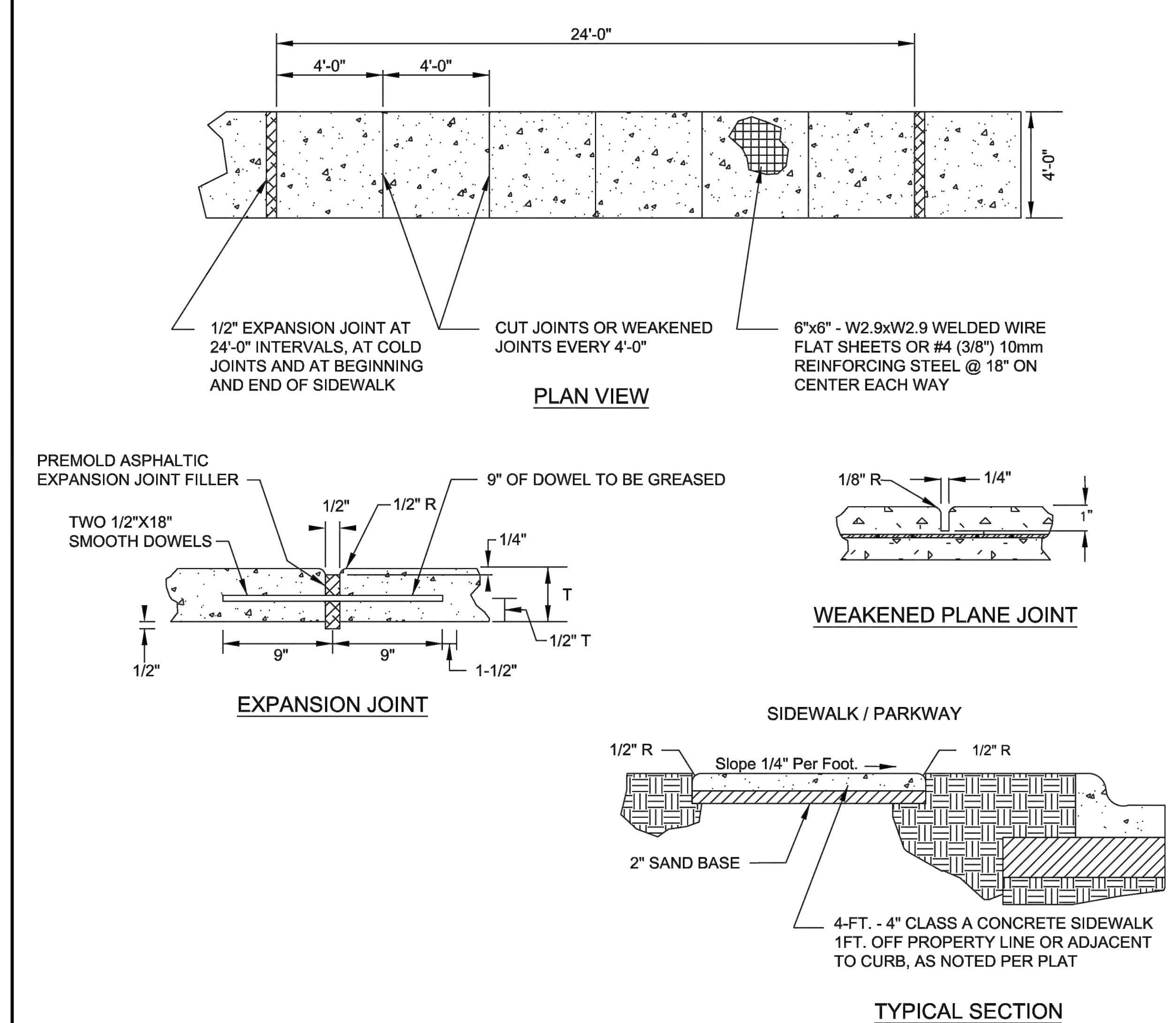
NOTES:

1. REINFORCING BARS SHALL BE LAPPED A MINIMUM OF 18".
2. CURB AND GUTTER SHALL HAVE FORMED TOOLED OR SAWED CONTRACTION JOINTS AT ± 10'. THE DEPTH OF THESE JOINTS SHALL BE SUFFICIENT TO ENSURE CRACKING AT THE JOINTS.
3. CURB OR CURB AND GUTTER SHALL HAVE EXPANSION JOINTS AT POINTS OF CURVATURE, AT INTERVALS NO GREATER THAN 100' AND AT ALL ADJACENT STRUCTURES.
4. UNLESS OTHERWISE SHOWN, TRANSITIONS BETWEEN CURBS OR CURBS AND GUTTER OF DIFFERING CROSS SECTION SHALL BE ACCOMPLISHED OVER A 10' LENGTH OR AS APPROVED BY THE CITY ENGINEER.
5. ALL CONCRETE TO BE CLASS "A" 3000 PSI CONCRETE.
6. ALL EXPOSED CONCRETE SURFACES TO BE BRUSHED SMOOTH AND UNIFORM.

DATE APPROVED: 07/2008	DWG. NO: ST-013	SCALE: N.T.S.	City of New Braunfels	ENGINEERING DEPARTMENT
DRAWN BY: RAS	SHEET: 1 OF 1			
FILENAME: CURB & GUTTER				

1 / 13

SIDEWALK
(RESIDENTIAL)

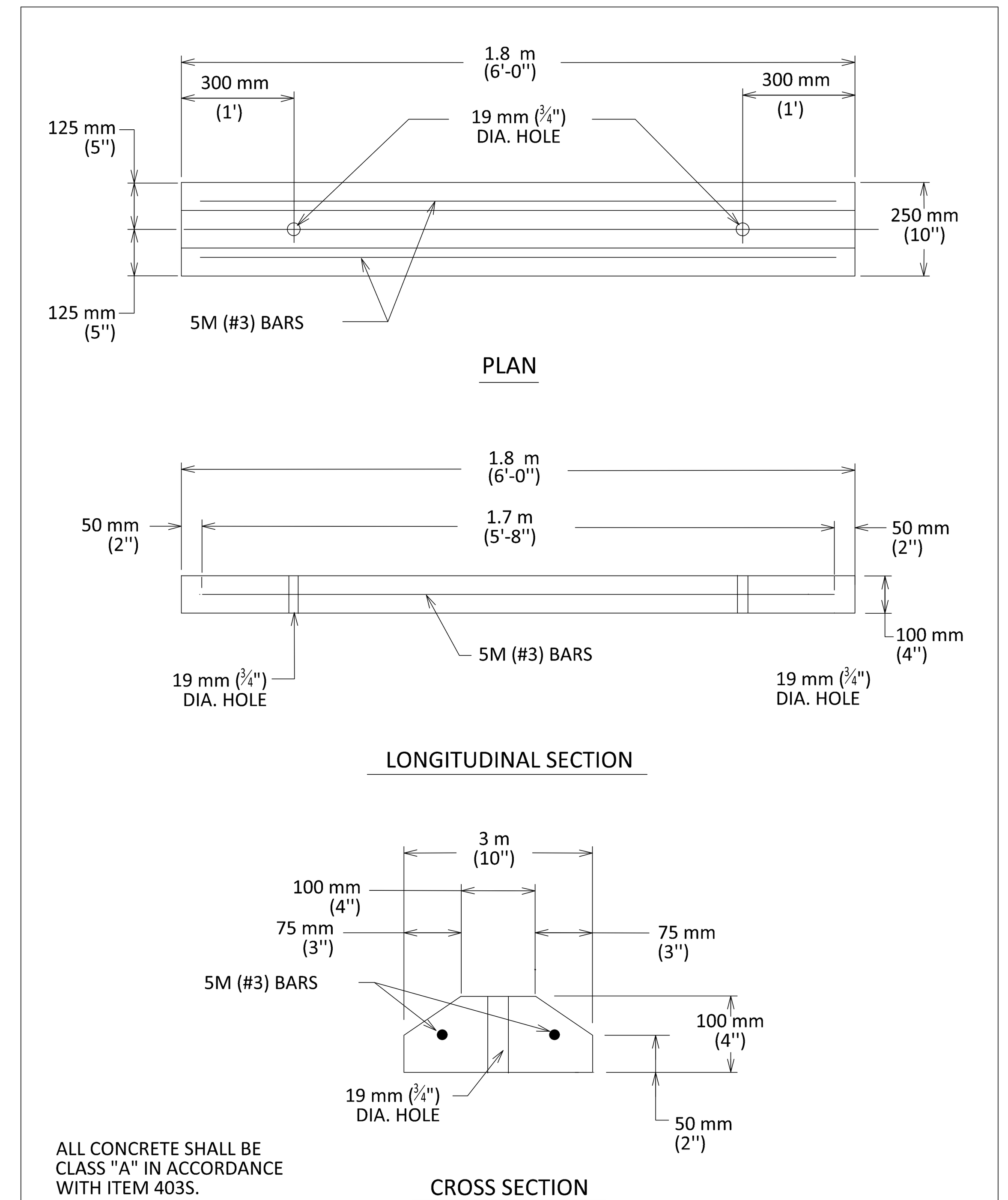


NOTES:

1. EXPANSION JOINTS ARE TO BE USED BETWEEN CONCRETE DRIVEWAY AND SIDEWALK.
2. SCORED JOINTS DENOTE SIDEWALK ACROSS THE DRIVEWAY AND ARE TO BE PLACED AT LEAST 1/3 rd. THROUGH THE SLAB THICKNESS.
3. ALL SIDEWALK AND DRIVEWAY CONSTRUCTION SHALL MEET A.D.A. SPECIFICATIONS.

DATE APPROVED: 07/2008	DWG. NO: ST-016	SCALE: N.T.S.	City of New Braunfels	ENGINEERING DEPARTMENT
DRAWN BY: RAS	SHEET: 1 OF 1			
FILENAME: SIDEWALK (RESIDENTIAL)				

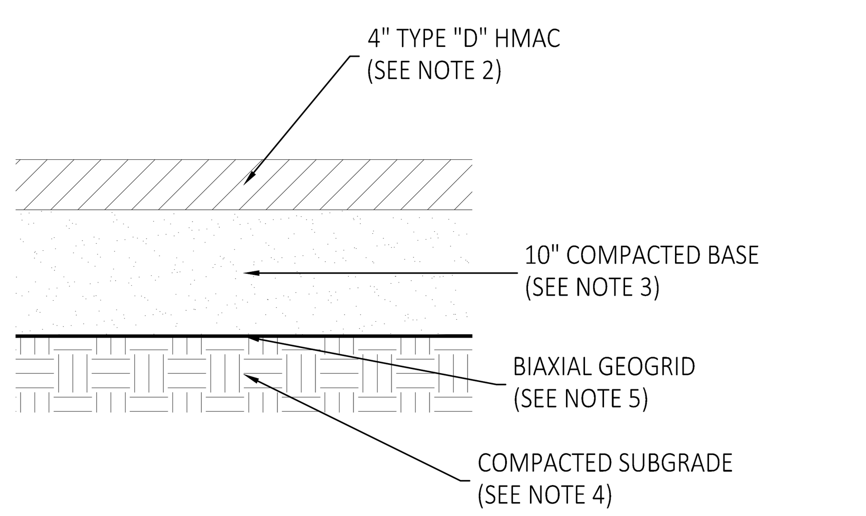
2 / 13



ALL CONCRETE SHALL BE CLASS "A" IN ACCORDANCE WITH ITEM 403S.

PARKING LOT BUMPER CURB	STANDARD NO.
THE ARCHITECT/ENGINEER ASSUMES RESPONSIBILITY FOR APPROPRIATE USE OF THIS STANDARD.	439S-1

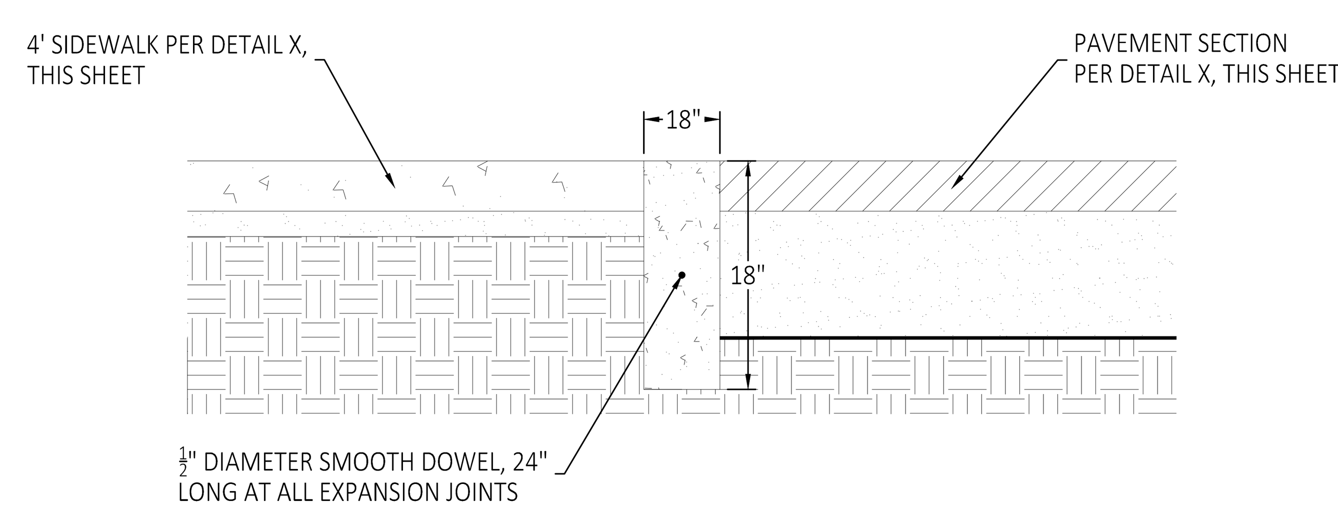
3 / 13 PARKING LOT BUMPER CURB
N.T.S.



NOTES:

1. IF EXISTING ADJACENT PAVEMENT THICKNESSES ARE FOUND TO BE GREATER THAN SHOWN HERE, MATCH EXISTING THICKNESSES.
2. HMAC SHALL BE TYPE "D" PER TXDOT ITEM 340
3. BASE SHALL BE CRUSHED LIMESTONE PER TXDOT ITEM 247, TYPE A, GRADE 2. BASE MUST EXTEND 1' BEYOND BACK OF CURB. THE MATERIAL SHOULD BE PLACED IN LIFTS NOT TO EXCEED 8 INCHES AND COMPACTED TO 6-INCH THICKNESS AT A MINIMUM OF 95% OF THE MAXIMUM DRY DENSITY AS DETERMINED BY ASTM D 1557. THE MOISTURE CONTENT SHOULD BE ADJUSTED TO WITHIN ±2 PERCENTAGE POINTS OF OPTIMUM.
4. SCARIFY THE EXISTING MATERIALS (AFTER REMOVING EXISTING PAVEMENTS AND ACHIEVING FINAL GRADES) AND RECOMPACT TO DENSITIES EQUIVALENT TO AT LEAST 95% OF THE ASTM D 698 MAXIMUM DRY DENSITY AT A MOISTURE CONTENT BETWEEN OPTIMUM AND +4 PERCENTAGE POINTS OF OPTIMUM.
5. THE BIAXIAL GEOGRID SHOULD MEET THE REQUIREMENTS OF TXDOT DEPARTMENTAL MATERIAL SPECIFICATION DMS-6240 TYPE 2 (SUCH AS TENSAR BX1200 OR EQUIVALENT). THE GEOGRID SHOULD EXTEND AT LEAST 3 FEET BEYOND THE LIMITS OF THE PAVEMENT WIDTH. IN AREAS WHERE GEOGRID SEAMS ARE PRESENT, THE GEOGRID SHOULD BE OVERLAPPED A MINIMUM OF 1 FOOT.

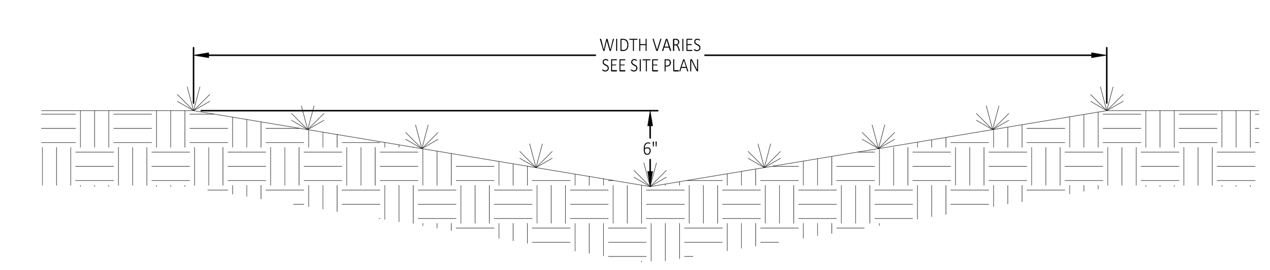
4 / 13 PAVEMENT DETAIL
NOT TO SCALE CUST-043



NOTES:

1. LAYDOWN CURB SHALL HAVE FORMED TOOLED OR SAWED CONTRACTION JOINTS AT ±10'. THE DEPTH OF THESE JOINTS SHALL BE SUFFICIENT TO ENSURE CRACKING AT THE JOINTS.
2. CURB SHALL HAVE EXPANSION JOINTS AT POINTS OF CURVATURE, AT INTERVALS NO GREATER THAN 100' AND ALL ALL ADJACENT STRUCTURES.
3. ALL CONCRETE TO BE CLASS "A" 3000 PSI CONCRETE.
4. ALL EXPOSED CONCRETE SURFACES TO BE BRUSHED SMOOTH AND UNIFORM.

5 / 13 18'' LAYDOWN CURB DETAIL
NOT TO SCALE CUST-043



NOTES:

1. VEGETATION WITHIN CONSTRUCTED EARTHEN CHANNELS SHALL BE ESTABLISHED IN ACCORDANCE WITH ITEM 164 (SEEDING FOR EROSION CONTROL) OF TXDOT'S STANDARD SPECIFICATIONS FOR CONSTRUCTION AND MAINTENANCE OF HIGHWAYS, STREETS, AND BRIDGES MANUAL. REFER TO GENERAL NOTES ON SHEET 2 FOR ADDITIONAL DETAIL REGARDING SEED MIXES.

6 / 13 EARTHEN ''V-BOTTOM'' CHANNEL
NOT TO SCALE CUST-043

THESE PLANS ARE RELEASED UNDER THE AUTHORITY OF JONATHAN CAREY, P.E., CFM TBPE# 131936, ON 12/20/24 FOR THE PURPOSES OF REVIEW AND ARE NOT TO BE USED FOR CONSTRUCTION PRIOR TO APPROVAL BY ALL GOVERNING JURISDICTIONS

STATE OF TEXAS
DAVID A. CLARK
123212
REGISTERED PROFESSIONAL ENGINEER
12/20/2024

DOUCET ENGINEERS
TBPELS Firm No. F-3937

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GOLF COURSE ROAD PARKING AREA AND BIOFILTRATION SYSTEM
GOLF COURSE ROAD
NEW BRAUNFELS, TX. 78130

STANDARD DETAIL
SHEET 1

PLOTTED: Dec 20, 2024 - 9:46am
Designed: JC
Drawn: ZR
Reviewed: JC
Issue Date: 7/19/24

SHEET
13
OF 13

Project No.:
24004114.001A

Drawing: C:\pwworking\klf-dct-prod\zridge\d0198322\24004114.001A SH DT.dwg
User: ZRIDGE
Last Modified: Dec. 19, 24 - 17:05
Plot Date/Time: Dec. 20, 24 - 09:46:08