Tate's Hell State Forest Hydrologic Restoration Plan

Volume II: Basin Restoration Plans 2010 - 2020

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Overview

In this volume, hydrologic restoration plans are presented for each of the 29 surface water drainage basins located in Tate's Hell State Forest. Restoration plans include a description of the historical ecological communities types and current conditions within each basin, a description of the proposed hydrologic improvements needed to restore historical surface water drainage patterns, estimated construction costs for the proposed improvements, and recommendations for habitat enhancements such as pine thinning, prescribed burning, and shrub reduction. For each surface water basin, the hydrologic restoration plan includes three figures: (1) the type and distribution of historical ecological communities together with the proposed hydrologic improvements, (2) current land cover conditions, proposed hydrologic improvements, and anticipated post-restoration drainage patterns, and (3) LiDAR elevation data (topography), proposed hydrologic improvements, and anticipated post-restoration drainage patterns. Proposed hydrologic improvements include road removals, low water crossings, bridges, box culverts, ditch blocks, flashboard risers, and culvert modifications.

Preliminary field reconnaissance of the proposed hydrologic improvements has been performed in most basins. However, due to the large area encompassed by Tate's Hell State Forest and the number of proposed hydrologic improvements (>1,200), it was not possible to field verify every location. Additionally, site conditions are anticipated to change over time in response to hydrologic restoration and Division of Forestry land management activities. As a result, additional engineering design, permitting, topographic surveys, and other tasks may be needed prior to initiating construction activities or habitat improvements associated with hydrologic restoration projects. It is strongly recommended that a detailed field reconnaissance be performed in each project area prior to finalizing the design and construction plans. During the field reconnaissance, the dimensions, materials and other specifications can be determined for proposed structures (e.g. culverts, low water crossings, and flashboard risers). Additional engineering design and analysis will be required for bridges.

The historical vegetation maps delineated by the Florida Natural Areas Inventory (FNAI 1997 and 2000) serve as a guideline for desired future habitat conditions and in most cases, target ecological conditions will be based on the historical ecological communities. In some areas, however, the ecological community type that is achievable may differ from the historical ecological community delineated by FNAI due to site-specific conditions or constraints. It is recommended that baseline ecological conditions be reviewed in the field and that target ecological community types be specified prior to finalizing the restoration goals and completing the engineering design and construction plans for specific hydrologic restoration projects.

Due to the large size of Tate's Hell State Forest and the extensive degree of hydrologic impacts, restoration is anticipated to be a gradual and incremental process. Hydrologic and habitat improvements will accrue over time as restoration and land management activities continue to be implemented during the next five to 20 years or more. To date, approximately a dozen wetland restoration projects have been implemented within Tate's Hell State Forest by various public agencies and private entities. Future restoration activities will build upon these efforts.

Approach used to Develop Hydrologic Restoration Plans

The development of hydrologic restoration plans involved several steps. First, a GIS-based review and analysis of each basin was performed by NWFWMD staff. Based on the GIS-based review, strategies were developed to restore historical surface water drainage patterns to the greatest extent possible in light of current site conditions. The locations of potential hydrologic improvements such as low water crossings, ditch blocks, flashboard risers, and culvert modifications were identified. Field reviews were conducted to check most road removal and low water crossing locations. The locations of some ditch blocks, flashboard risers, and culverts were also verified in the field. Based on the findings of the field reviews, appropriate revisions were made to the basin restoration plans.

Preliminary hydrologic restoration plans for each basin were then reviewed with the Division of Forestry. Forestry staff has extensive knowledge of past and current site conditions, existing and planned recreational sites, road access needs, firebreak locations, and timber management activities. Forestry staff made certain that hydrologic restoration activities would not adversely impact other uses of the property. Following discussions with Forestry staff, the preliminary hydrologic restoration plans were revised and final plans were created for each basin.

Recommended Hydrologic Improvements

NWFWMD staff reviewed the following data during the initial GIS-based review: (1) Aerial photography for 1953, 2004, and 2007, (2) hydrologic basin boundaries (3) 2007 LiDAR elevation data, (4) Vegetation Management Guidelines for the Tate's Hell State Forest (DOF and FNAI 2001), (5) 2000-2001 forest stand inventory data, (6) historical ecological communities delineated by the Florida Natural Areas Inventory (FNAI 1997 and 2000), (7) locations of Red-cockaded Woodpecker clusters, (8) road attributes, (9) culvert attributes, and (10) locations of OHV trails, primitive campsites, and other recreational facilities.

Hydrologic basin boundaries obtained from the Natural Resources Conservation Service were revised based on the 2007 LiDAR elevation data obtained for Franklin County and Liberty County. Because of the extensive network of ditches and the large number of existing culverts (more than 800), surface water flows can be conveyed across topographic basin boundaries. As a result, the basin boundaries may need to be further refined as additional data regarding surface water drainage patterns become available.

Additional factors considered when recommending locations for specific types of hydrologic improvements are discussed below.

Road Removals

Road removals involve using bulldozers or other heavy equipment to excavate and recontour a segment of a dirt logging road to match the adjacent natural grade. The excavated road material is used to fill in adjacent drainage ditches. Road removals have been proposed in selected areas where existing roads bisect existing or former wetlands and streams and where roads have altered natural surface water drainage patterns. Road removals were generally limited to areas where both sides of the road are unsuitable for long-term timber management and where pines are currently absent or will be thinned within the next five to ten years. Due to the Division of Forestry's need to maintain vehicle access across Tate's Hell State Forest, road removals have not been proposed on primary or secondary roads, the blue OHV trail, or roads leading directly to campsites.

Figure 1. Road removal footprint following one year of vegetation regrowth.

Low Water Crossings

Low water crossings have been proposed in areas where it is desirable to maintain road access while also restoring surface water flows in streams or wetlands. The construction of a low water crossing involves lowering a segment of the road to match the natural wetland or stream grade. A geotextile topped with coarse aggregate material is placed in the center of the crossing to enable vehicle access while also allowing water to flow perpendicular to the travel lane. Rock aprons are installed on either side of the travel lane to prevent erosion of the crossing. Locations for low water crossings were identified by reviewing locations were streams and wetlands are bisected by roads.

Figure 2. Low water crossing

Road attributes and LiDAR land surface elevations were also reviewed. In some instances, existing culverts are proposed to be replaced with low water crossings to increase conveyance capacity and restore channel morphometry. Due to the need to maintain year-round vehicle access, low water crossings have generally not been proposed on primary roads or roads leading directly to campsites.

Ditch Blocks and Flashboard Risers

Ditch blocks and flashboard risers are proposed where it is desirable to reduce, redirect, or prevent surface water flow in roadside ditches. Ditch blocks also may be used to restore local topographic features or to prevent ditch flow across hydrologic basins. The construction of a ditch block involves placing fill material in a ditch, compacting the material, and seeding and mulching the ditch block top surface and side slopes with native grasses to prevent erosion. Ditch blocks are generally constructed using onsite soil materials such as road fill excavated during the construction of low water crossings.

Figure 3. Earthen ditch block

Flashboard risers can be thought of as a culvert with an adjustable weir structure. Flashboard risers offer more flexibility than ditch blocks because boards can be added or removed to regulate surface water flow in response to hydrologic conditions and land management needs. Flashboard risers may be preferable to ditch blocks in areas where it is desirable to maintain the ability to convey flows through ditches under certain conditions.

Figure 4. Recently installed culvert

Culvert Modifications

Culverts modifications include the installation of new culverts and the replacement or removal of existing culverts. The evaluation of recommended culvert modifications focused on adding culverts to re-connect contributing drainage areas and removing culverts that transfer water across historical basin boundaries. Some but not all of the more than 800 existing culverts were examined in the field. There are likely numerous culverts in need of replacement that are not included in the hydrologic restoration plans.

Bridges and Box Culverts

Several locations for box culverts and small bridges also have been proposed. Bridges may be proposed in areas where the existing culverts have insufficient capacity to convey streamflows or where it is desirable to restore a more natural stream channel. Box culverts may be proposed in lieu of bridges for smaller stream crossings or for wetland sloughs.

Construction Cost Estimates

Estimates of construction costs are provided for the recommended hydrologic improvements in each surface water basin. The total construction cost reflects the sum of the costs of individual improvements rounded to the nearest ten thousand dollars. Unit costs for hydrologic improvements are based on bids received in 2009 for restoration activities at Tate's Hell State Forest (Table 1). Unit costs reflect the sum of labor and materials. Because unit costs reflect average values, actual construction costs will differ due to differences in pipe sizes and the dimensions of low water crossings and ditch blocks. Labor and materials costs fluctuate from year to year due to changes in market conditions. Costs for associated habitat improvements (e.g. prescribed burning, replanting, and shrub reduction) have not been included. Some of these activities are conducted by the Division of Forestry. Additionally, it is difficult to determine the habitat improvements needed for a particular project as it will depend on the site conditions encountered immediately prior to project implementation. For these reasons, costs should be viewed as planning level estimates.

Table 1. Unit costs for hydrologic improvements (2009 dollars)

Hydrologic Improvement	Unit	Unit Cost
Low water crossing	Each	$15,000
Road removal	Per mile	$17,000
Culvert installation	Each	$5,000
Culvert removal	Each	$450
Flashboard riser	Each	$6,000
Ditch block	Each	$2550
Box culvert / weir	Each	$40,000
Bridge	Each	$100,000

Grouping of Surface Water Drainage Basins

Figure 5 is a map of the surface water drainage basins in the vicinity of Tate's Hell State Forest. Due the large number of basins, some smaller basins in the same geographic area have been grouped together for the purpose of presenting the hydrologic restoration plans. Hydrologic restoration plans are presented for 15 basins or groups of basins.

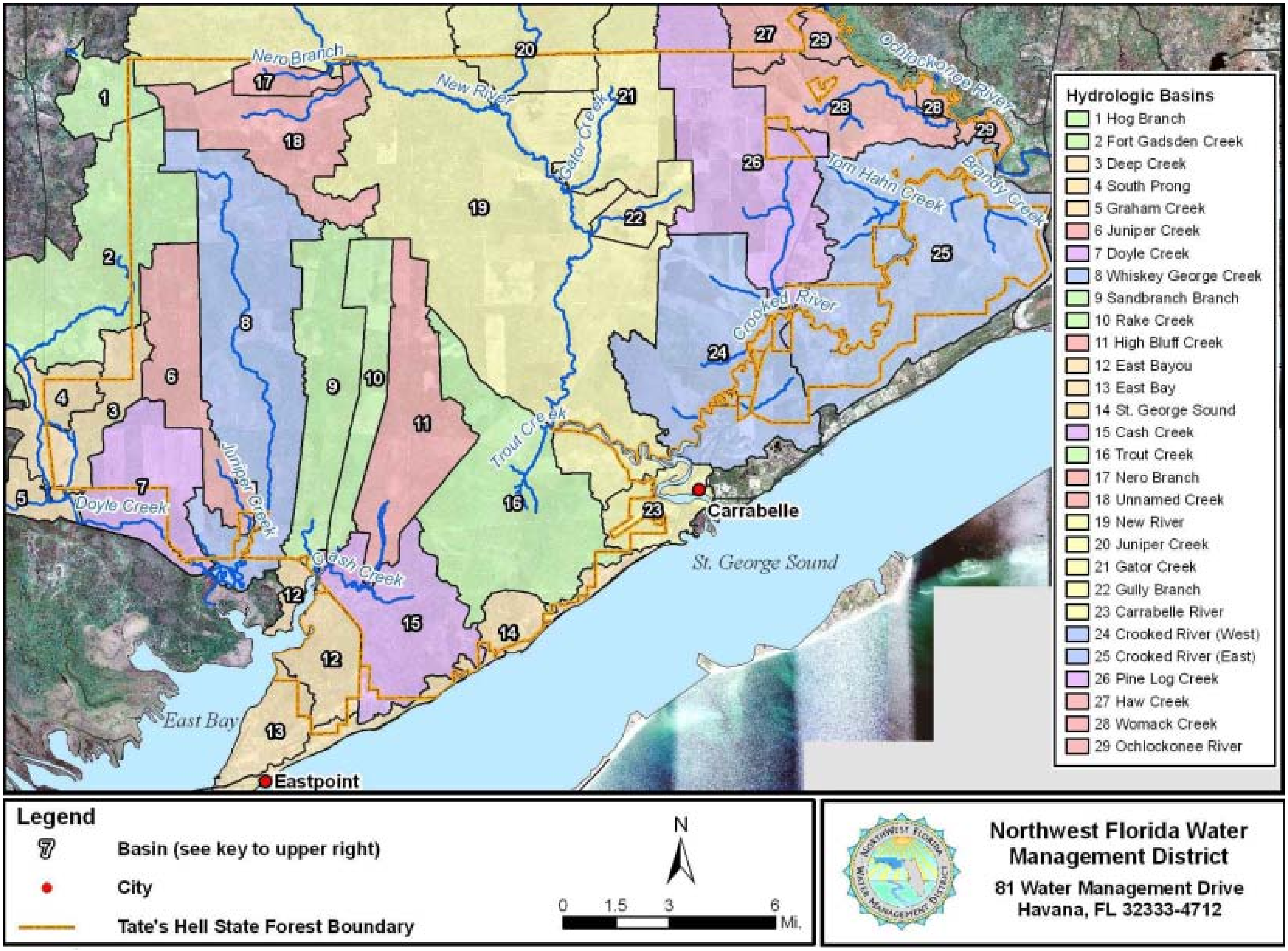

Figure 5. Surface water basins grouping used to present the hydrologic restoration plans.

Hydrologic Restoration Plans

Hog Branch and Fort Gadsden Creek

Restoration Priority: High

Basin Area: 18,349 acres (including areas outside Tate's Hell)

Description: Approximately one-third of the Fort Gadsden Creek drainage basin lies within Tate's Hell State Forest. Historical ecological communities in this basin included cypress flats, basin swamps, and wet savanna pine-flatwood mosaics, with cypress strands comprising the stream corridor (Figures 6 and 7). The general direction of surface water flow in the basin is to the south and west.

The majority of the 2,900 acre Hog Branch basin lies within the Apalachicola National Forest. Only about 450 acres lie within Tate's Hell State Forest. Hog Branch drains into Black Creek which then flows into Rowlett Creek and eventually to the Apalachicola River. The historical ecological communities in the portion of the Hog Branch basin within Tate's Hell consisted mostly of mesic flatwoods. A former 12-acre cypress wetland is now bisected by West Boundary Road.

Similar to other basins, the road construction and conversion to pine plantation that occurred in this area during the 1960s and 1970s significantly altered natural habitats and disrupted surface water drainage patterns. Most of the former wet savannas and natural pine flatwoods were converted to dense stands of planted slash pines. Many historical basin swamps now have a very dense tree canopy that may include pockets of planted pines. Because of the surface water drainage alterations, some habitats are likely wetter than they were historically. Additionally, some areas that now drain towards the south likely drained towards the west prior to the construction of West Boundary Road. As noted previously, the boundary between the Fort Gadsden Creek and Juniper Creek basins is not well-defined, particularly in the vicinity of West Boundary Road.

Restoration activities in the Fort Gadsden Creek basin include the removal of road segments and adjacent ditches in the northern corner of the basin as part of the Whiskey George Savannas Restoration Project implemented by the NWFWMD in 2009. A low water crossing was also constructed as part of this project to reconnect a historical cypress slough. An existing low water crossing is located farther downstream. Post construction monitoring conducting during the spring of 2010 indicates the low water crossings are conveying surface water flows and that wetland vegetation has begun colonizing the road removal areas.

2010 – 2020 Hydrologic Restoration Plan: Future restoration activities are aimed at decreasing surface water flows in the roadside ditches and re-establishing historical surface water drainage patterns. Because West Boundary Road is a primary road, installing additional low water crossings or removing segments of this road has not been recommended. However, five new culverts are proposed across West Boundary Road to improve hydrologic connectivity and enhance the conveyance of surface water flows towards the west (Figures 6 through 11).

North of Gully Branch Road, three low water crossings and a 0.46-mile segment of road removal are proposed to restore natural drainage patterns and reconnect a series of forested basins swamps (Figures 6 and 8). Because some of these low water crossings will reconnect relatively shallow wetland systems, they may only contain water during high rainfall periods. South of Gully Branch Road, three culverts are proposed across West Boundary Road to reconnect a cypress wetland system that has been severed by the road (Figures 7 and 9). A flashboard riser will reduce southerly flow in the large ditch on the west side of West Boundary Road. In total, 11 ditch blocks are proposed to be constructed in association with the proposed culverts and low water crossings.

Because much of the vegetation is very dense throughout this basin, two or more cycles of pine thinning will be needed in most areas to achieve appropriate tree densities. Titi shrub reduction is also needed throughout much of the basin. Most of the existing road network is anticipated to be maintained through 2020 to facilitate tree thinning, prescribed burning and shrub reduction activities. As pines are thinned to appropriate densities, additional road removals should be considered.

Due to the wet conditions throughout much of this basin, relatively few areas are suitable for long-term timber production. However, the proposed hydrologic improvements will restore more natural surface water drainage patterns and may improve conditions for planted pines.

Estimated Construction Cost for Hydrologic Improvements: $ 140,000

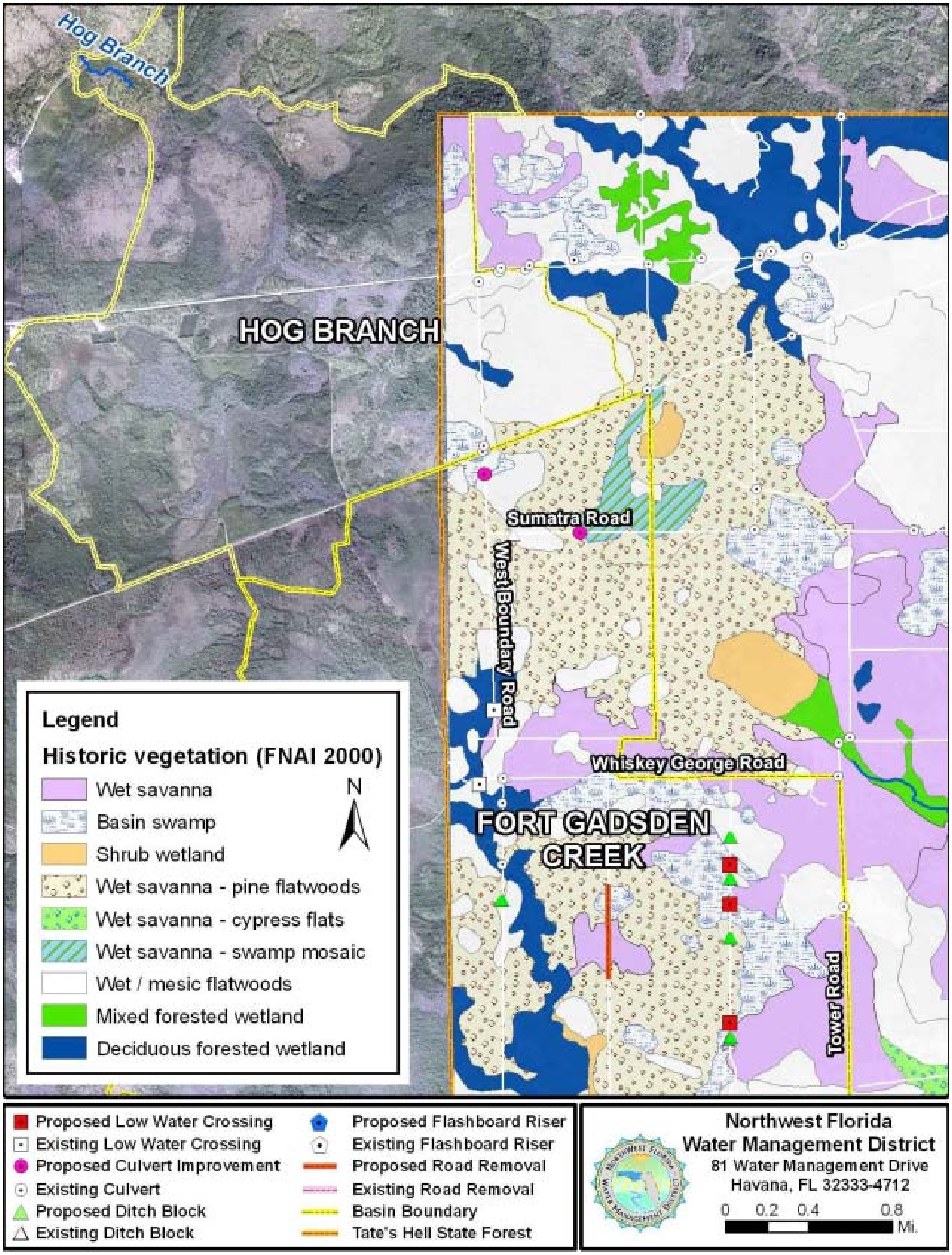

Figure 6. Historical ecological communities and proposed hydrologic improvements in the Hog Branch basin and the northern portion of the Fort Gadsden Creek basin.

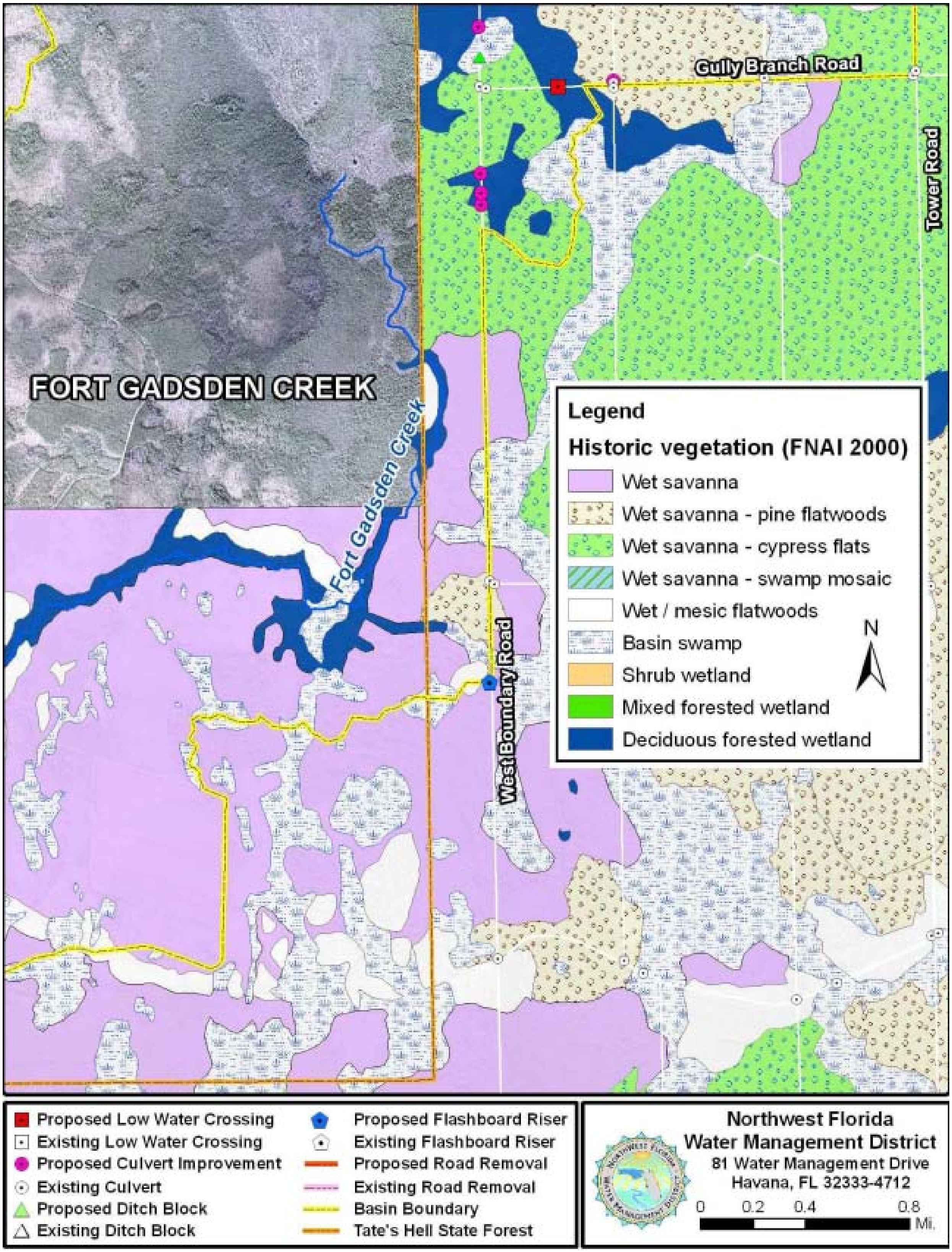

Figure 7. Historical ecological communities and proposed hydrologic improvements in the southern portion of the Fort Gadsden Creek basin

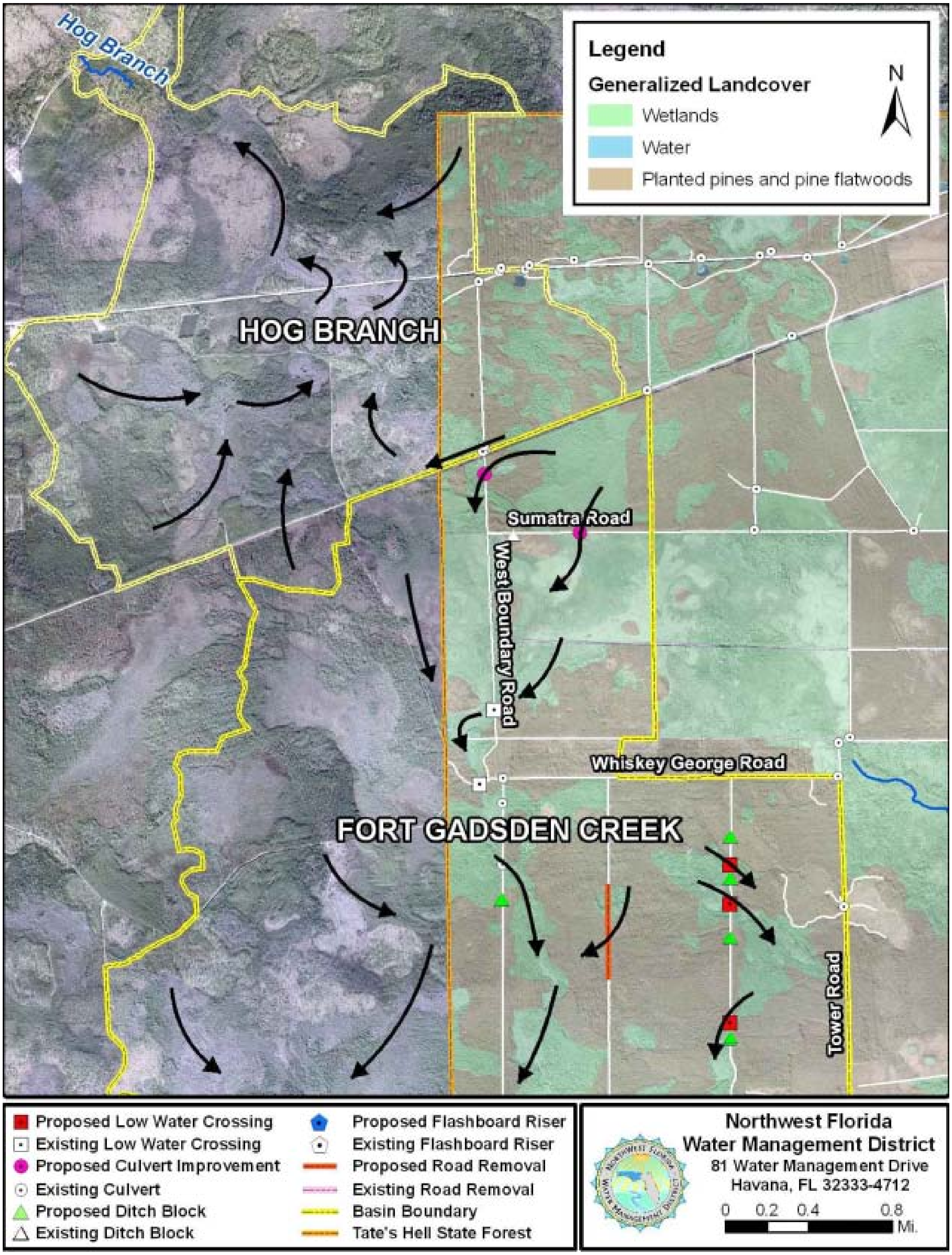

Figure 8. Proposed hydrologic improvements and post-restoration drainage patterns in the Hog Branch basin and the northern portion of the Fort Gadsden Creek basin.

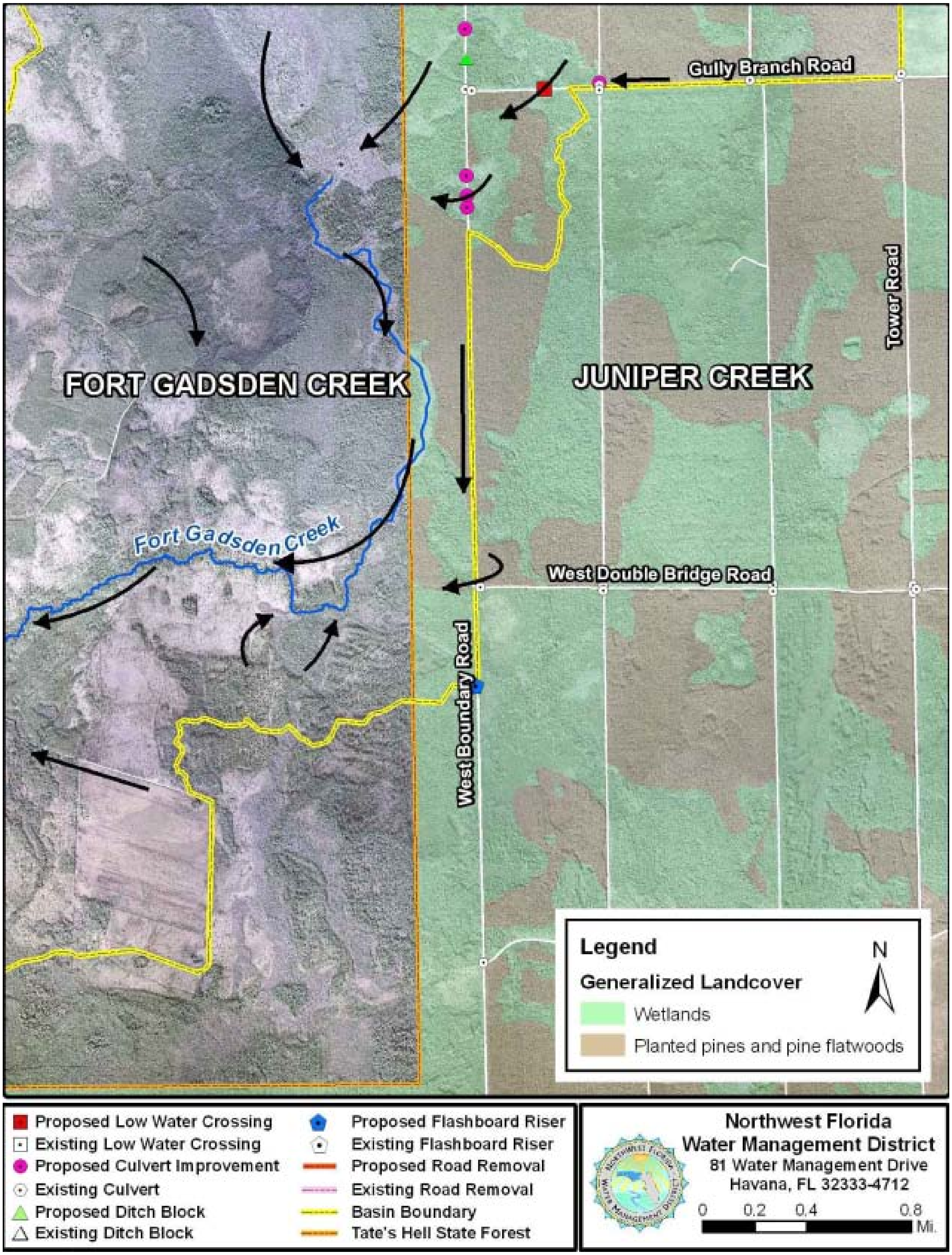

Figure 9. Proposed hydrologic improvements and post-restoration drainage patterns in the southern portion of the Fort Gadsden Creek basin

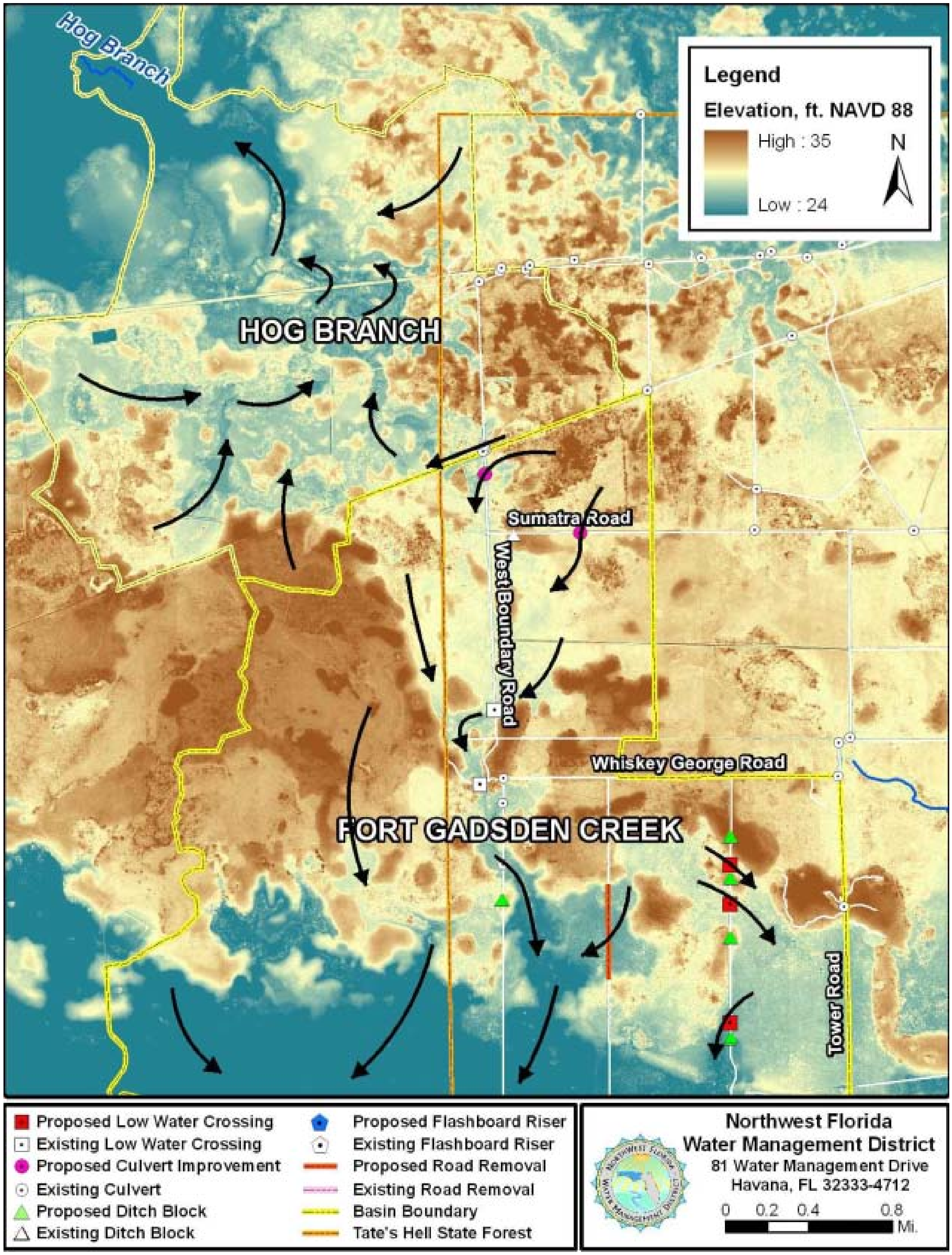

Figure 10. LiDAR elevation data, proposed hydrologic improvements and post-restoration drainage patterns in the Hog Branch basin and the northern portion of the Fort Gadsden Creek basin.

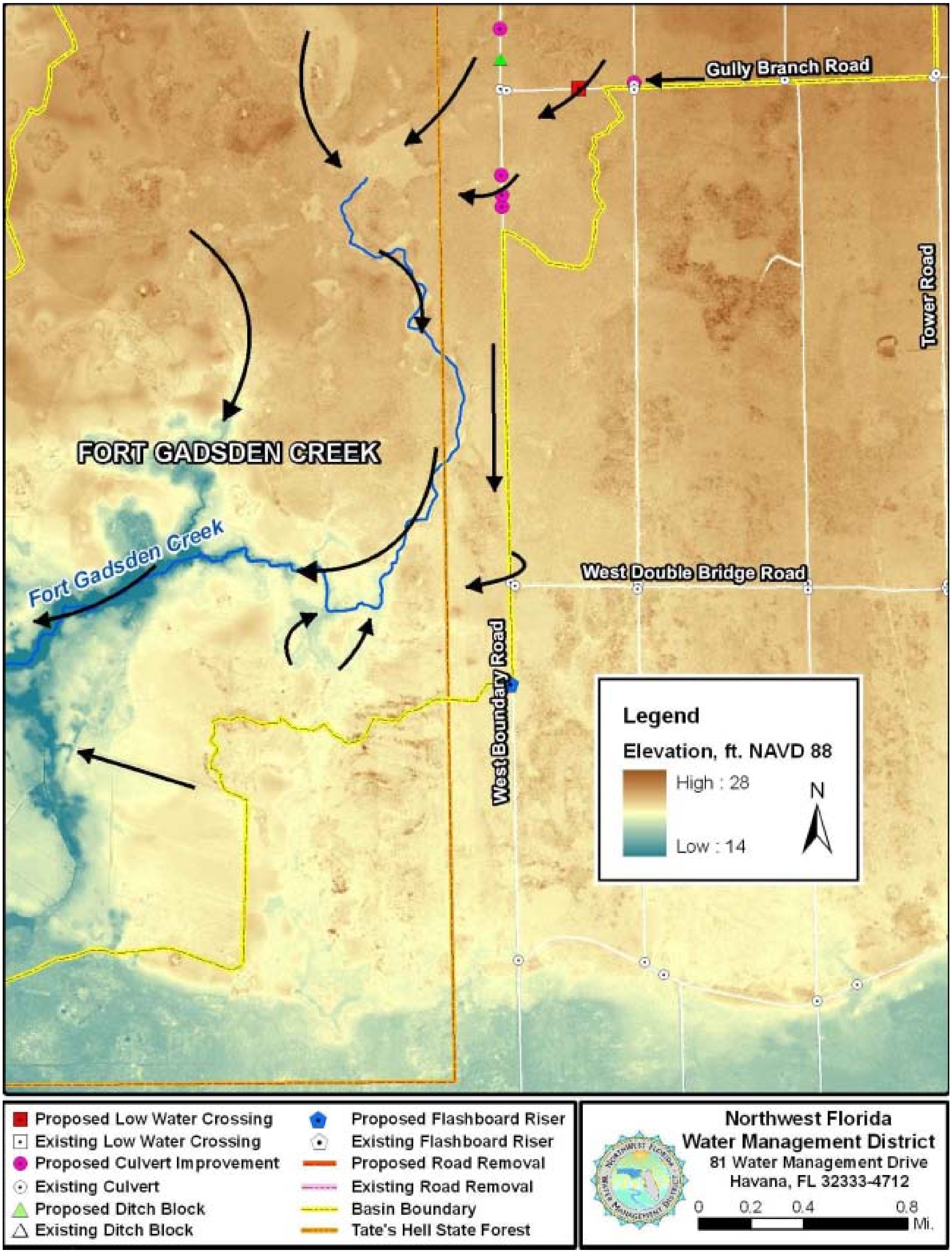

Figure 11. LiDAR elevation data, proposed hydrologic improvements and post-restoration drainage patterns in the southern portion of the Fort Gadsden Creek basin.

Deep Creek, Graham Creek, and the South Prong Basins

Restoration Priority: High

Basin Area: 8,600 acres (three basins combined, including areas outside Tate's Hell)

Description: Prior to the conversion of native habitats to pine plantation, surface water runoff in these basins flowed west and south across wet savannas, basin swamps, and pine flatwoods before eventually discharging to Deep Creek, Graham Creek, and the South Prong (Figure 12). Deep Creek and the South Prong flow into Graham Creek, which then flows west to the Apalachicola River. Both Graham Creek and the South Prong are tidally influenced. As a result, the basin boundaries, flow directions, and flow velocities may vary with time depending on tidal conditions.

The construction of the network of dirt logging roads and adjacent ditches during the 1960s and 1970s altered surface water drainage patterns and impacted natural ecological communities. Today, much of the runoff is conveyed to large ditches located on Deep Creek Road, West Boundary Road, Buck Siding Road. There have been few hydrologic restoration improvements in these three basins. Existing water control structures include a bridge across Deep Creek, a small low water crossing on Deep Creek Road, and numerous culverts. There is also a flashboard riser on the northwest corner of the West Boundary Road and North Loop Road; however, it is not known whether this structure has been operated in recent years.

2010 – 2020 Hydrologic Restoration Plan: The proposed hydrologic restoration activities will re-establish hydrologic connections, reduce ditch flow, and restore more natural surface water drainage patterns. Proposed improvements include three low water crossings along the Loop Road in the Deep Creek and South Prong basins (Figures 12 through 14). This road is frequently overtopped with water and the proposed crossings will restore natural flow patterns between wetlands while maintaining vehicle access. Three ditch blocks should be installed in conjunction with the low water crossings to direct water towards the crossings and prevent the water from bypassing the crossings and continuing to flow downstream in ditches. Additionally, three new culverts are proposed in the Deep Creek basin to reconnect contributing drainage areas to the creek.

Recommended habitat improvements include shrub (e.g. titi) reduction in the area immediately east of Deep Creek. Pine thinning should be continued in all three basins to restore appropriate tree densities in historical wetlands that were converted to pine plantation. Areas best suited for long-term timber production consist of the wet and mesic flatwoods located south of Buck Siding road. The Division of Forestry should continue with the prescribed burning activities at appropriate intervals to maintain optimal habitat conditions.

Estimated Construction Cost for Hydrologic Improvements: $70,000

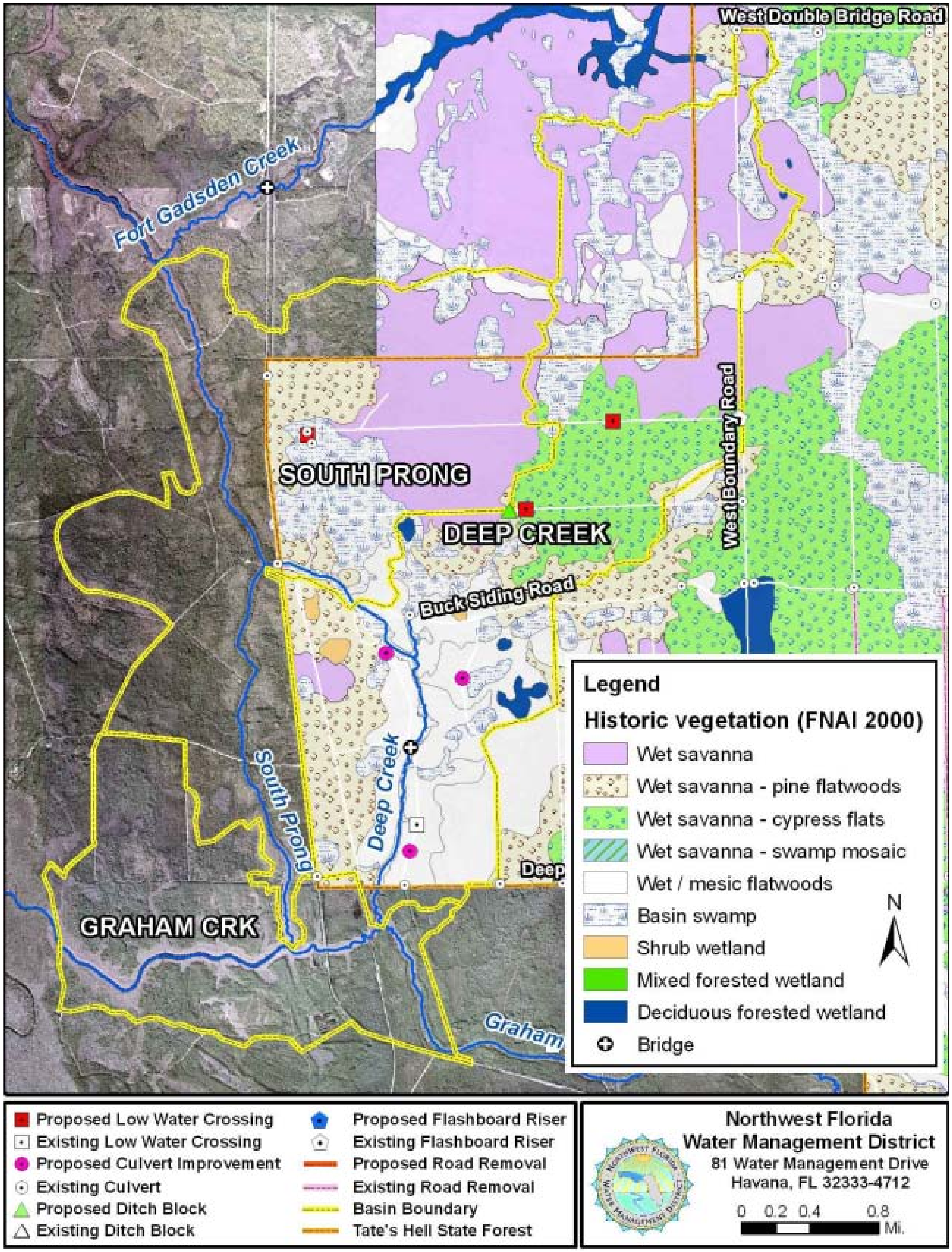

Figure 12. Historical ecological communities and proposed hydrologic improvements in the South Prong, Deep Creek, and Graham Creek basins

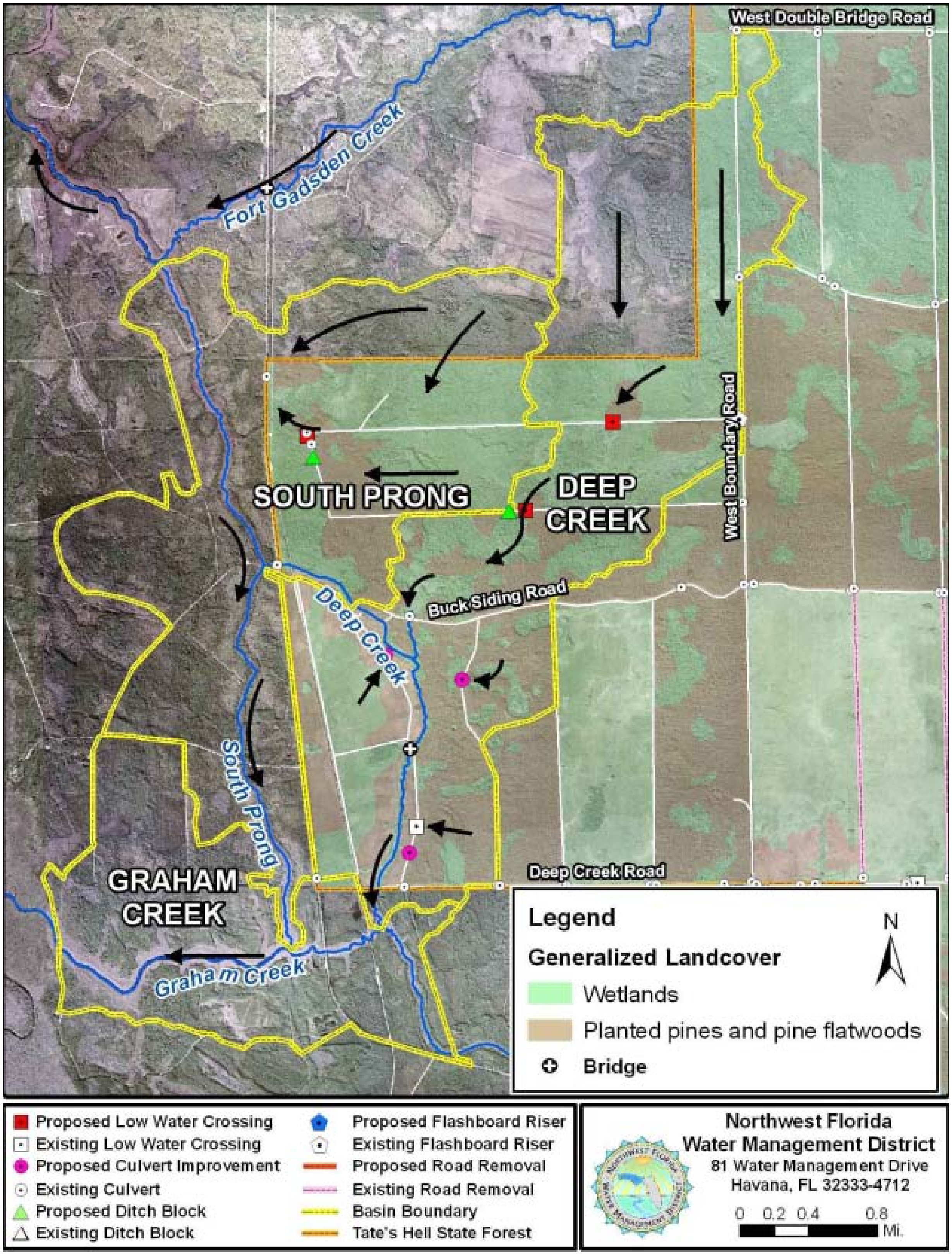

Figure 13. Proposed hydrologic restoration activities, current landcover, and post-restoration drainage patterns in the South Prong, Deep Creek, and Graham Creek basins

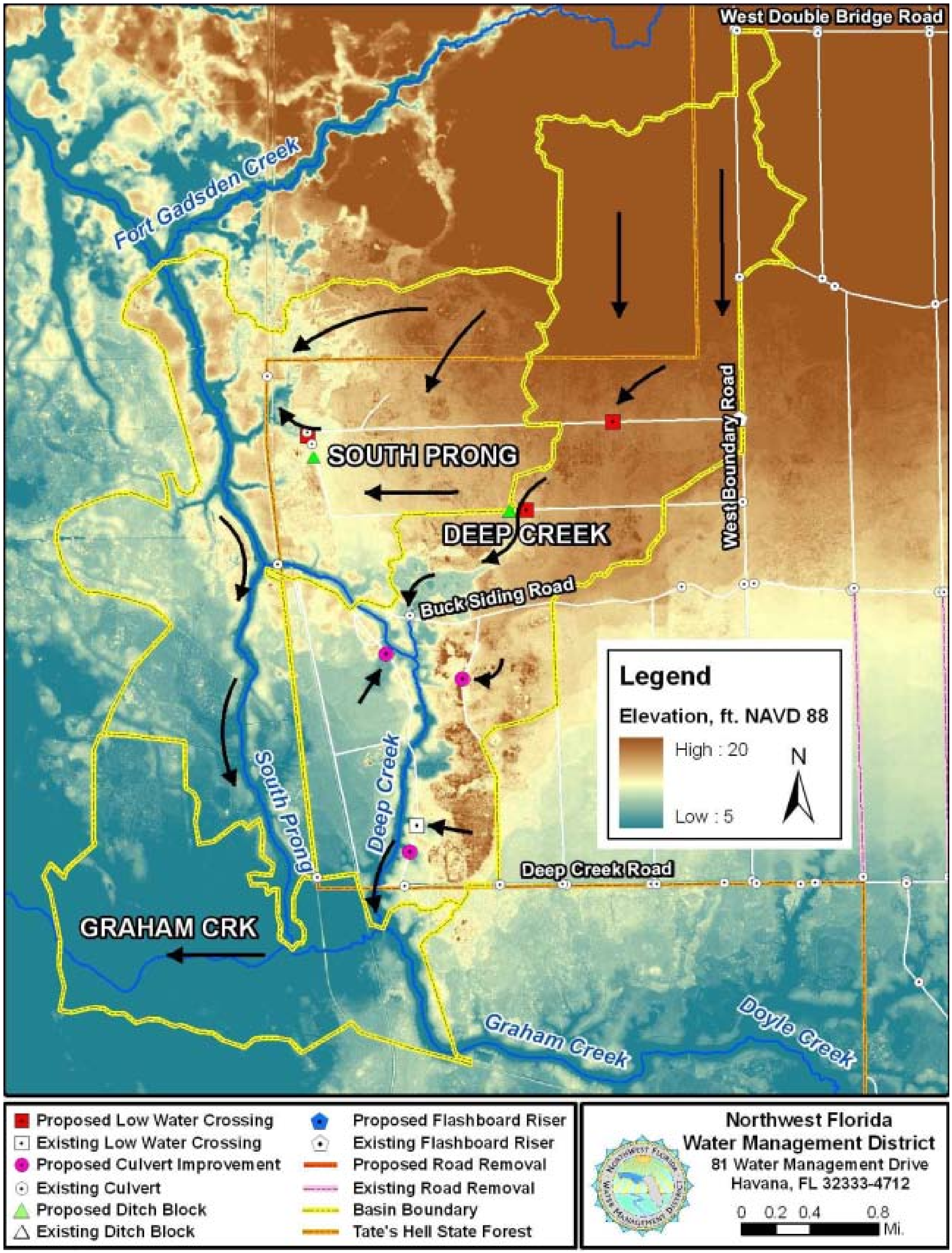

Figure 14. LiDAR elevation data, proposed hydrologic improvements and post-restoration drainage patterns in the South Prong, Deep Creek, and Graham Creek basins.

Doyle Creek

Restoration Priority: High

Basin Area: 7,300 acres

Description: Doyle Creek flows south and east and discharges to Whiskey George Creek, which subsequently flows into the West Bayou of East Bay. Because East Bay serves as the primary nursery area for the Apalachicola Bay system, basins which discharge surface water runoff into East Bay are a high priority for hydrologic restoration. Surface water runoff generated within the Doyle Creek basin currently flows to large drainage ditches located along West Boundary Road, Buck Siding Road and Deep Creek Road. Surface water runoff generally flows east and south in the basin and eventually discharges towards the creek through several large culverts and a low water crossing on Deep Creek Road.

Historically, the Doyle Creek drainage basin was comprised mostly of wet savanna – cypress flats, deciduous forested wetlands, and wet savanna pine flatwood mosaic (Figure 15). The wet savanna-cypress flats habitat is described by the Florida Natural Areas Inventory as having widely spaced cypress and slash pines with an abundant woody and herbaceous understory (FNAI 2000). It can be thought of as transitional community between wet savanna and cypress swamp (FNAI 2000). The extensive network of logging roads and ditches was constructed during the 1960s and 1970s and most of the basin was converted to slash pine plantation. The planted pines located between West Boundary Road and Tower Road were clearcut by the Division of Forestry during 1998 and 1999 and the area was chopped and burned as the first phase of restoration in this basin.

The historical surface water drainage patterns in this basin have been largely restored. In 2005, the NWFWMD installed three low water crossings and restored more than 1,700 acres of wet savanna and cypress flats by removing 3.4 miles of logging roads and adjacent ditches (Figure 16). The former road footprints were planted with cypress seedlings and wiregrass. The Florida Fish and Wildlife Conservation Commission (FWC) also installed several low water crossings south of Tate's Hell State Forest to restore historical surface water drainage patterns in the Doyle Creek basin.

2010 – 2020 Hydrologic Restoration Plan: The proposed additional hydrologic improvements include three flashboard risers, three culverts, and three ditch blocks (Figure 15 through 17). The flashboard risers are intended to reduce the easterly flow of water in the large ditch on the north side of Deep Creek Road. The new culverts will reconnect and redirect ditch flow towards historical wetland sloughs and basin swamps that drain to Doyle Creek. The ditch blocks will reduce ditch flows and increase surface water flow through a proposed culvert and an existing low water crossing.

A road closure is proposed in the southern portion of the basin immediately to the west of Doyle Creek Road. The existing road is at natural grade and has no adjacent ditches. Once the road is closed to vehicle access, it is anticipated that wetland vegetation will naturally recolonize the road footprint. There is also a 0.4-mile segment of road proposed for removal north of Deep Creek Road. This road removal will help to restore a former wet savanna – cypress flats wetland community. An additional road removal is proposed by the FWC on their property to the south.

There are relatively few areas suitable for pine management within this basin. They generally consist of scattered mesic flatwoods and the drier portions of wet savanna – pine flatwoods mosaics. The maintenance of an appropriate fire regime through prescribed burning will be necessary to restore and maintain historical ecological communities, particularly the wet savanna – cypress flats and wet savannas.

Estimated Construction Cost for Hydrologic Improvements: $50,000; excludes hydrologic improvements on the FWC property.

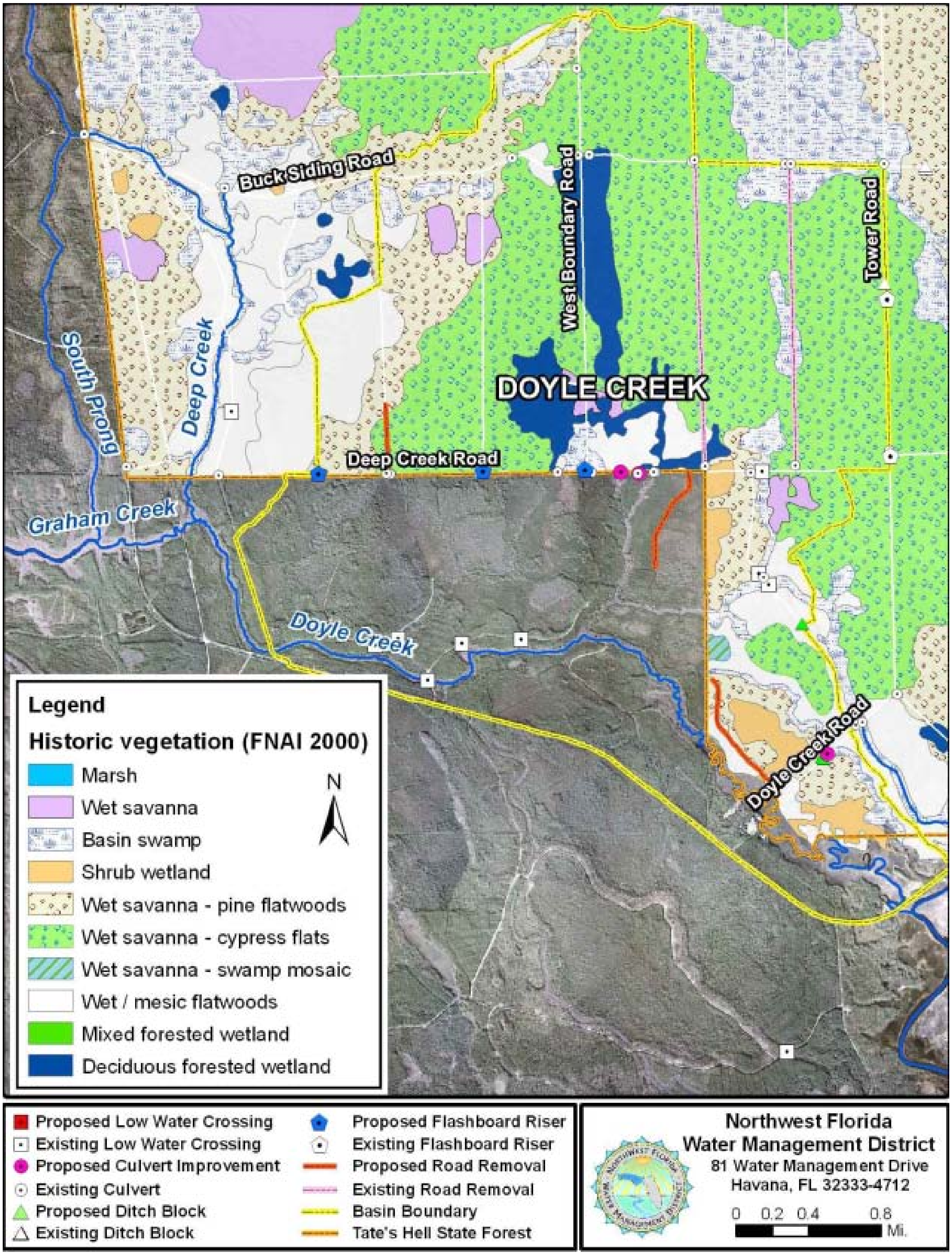

Figure 15. Historical ecological communities and proposed hydrologic improvements in the Doyle Creek basin

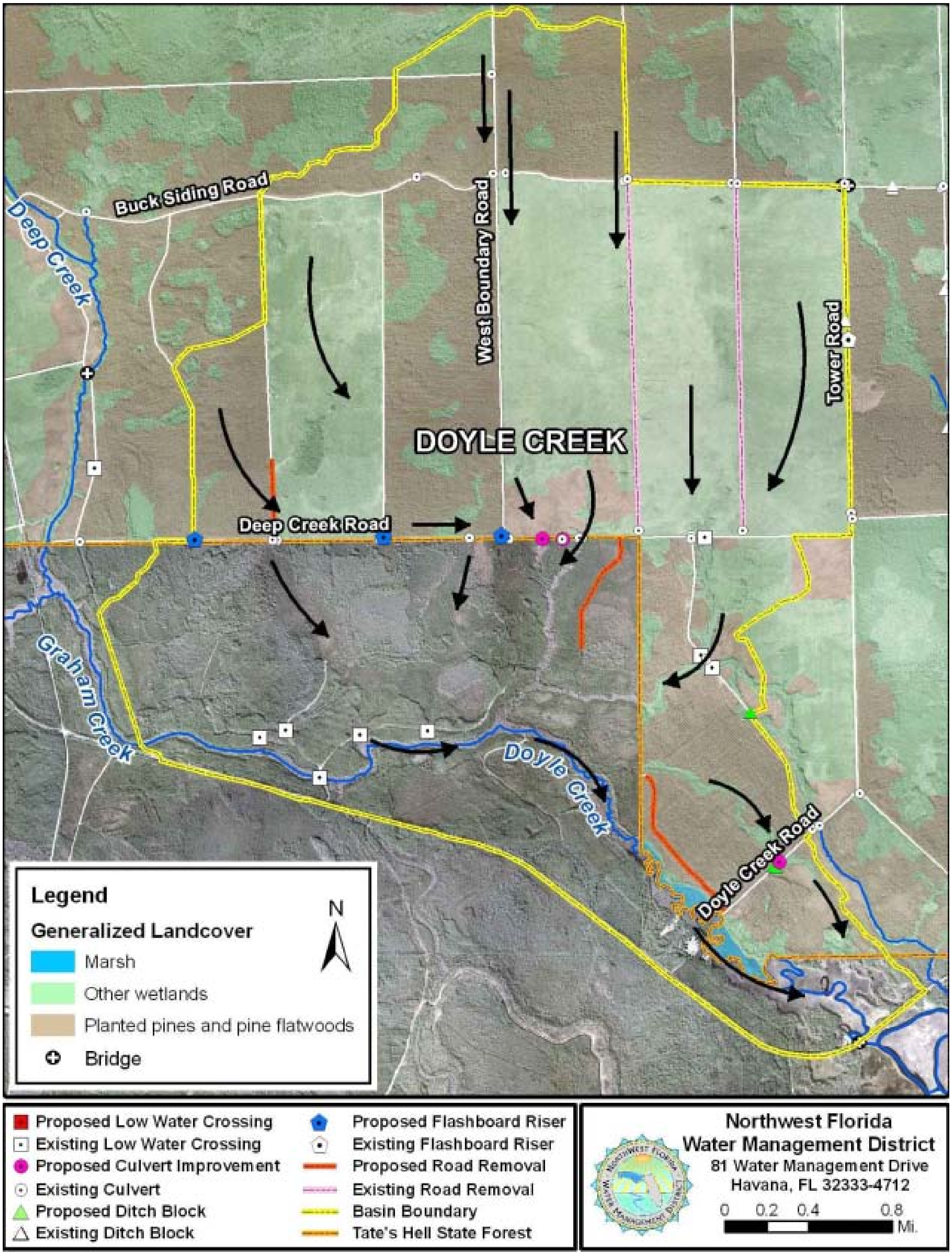

Figure 16. Proposed hydrologic restoration activities, current landcover, and post-restoration drainage patterns in the Doyle Creek basin

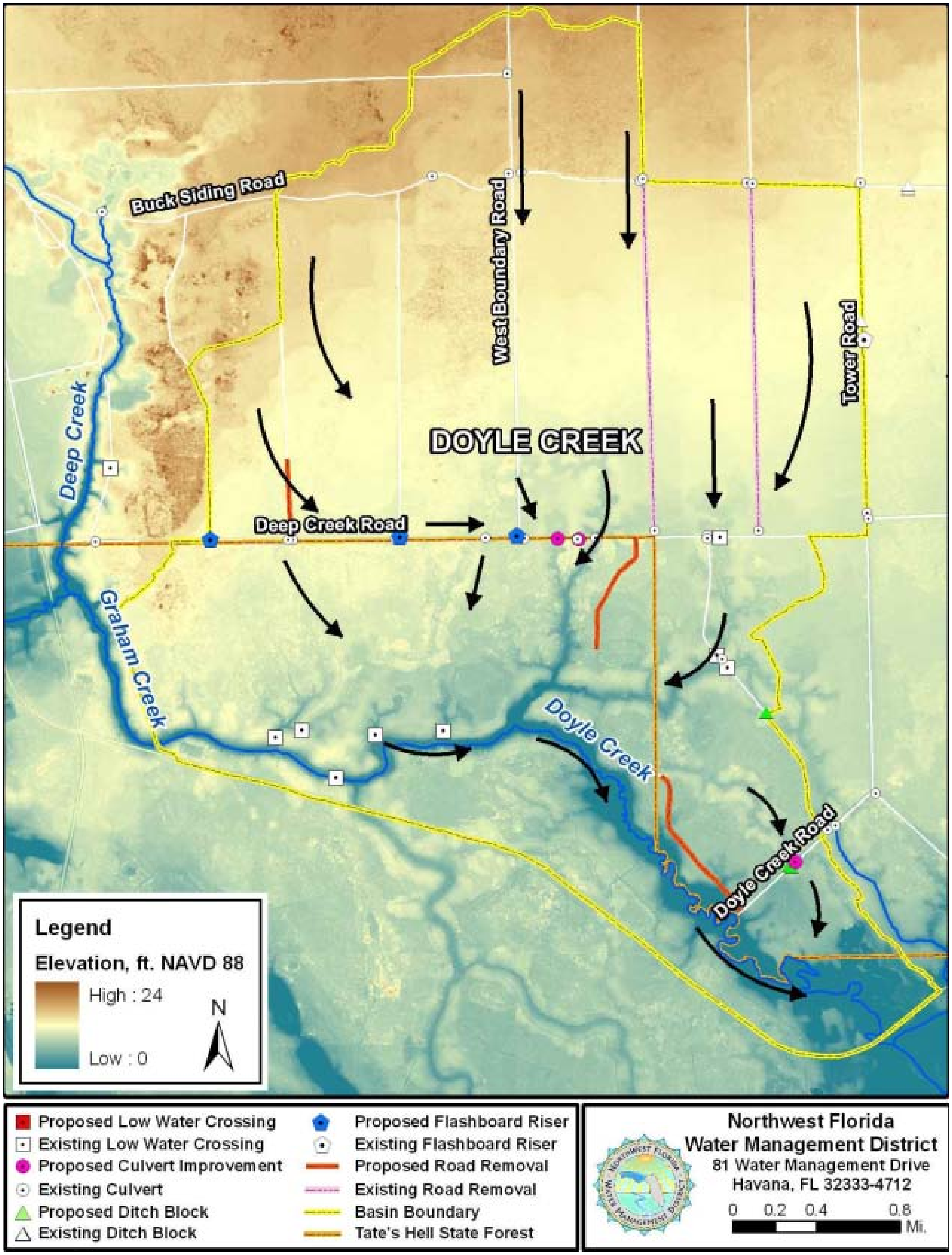

Figure 17. LiDAR elevation data, proposed hydrologic improvements and post-restoration drainage patterns in the Doyle Creek basin

Juniper Creek

Restoration Priority: High

Basin Area: 6,800 acres

Description: There are two streams named Juniper Creek within Tate's Hell State Forest. This Juniper Creek basin is located southwest of Whiskey George Creek. This basin is a long and relatively narrow watershed totaling approximately 6,800 acres. At the southern end of the watershed, Juniper Creek flows into Whiskey George Creek, which then flows into the West Bayou of East Bay.

Historical ecological communities were comprised of basin swamps and wet savanna – cypress flats, with scattered pine flatwoods and savannas (Figures 18 and 19). The headwaters of Juniper Creek are formed by a series of wetlands and basin swamps located north of Buck Siding Road. Today, most of the basin consists of densely planted pines and basin swamps, with some mixed forested wetlands located north of Evans Lake Tram Road (Figures 20 and 21). The basin swamps located north of Buck Siding Road have a dense forest canopy comprised primarily of bays, Atlantic white cedar and titi mixed with planted pines and scattered cypress trees.

The basin divide between the Juniper Creek and Fort Gadsden Creek basins is not well-defined. Natural drainage patterns have been altered by the construction of West Boundary Road. Some of the surface water runoff that currently flows south along West Boundary Road probably once flowed west towards Fort Gadsden Creek. However, because West Boundary Road is classified as a primary road that is needed for year-round access for forest management and recreational activities, installing low water crossings or removing segments of this road to restore surface water drainage towards the west has not been recommended.

2010 – 2020 Hydrologic Restoration Plan: Proposed hydrologic improvements in the Juniper Creek basin include the installation of ten low water crossings and associated ditch blocks to reconnect the series of basin swamps and forested wetlands that comprised the historical stream channel (Figures 18 through 23). A 0.4-mile road segment that bisects one of these basin swamps is proposed for removal (Figure 19). Four new culverts are proposed to restore surface water drainage patterns to the east across Tower Road (three 24-in culverts) and to the south across Buck Siding Road (one 36-in culvert) (Figures 19, 21, and 23). There are two existing bridges at the intersection of the Tower Road and Buck Siding Road that currently convey water to the south. The proposed culverts across Tower Road and Buck Siding Road are intended to restore southerly flows in the former stream channel that is located immediately east of this intersection.

In the southern portion of the Juniper Creek basin, the Franklin County School Board implemented a wetland restoration project to satisfy mitigation requirements for offsite construction activities. Their project involved the removal of a short section of road, and the installation of a low water crossing, a flashboard riser, and several ditch blocks (see existing structures in southern portion of the basin). Additional hydrologic improvements proposed in this area include a low water crossing and two associated ditch blocks, which will reconnect a basin swamp to the stream corridor (Figures 19, 21, and 23).

Recommended habitat improvements include shrub (titi) reduction and the continued thinning of densely planted pines east of Tower Road and north of Evans Lake Tram Road. Prescribed burning will continue to be required to maintain historical ecological communities. Flatwoods areas suitable for pine management are scattered throughout the basin. Some areas that are currently too wet for long-term pine production may become suitable following hydrologic improvements that restore historical surface water drainage patterns.

Estimated Construction Cost for Hydrologic Improvements: $230,000

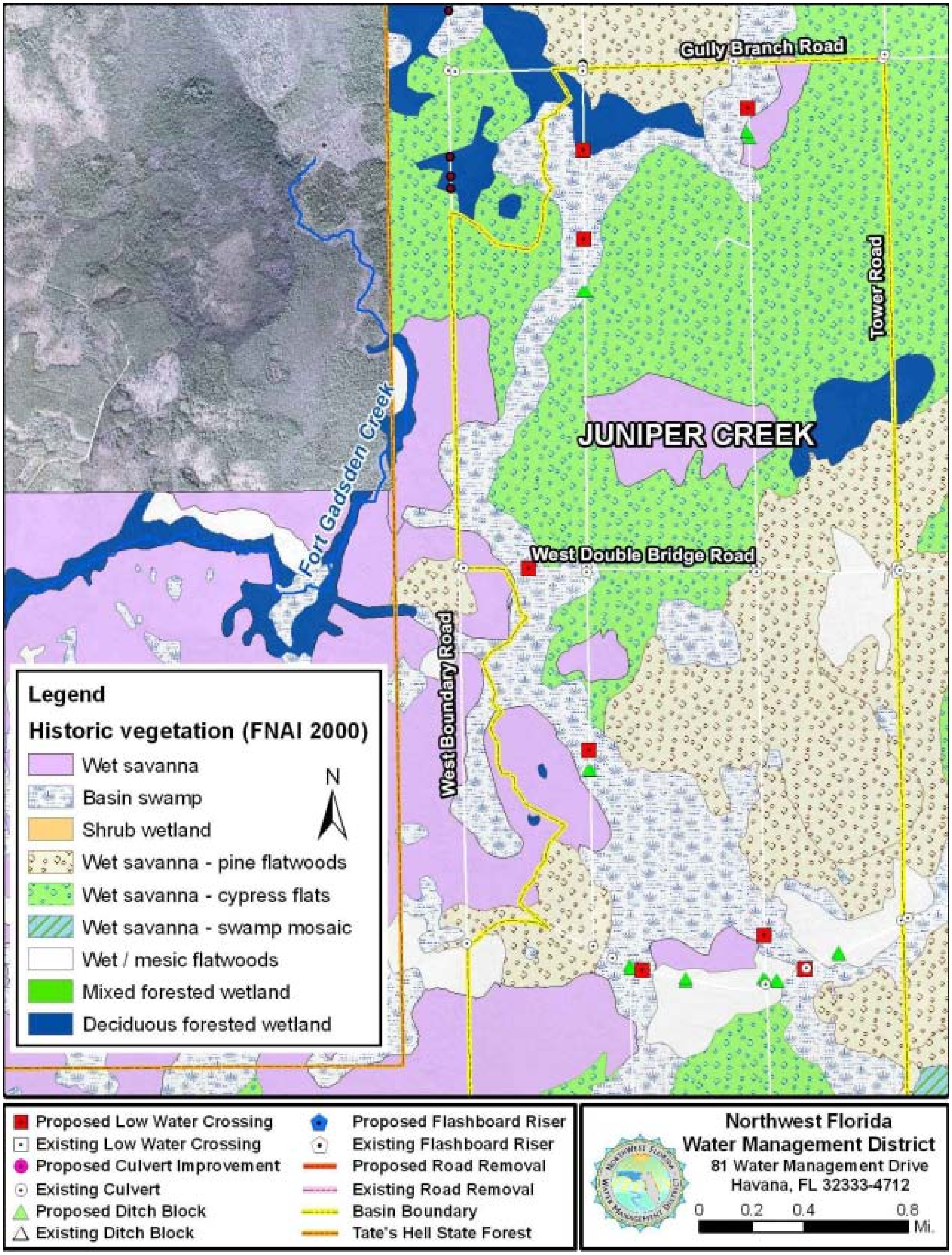

Figure 18. Historical ecological communities and proposed hydrologic improvements in the northern portion of the Juniper Creek basin

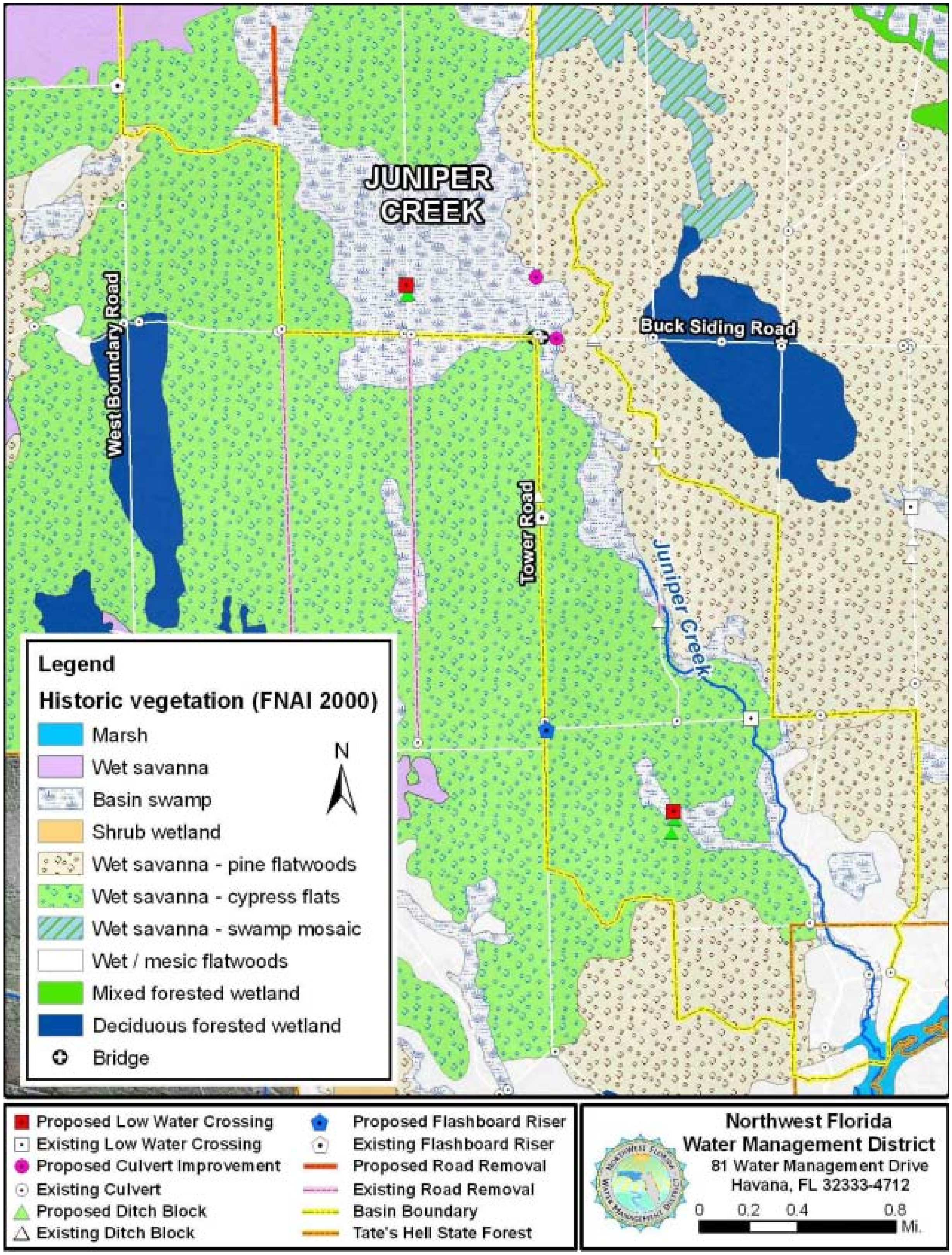

Figure 19. Historical ecological communities and proposed hydrologic improvements in the southern portion of the Juniper Creek basin

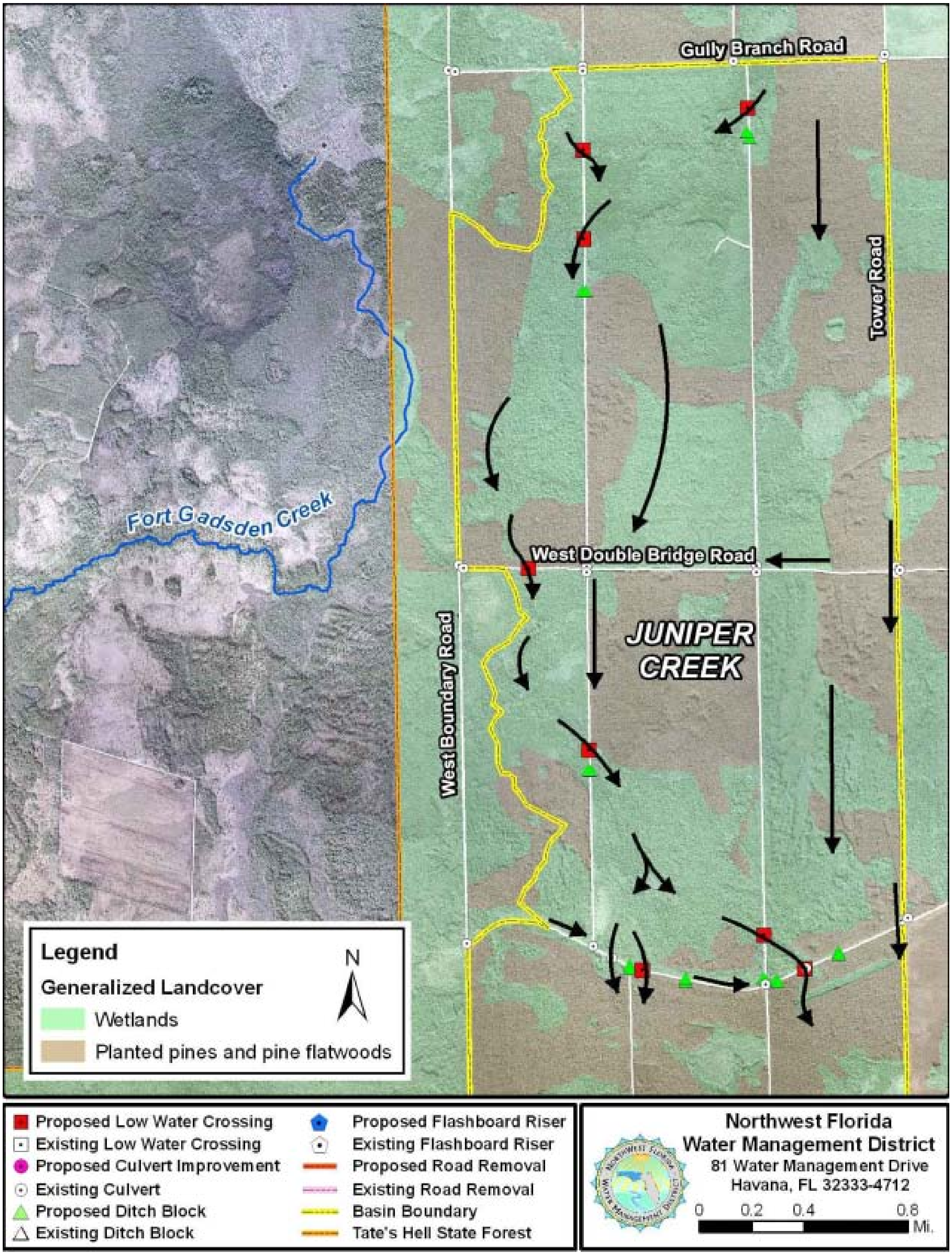

Figure 20. Proposed hydrologic improvements and post-restoration drainage patterns in the northern portion of the Juniper Creek basin

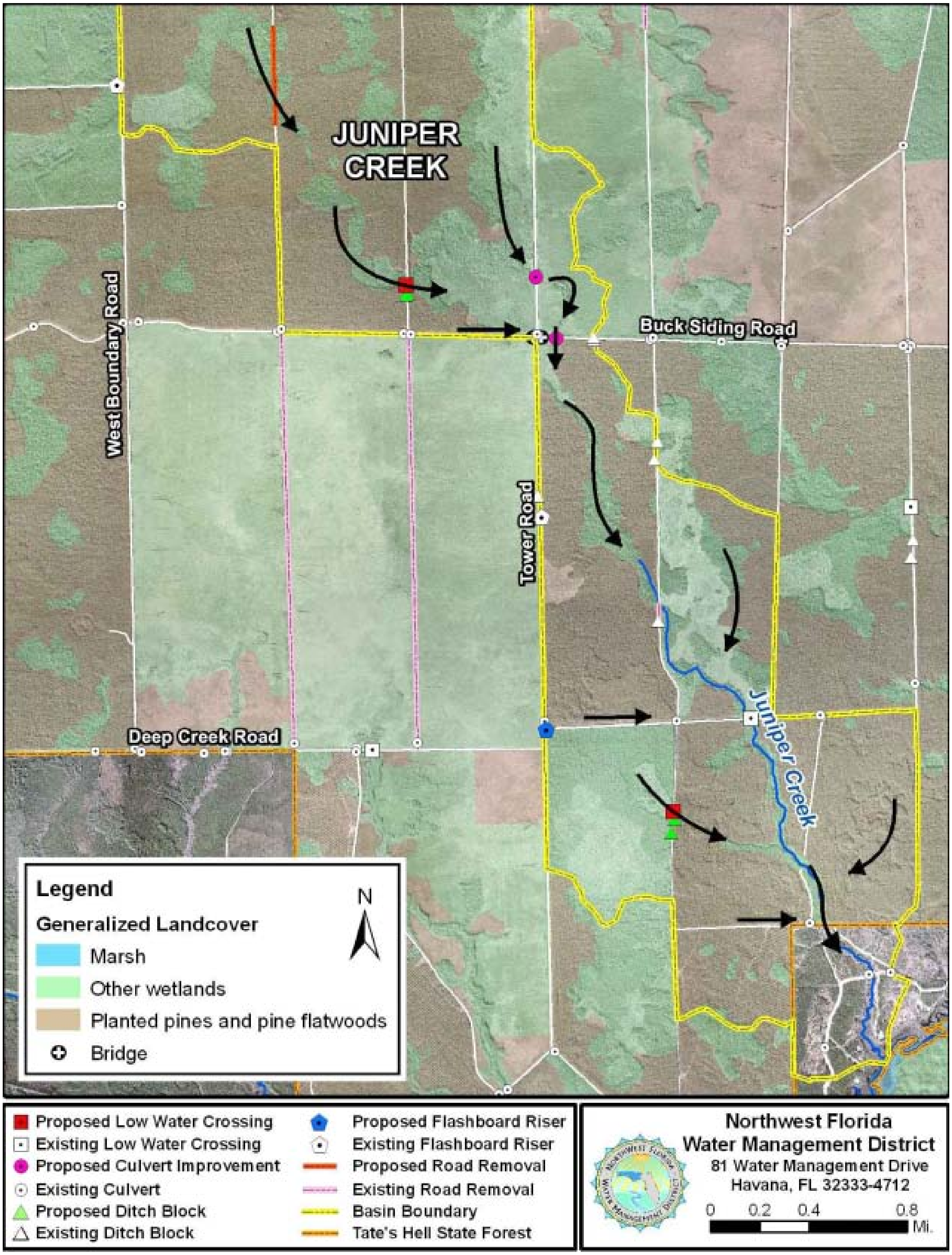

Figure 21. Proposed hydrologic improvements and post-restoration drainage patterns in the southern portion of the Juniper Creek basin

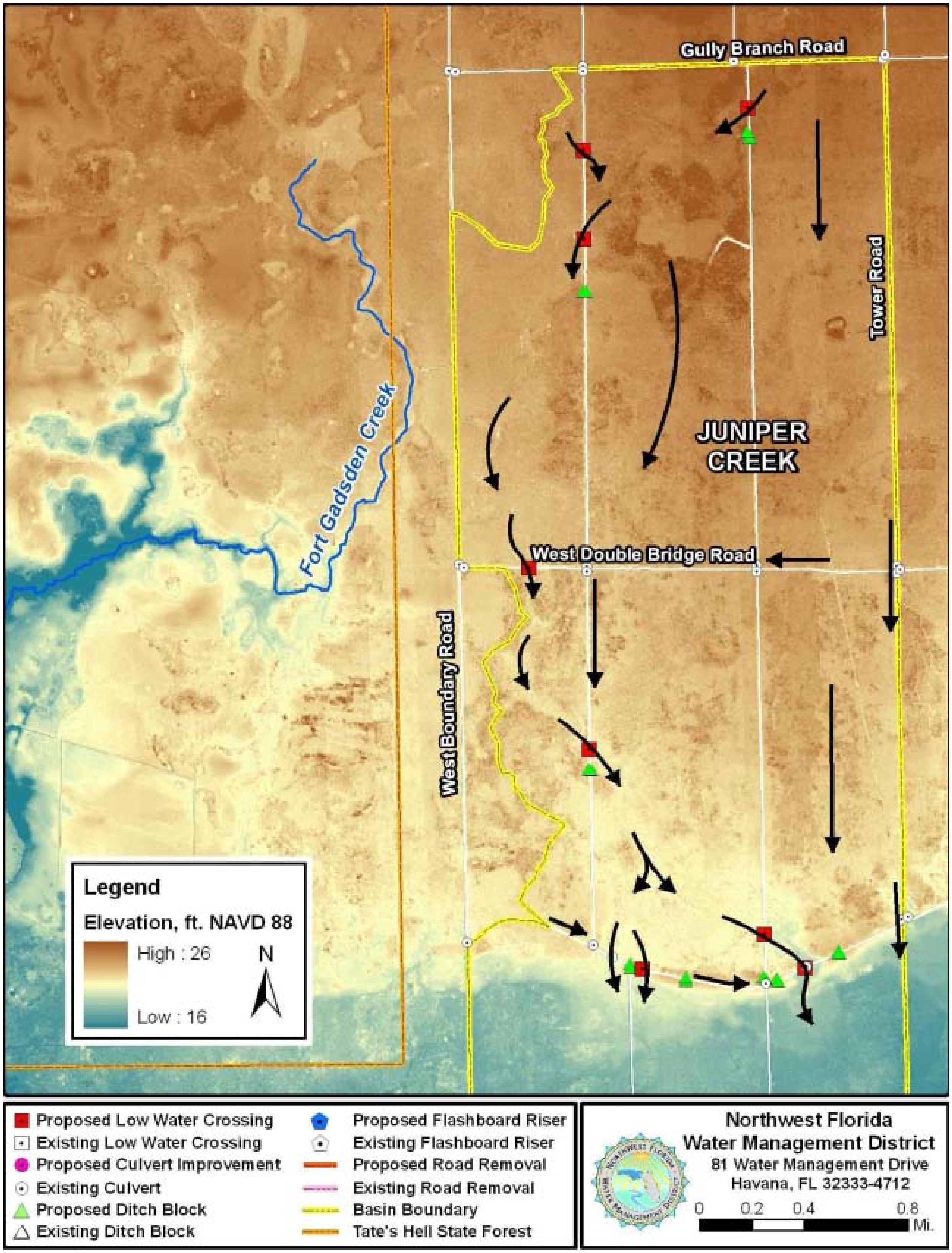

Figure 22. LiDAR elevation data, proposed hydrologic improvements and post-restoration drainage patterns in the northern portion of the Juniper Creek basin

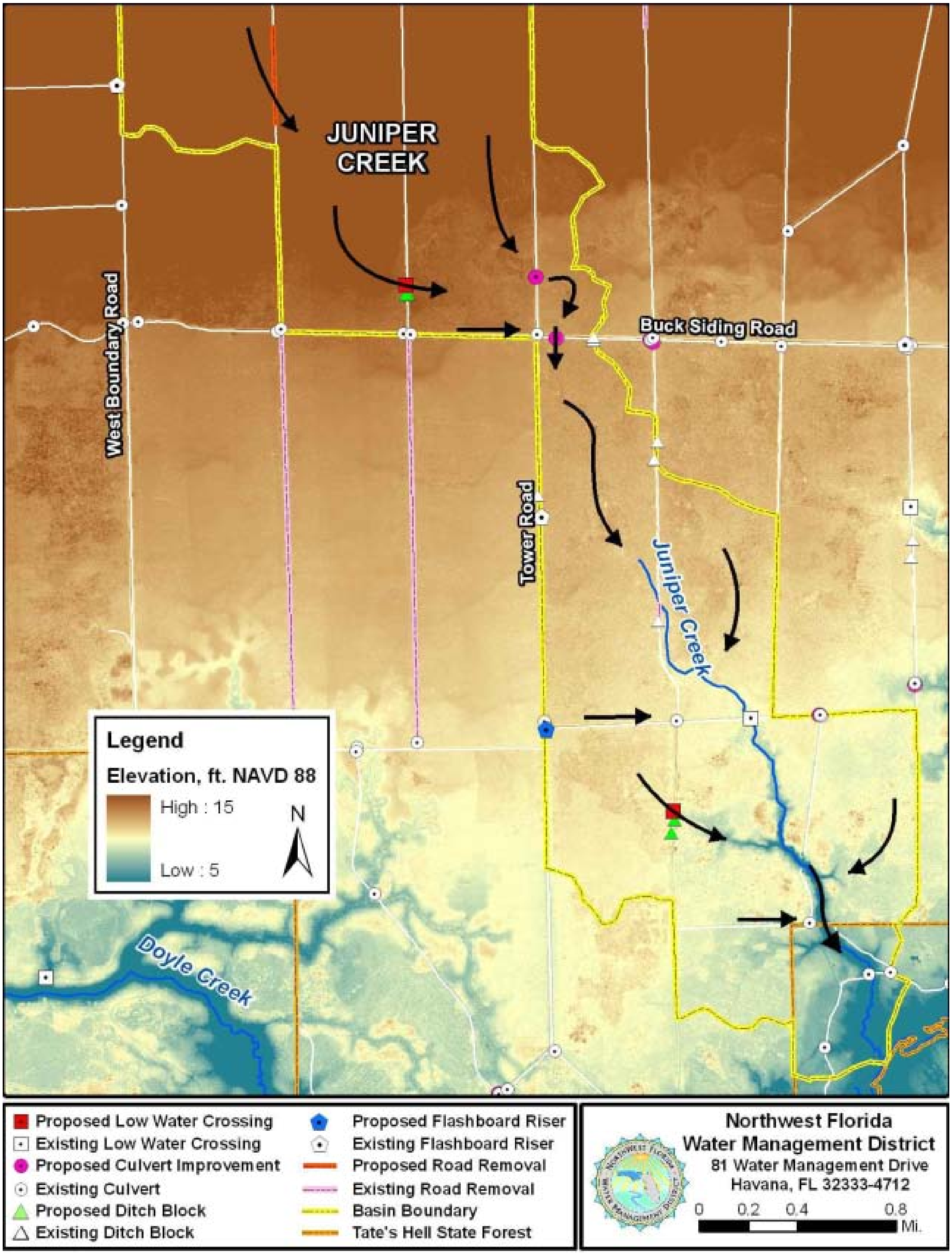

Figure 23. LiDAR elevation data, proposed hydrologic improvements and post-restoration drainage patterns in the southern portion of the Juniper Creek basin

Whiskey George Creek Basin

Restoration Priority: High

Basin Area: 19,900 acres

Description: Whiskey George Creek is one of the longest streams in the Tate's Hell State Forest with a total length of nearly 22 miles. Whiskey George Creek flows south, merges with Juniper Creek, Doyle Creek, and another small tributary and then discharges into the West Bayou of East Bay. Because East Bay serves as the primary nursery area for the Apalachicola Bay system, Whiskey George Creek and its tributary basins are a high priority for hydrologic restoration.

Historically, Whiskey George Creek was fed by local surface water runoff that flowed through wet savannas and basin swamps before discharging toward the stream. The stream corridor was comprised of cypress sloughs and mixed forested wetlands (Figures 24 and 25). The network of roads and ditches constructed during the 1960s and 1970s severed wetland connections, altered surface water drainage patterns, and impacted wetland functions. Many historical wet savannas were converted to slash pine plantation. The amount of remnant wetland vegetation remaining under the planted pines varies. Some planted pines have been bedded and fertilized and these soil alternations have further impacted drainage patterns and native plant communities.

Today, much of the surface water runoff discharges to Whiskey George Creek via large drainage ditches located along Tower Road, Gully Branch Road, West Double Bridge Road, Buck Siding Road, and Dry Bridge Road. A primary goal of restoration activities is to reduce the flow of water in these roadside drainage ditches and increase natural sheet flow through existing and remnant wetland systems.

Several hydrologic restoration projects have been implemented in the Whiskey George Creek basin. The Big Slough Restoration Project was implemented by the NWFWMD in 1998. The project, located north of Gully Branch Road, involved reconnecting a large cypress slough system to the creek by removing road segments and installing several low water crossings and ditch blocks. In 2009, the NWFWMD implemented the Whiskey George Savannas Restoration Project which involved two separate project areas. In the northernmost part of the basin, the large shrub wetland that once comprised the headwaters of Whiskey George Creek was reconnected to the stream by removing nearly three miles of dirt logging roads and installing two new culverts and a low water crossing (Figures 24 and 27). South of West Double Bridge Road, historical surface water drainage patterns in a wet savanna – pine flatwoods mosaic were restored by removing an additional three miles of logging roads and installing four low water crossings, several ditch blocks, and three culverts (Figures 25 and 28). Post-construction monitoring conducting during the spring of 2010 indicates the low water crossings are conveying surface water flows and that wetland vegetation has begun recolonizing the road removal areas. The ditch blocks are functioning well but some additional fill will be needed to repair minor erosion of ditch block side slopes.

An additional low water stream crossing and associated ditch blocks were constructed south of Buck Siding Road as part of a separate wetland mitigation project implemented by Superholdings LLC (Figures 26 and 29). To date, restoration activities in the Whiskey George Creek basin have involved the installation of 10 low water crossings, the removal of more than six miles of dirt logging roads and adjacent ditches, and the installation of numerous ditch blocks and culverts. To improve habitat conditions, the Division of Forestry is reducing pine densities in historical wetland habitats and is conducting prescribed burns to maintain appropriate fire frequencies.

2010 – 2020 Hydrologic Restoration Plan: Although a significant amount of hydrologic restoration has been accomplished in the Whiskey George Creek basin, many additional opportunities remain. Future hydrologic improvements will build and expand on previous efforts. Proposed improvements include 12 low water crossings, two flashboard risers, approximately 23 ditch blocks, 20 culvert modifications, and two segments of road removal (Figures 24 through 32). The proposed low water crossings are wetland crossings rather than stream crossings and will likely only contain water intermittently. Some of the proposed low water crossing locations will reconnect former wetlands that are currently planted in pines. As a result, surface water flow paths may not be readily visible on the aerial photography. However, flow paths can generally be discerned from either the LiDAR elevation data or the 1953 black-and-white aerial photography. Water has been observed flowing across the road at several of the proposed low water crossing locations.

The proposed ditch blocks will reduce the flow in roadside ditches or reroute ditch flow towards low water crossings or culverts. Ditch blocks will also restore local topographic features and prevent surface water flow across hydrologic basin divides. Two flashboard risers are proposed to be installed in the northern portion of the basin in the large drainage ditch adjacent to Tower Road. Flashboard risers, rather than permanent ditch blocks, have been proposed because the Division of Forestry needs to maintain the ability to convey surface water flows in these ditches under extremely wet conditions or in advance of pine harvesting operations.

Culvert modifications located throughout the Whiskey George Creek basin include seven new culverts, three culvert removals, and four culvert replacements. Culverts have been proposed in lieu of low water crossings on primary roads such as Tower Road and Buck Siding Road where year-round vehicle access is needed. The new culverts will reconnect contributing drainage areas and increase the conveyance capacity. Additional road fill will be needed in some areas to achieve sufficient cover depths (18") over the culvert pipes.

There are two road segments proposed for removal that total approximately 0.6 miles. However, the pines adjacent to these road segments must be first thinned or harvested. Accordingly, these road segments will not likely be removed until after 2015.

Recommended habitat improvements include shrub (titi) reduction north of Gully Branch Road and in the area between Tower Road and Whiskey George Creek and south of Evans Lake Tram Road. Pine thinning is needed in many areas. Areas suitable for long-term timber production consist primarily of mesic flatwoods located in the northern part of the basin and the drier portions of pine flatwood mosaics located in the southern part of the basin.

Estimated Construction Cost for Hydrologic Improvements: $ 320,000

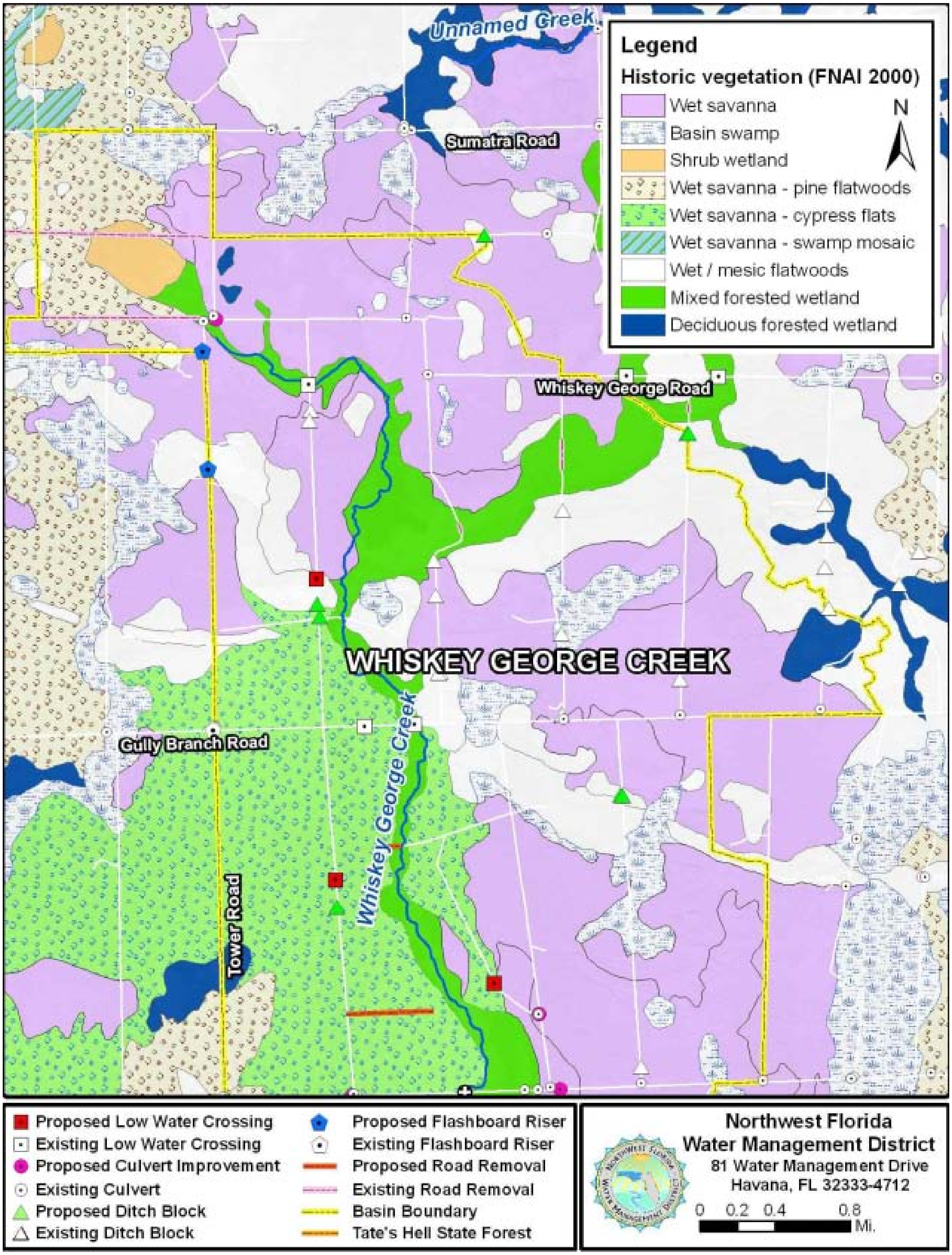

Figure 24. Historical ecological communities and proposed hydrologic improvements in the northern portion of the Whiskey George Creek basin

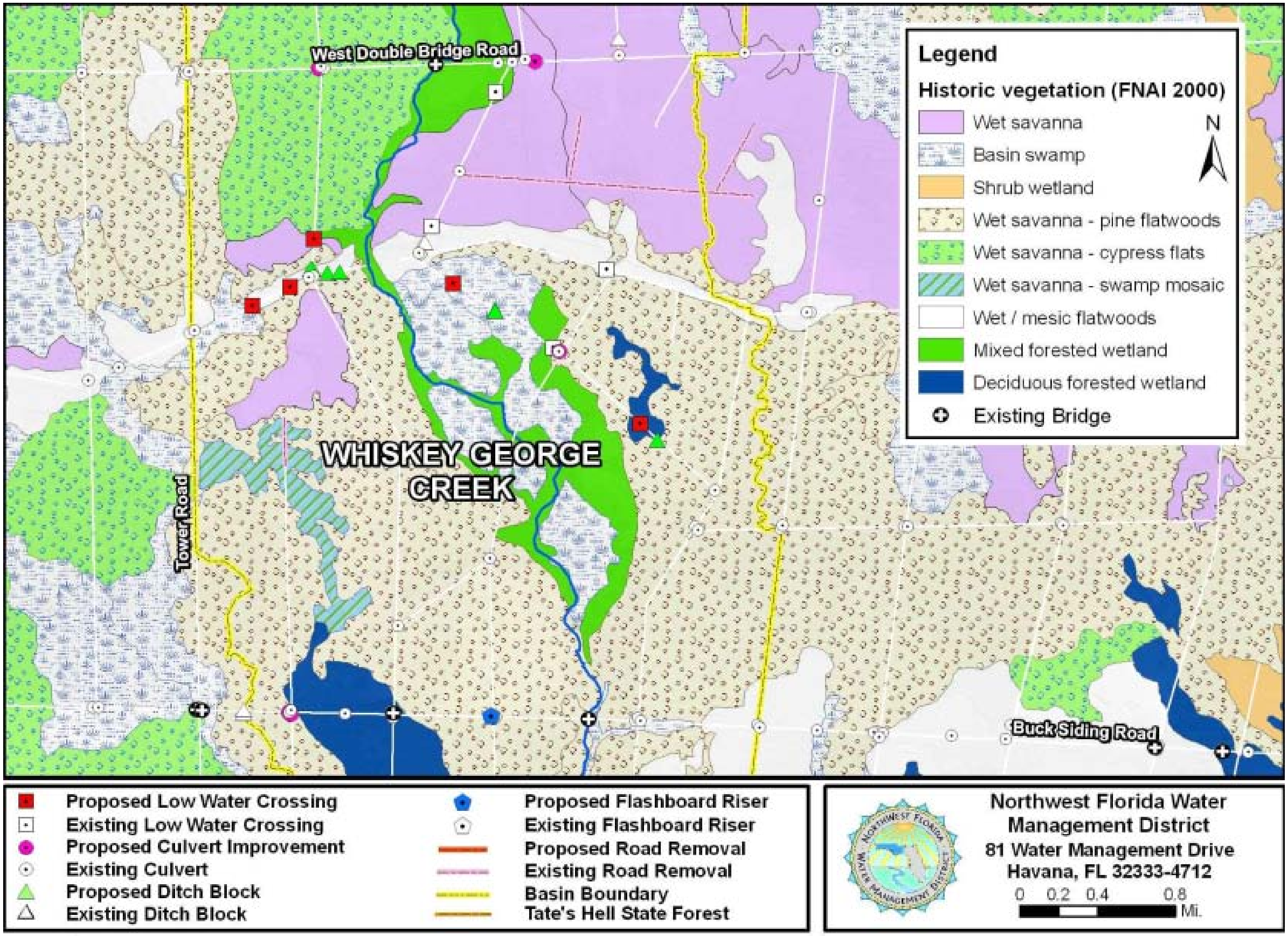

Figure 25. Historical ecological communities and proposed hydrologic improvements in the central portion of the Whiskey George Creek basin

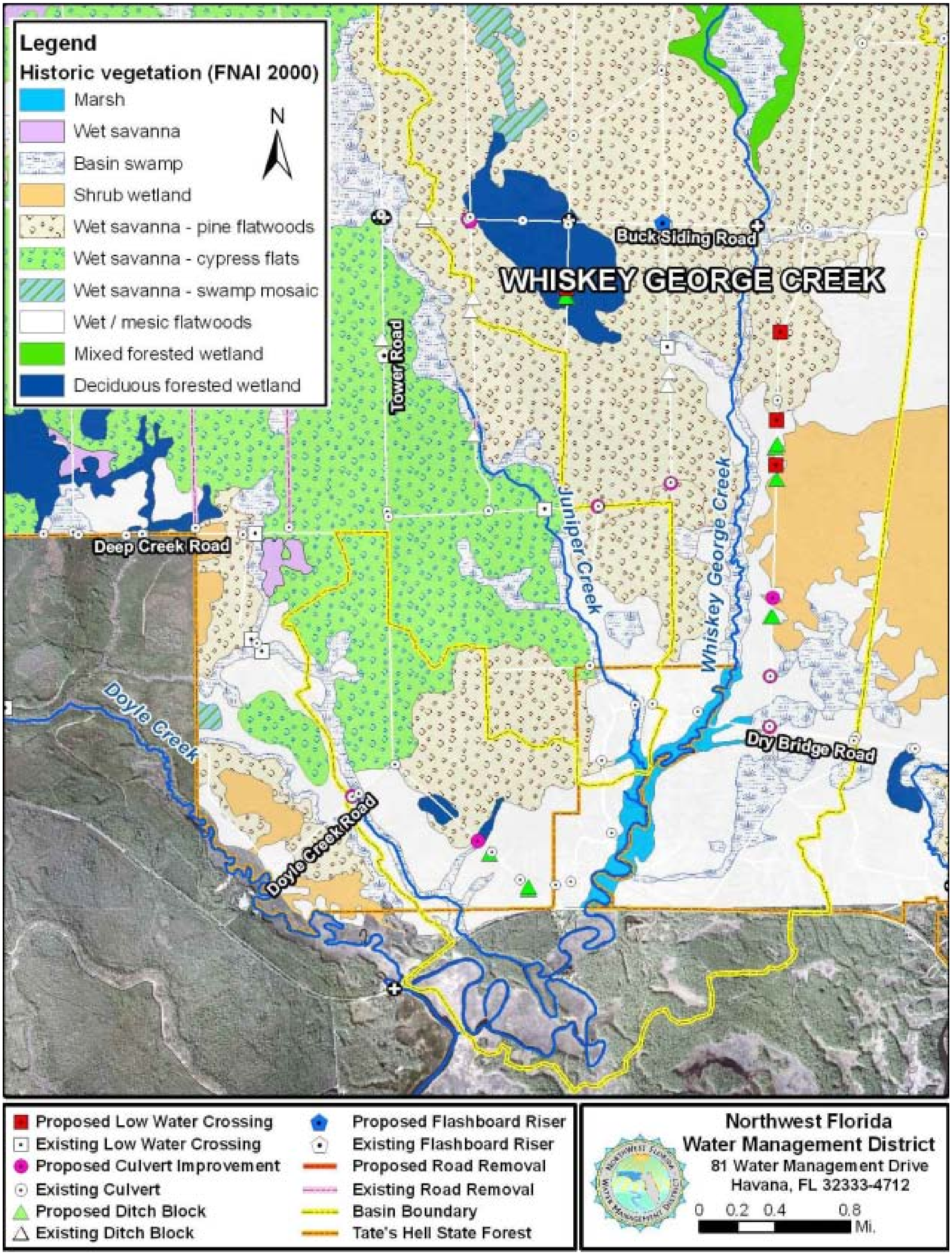

Figure 26. Historical ecological communities and proposed hydrologic improvements in the southern portion of the Whiskey George Creek basin

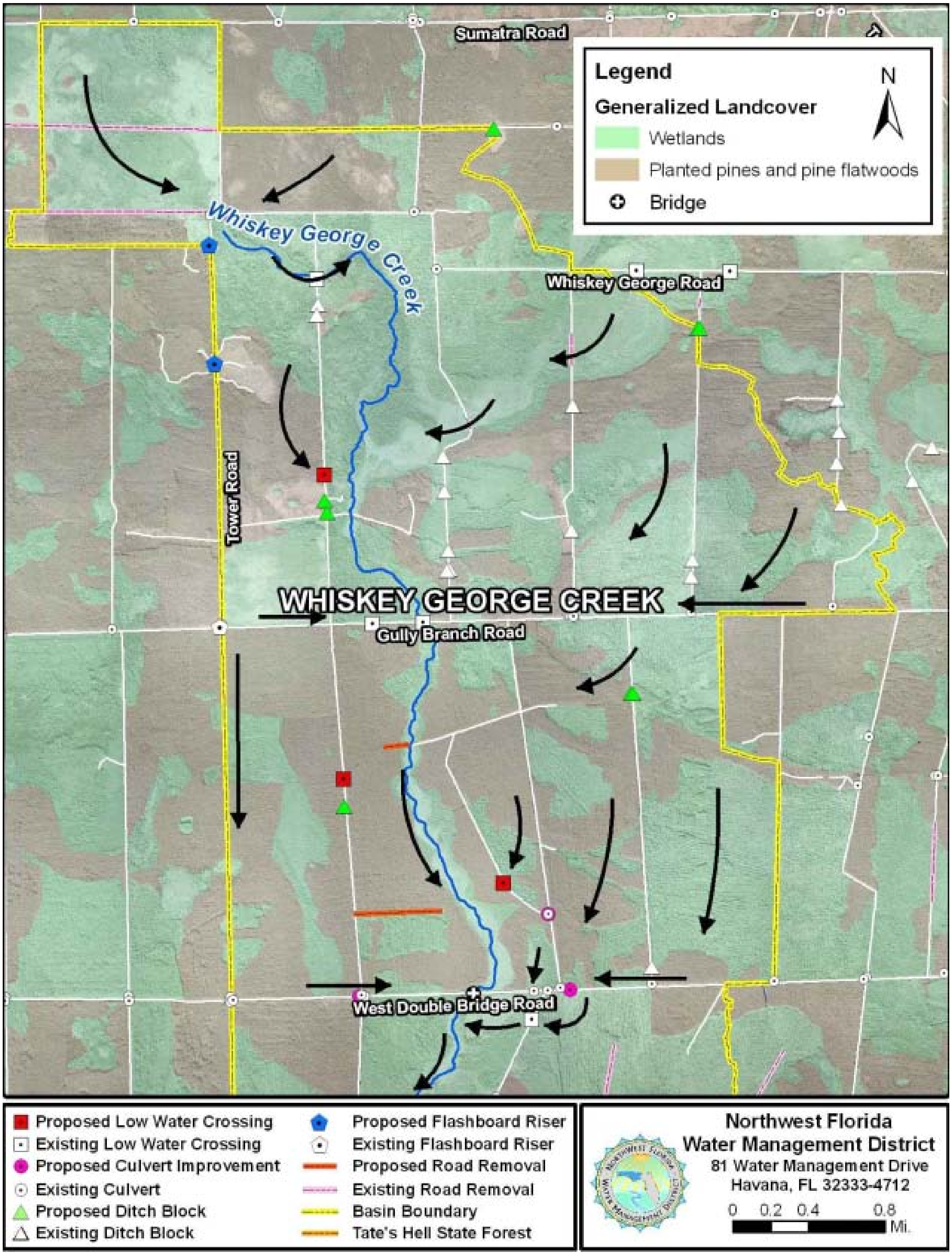

Figure 27. Proposed hydrologic improvements and post-restoration drainage patterns in the northern portion of the Whiskey George Creek basin

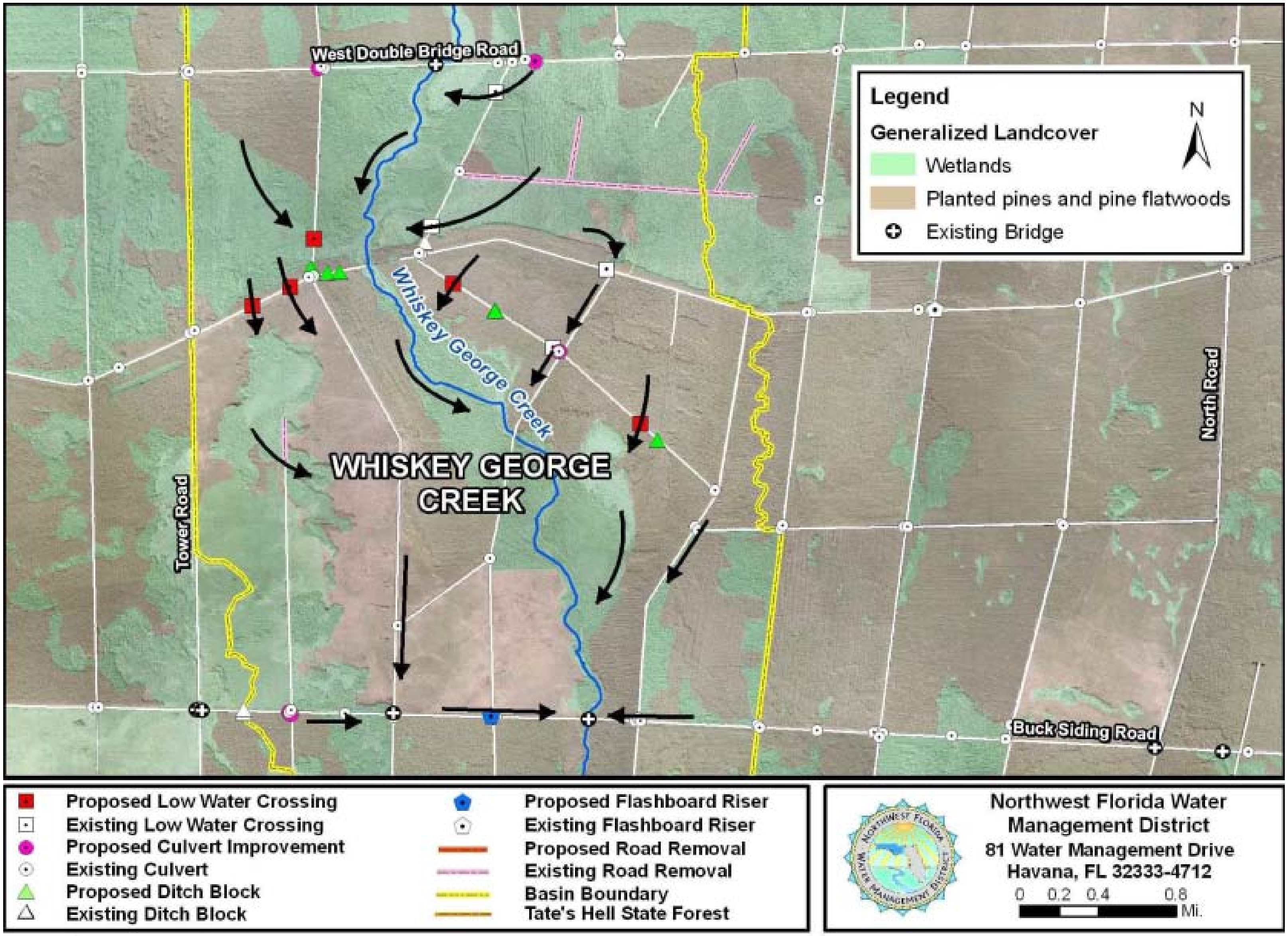

Figure 28. Proposed hydrologic improvements and post-restoration drainage patterns in the central portion of the Whiskey George Creek basin

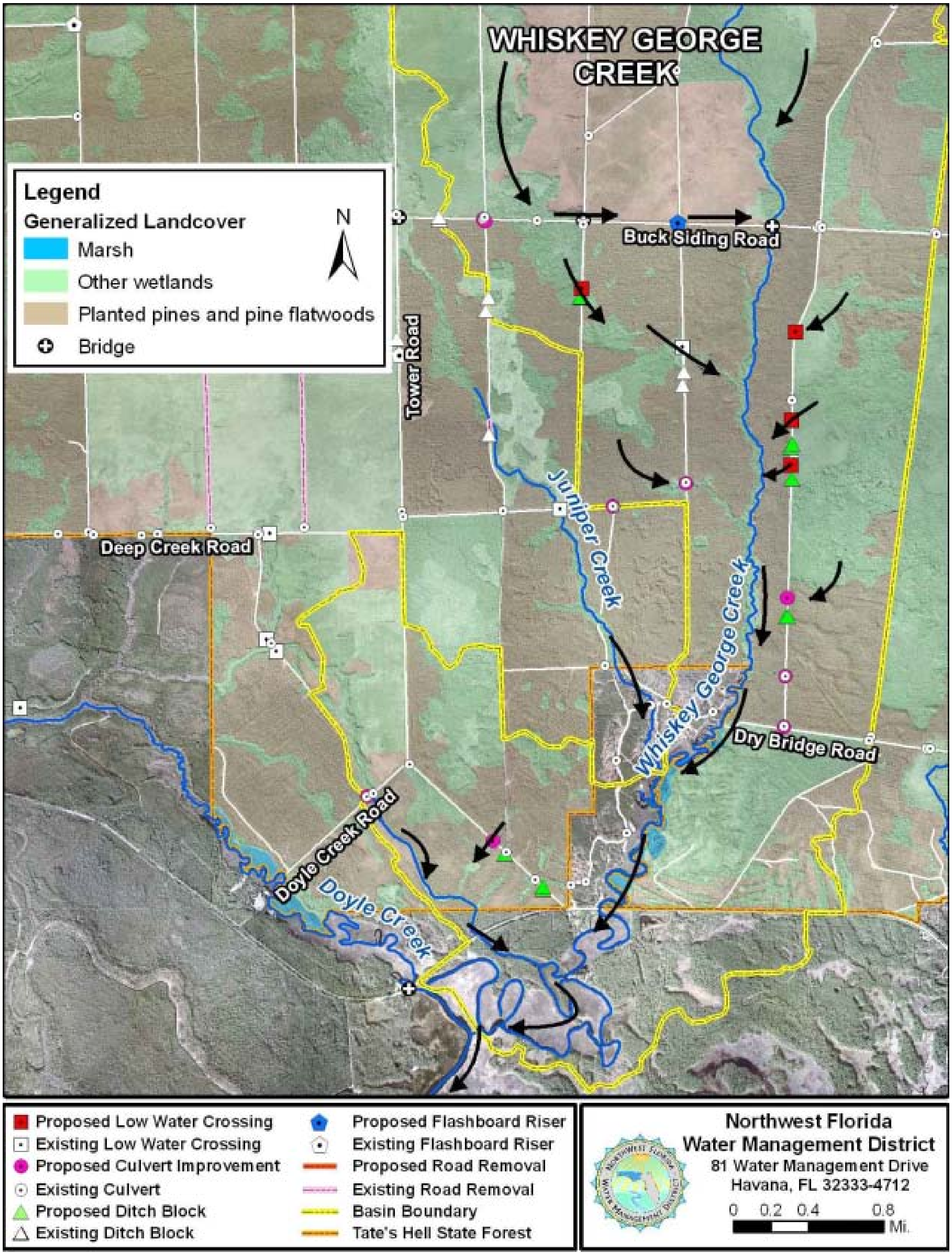

Figure 29. Proposed hydrologic improvements and post-restoration drainage patterns in the southern portion of the Whiskey George Creek basin

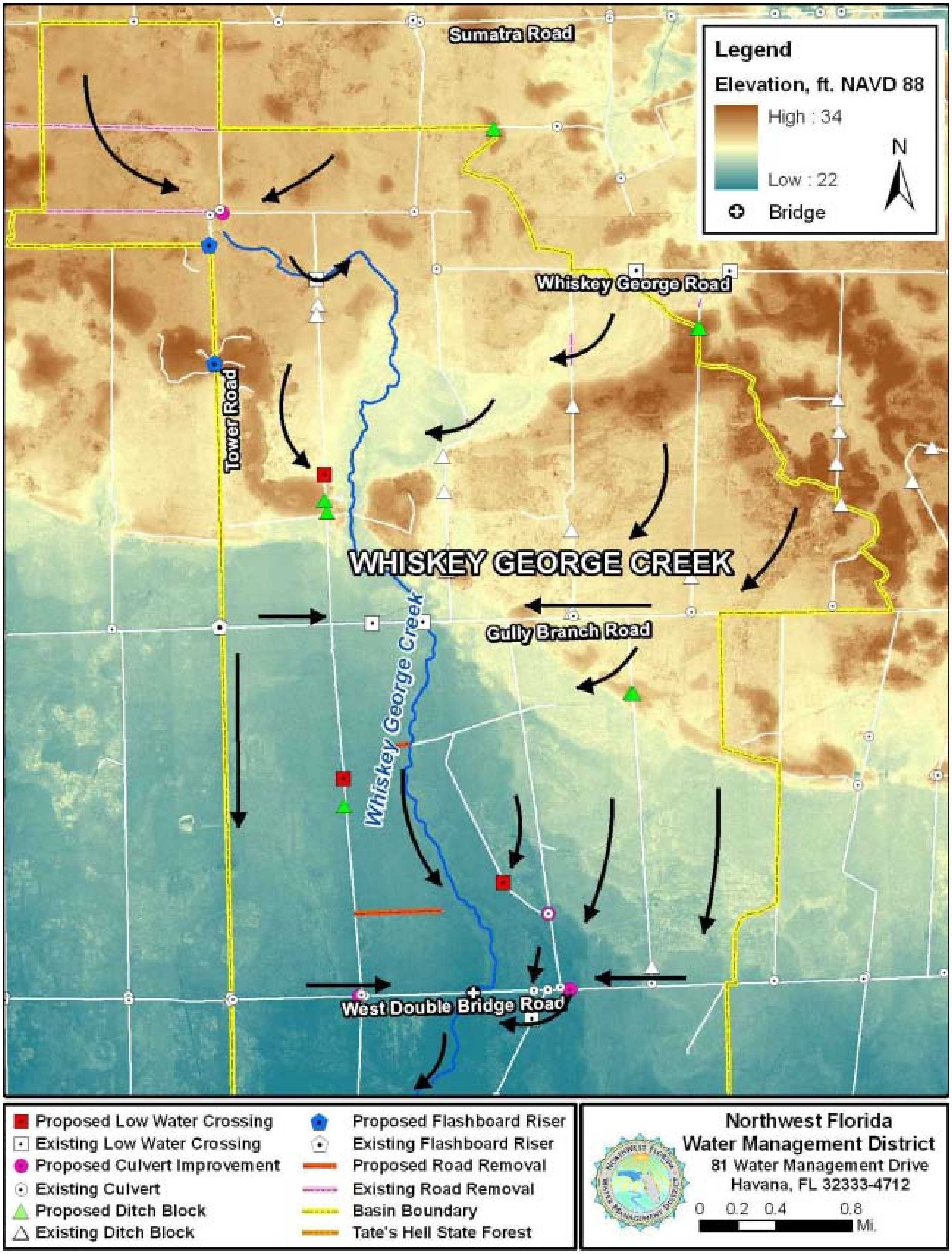

Figure 30. LiDAR elevation data, proposed hydrologic improvements and post-restoration drainage patterns in the northern portion of the Whiskey George Creek basin.

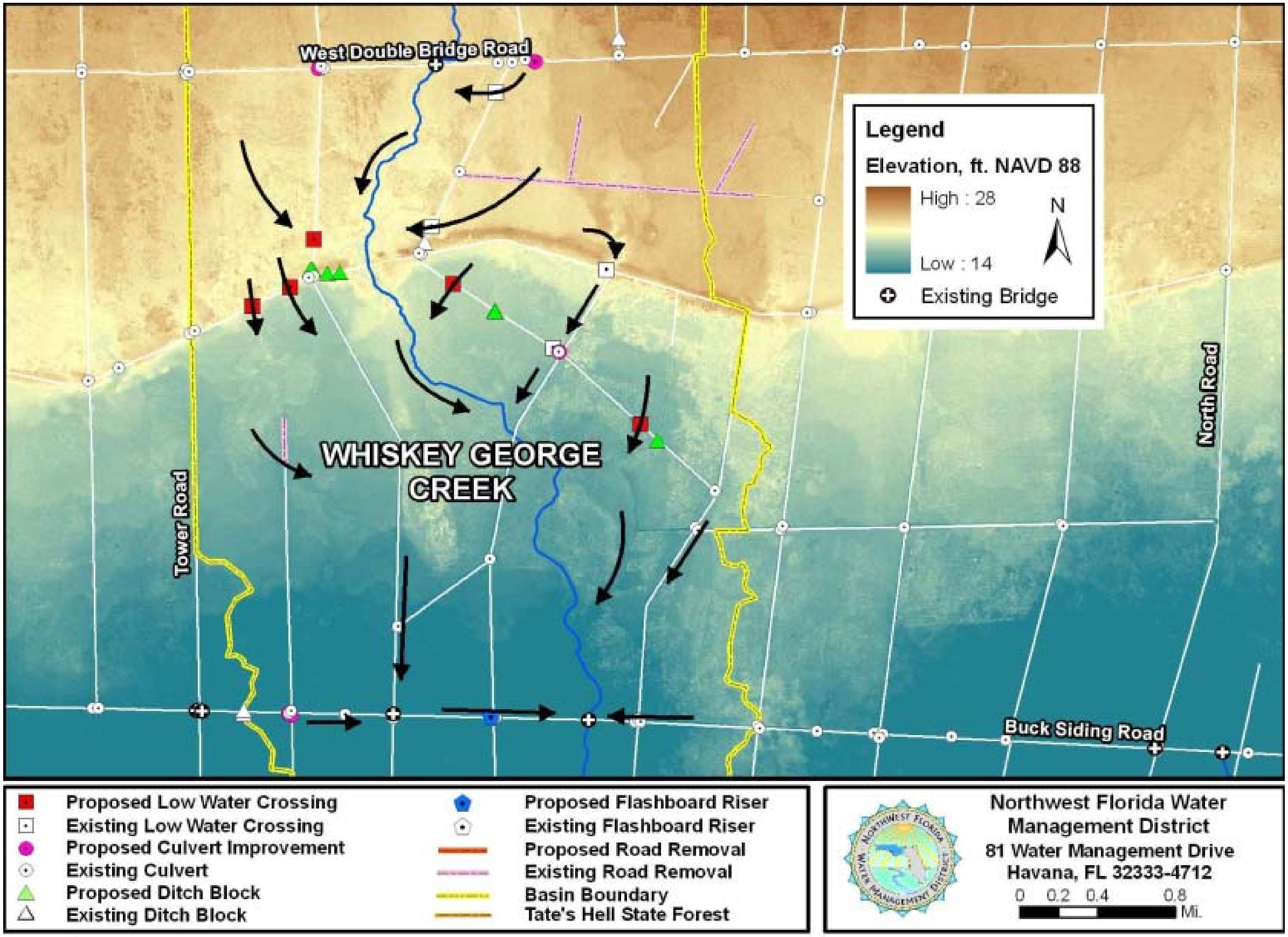

Figure 31. LiDAR elevation data, proposed hydrologic improvements and post-restoration drainage patterns in the central portion of the Whiskey George Creek basin.

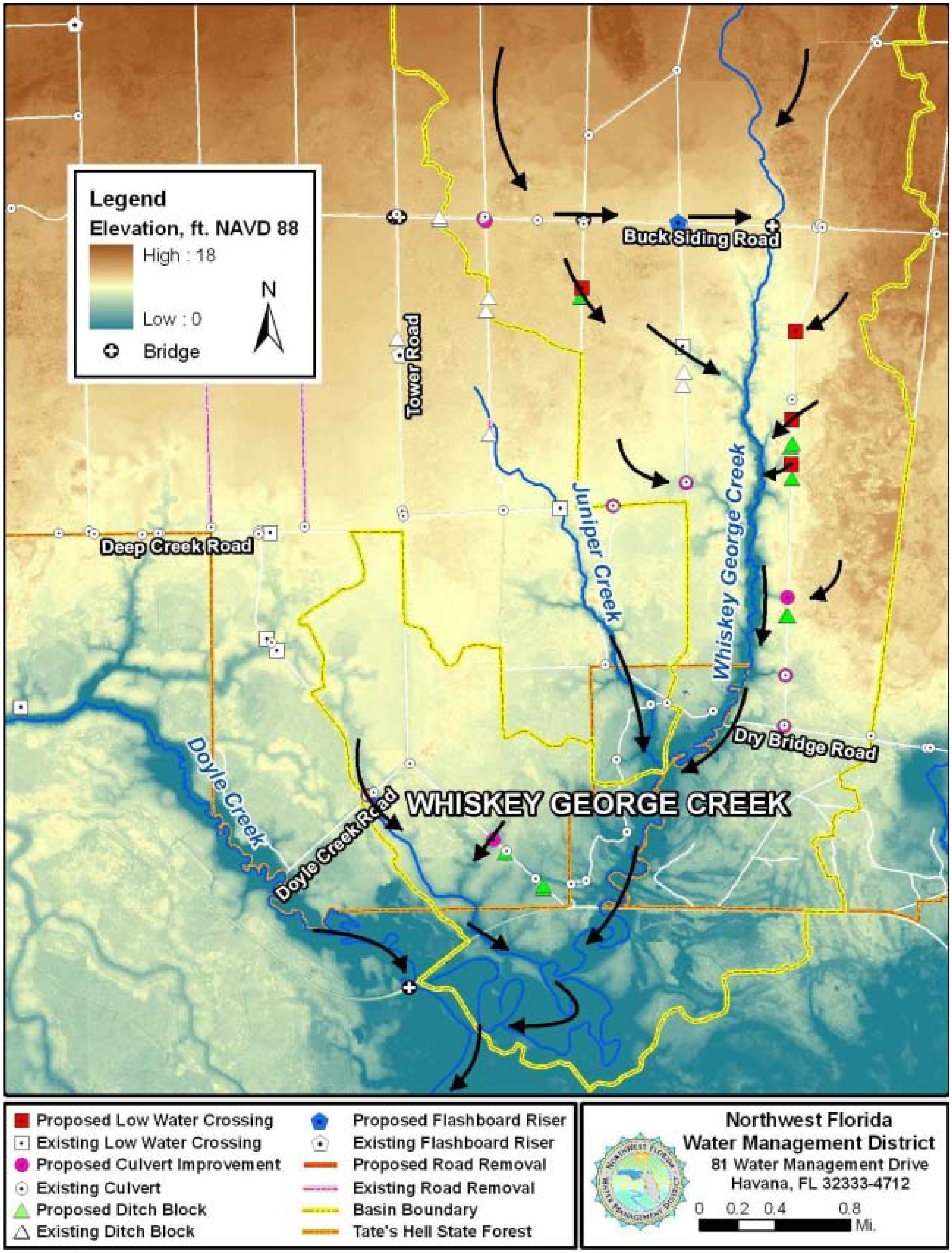

Figure 32. LiDAR elevation data, proposed hydrologic improvements and post-restoration drainage patterns in the southern portion of the Whiskey George Creek basin.

East Bayou and portions of the East Bay and St. George Sound Basins

Restoration Priority: High

Basin Area: 7,500 acres (East Bay and East Bayou) and 4,900 acres (St. George Sound)

Description: Because the East Bayou and East Bay basins discharge directly into East Bay, which serves as the primary nursery area for the Apalachicola Bay system, they are a high priority for hydrologic restoration activities. Historical ecological communities were delineated for only a portion of these basins and include mesic flatwoods, basin swamps, and wet savanna pine flatwood mosaics (Figure 33). Other ecological communities present include coastal marshes, wet flatwoods, and sand pine scrub. The LiDAR elevation data (Figure 35) clearly shows the coastal ridge that forms the boundary between the East Bayou and St. George Sound watersheds.

There has been relatively little hydrologic restoration in this area. There is one low crossing that was installed by the Division of Forestry along Bear Creek Road. To the south of Tate's Hell Forest, there are two additional low water crossings. Most of the roads in this area are very sandy and are at or below the natural grade. Because the roads are below natural grade, they may act as shallow ditches and convey surface water runoff during periods of high rainfall. There are numerous road sections that are difficult to access or are impassable during very wet weather.

In addition to the relatively poor road conditions, there has also been extensive ditching in this area. Several of the large drainage ditches that convey water east towards the bay are visible on the 1953 aerial photographs indicating that they were constructed more than five decades ago.

2010 – 2020 Hydrologic Restoration Plan: Proposed restoration activities are aimed at improving wetland and stream road crossings, restoring historical drainage patterns, and reducing flow in some of the ditches. In the East Bayou basin, nine low water crossings and nine culvert modifications are proposed as well as 17 ditch blocks (Figure 34). Two flashboard risers are also recommended for consideration to reduce flow in one of the larger drainage ditches. The existing roads will need to be improved and built up in the vicinity of most of the proposed culverts to achieve sufficient cover depth to support the weight of logging trucks and other vehicles.

In the western portion of the St. George Sound basin, one low water crossing, two new culverts and a culvert replacement, and four ditch blocks are proposed to restore drainage south towards the coast. However, further evaluation of these improvements is recommended prior to implementation to ensure that there is sufficient conveyance capacity downstream in the Eastpoint area.

Estimated Construction Cost for Hydrologic Improvements: $ 280,000

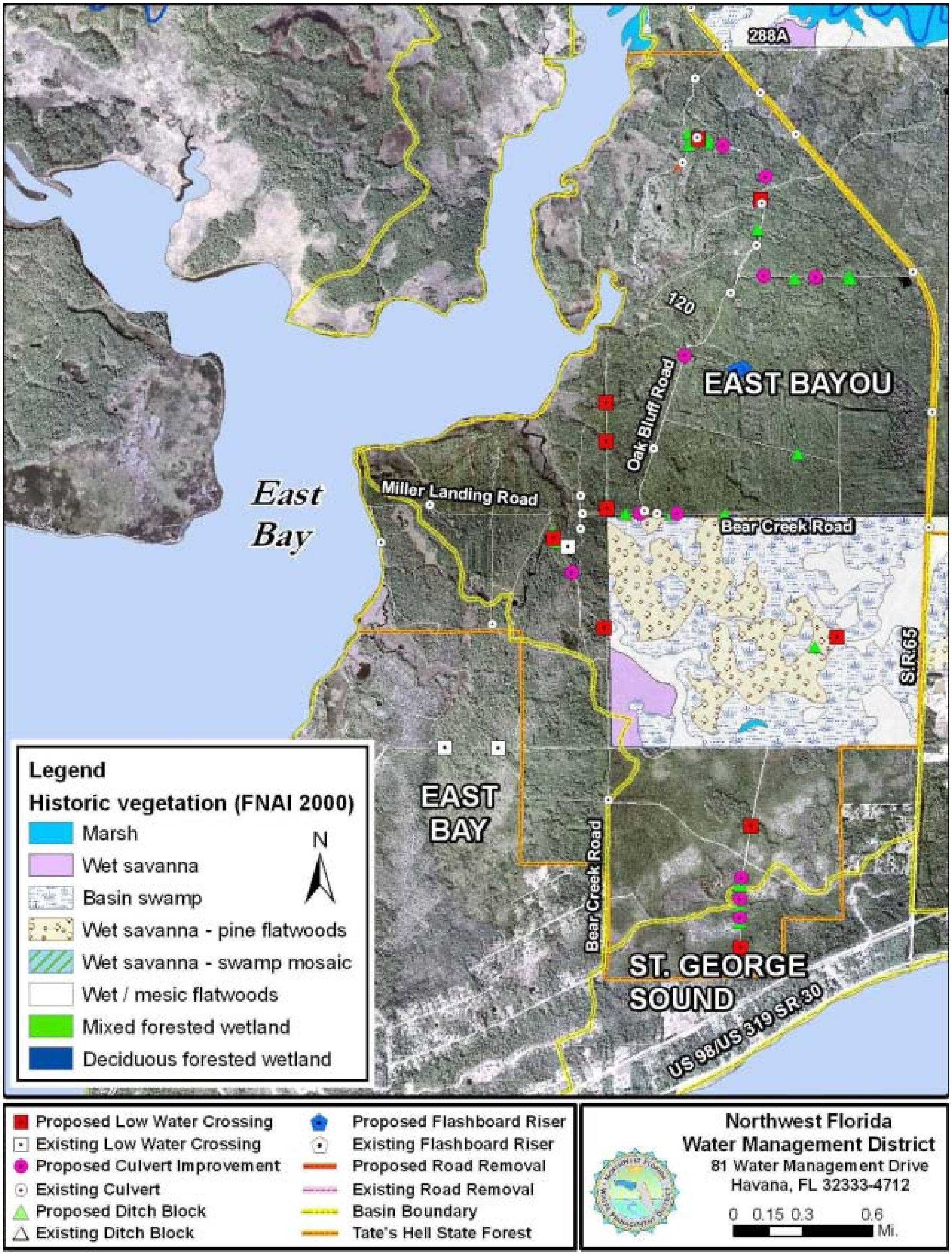

Figure 33. Historical ecological communities and proposed hydrologic improvements in the East Bayou, East Bay, and western St. George Sound basins.

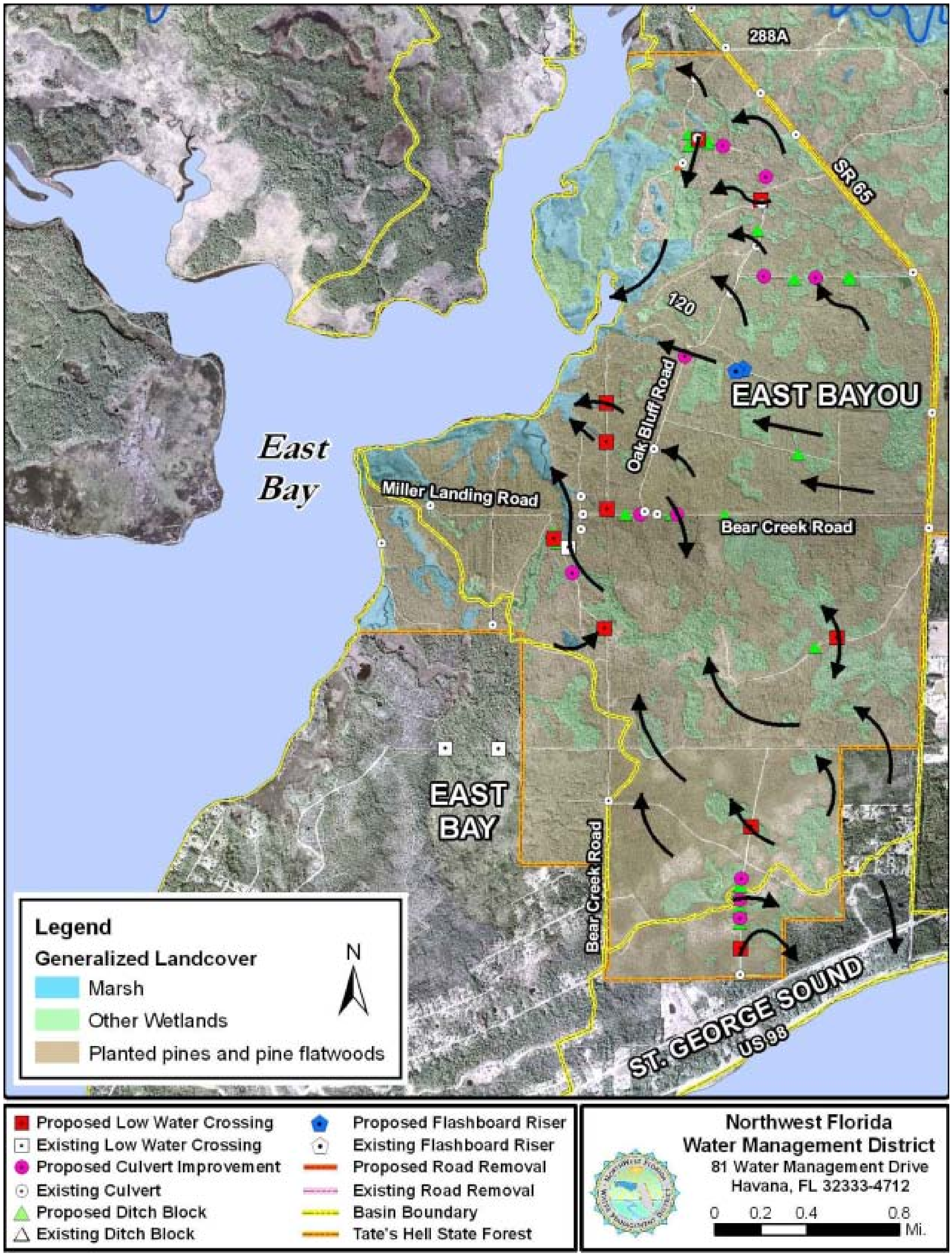

Figure 34. Proposed hydrologic improvements and post-restoration drainage patterns in the East Bayou, East Bay and western St. George Sound basins.

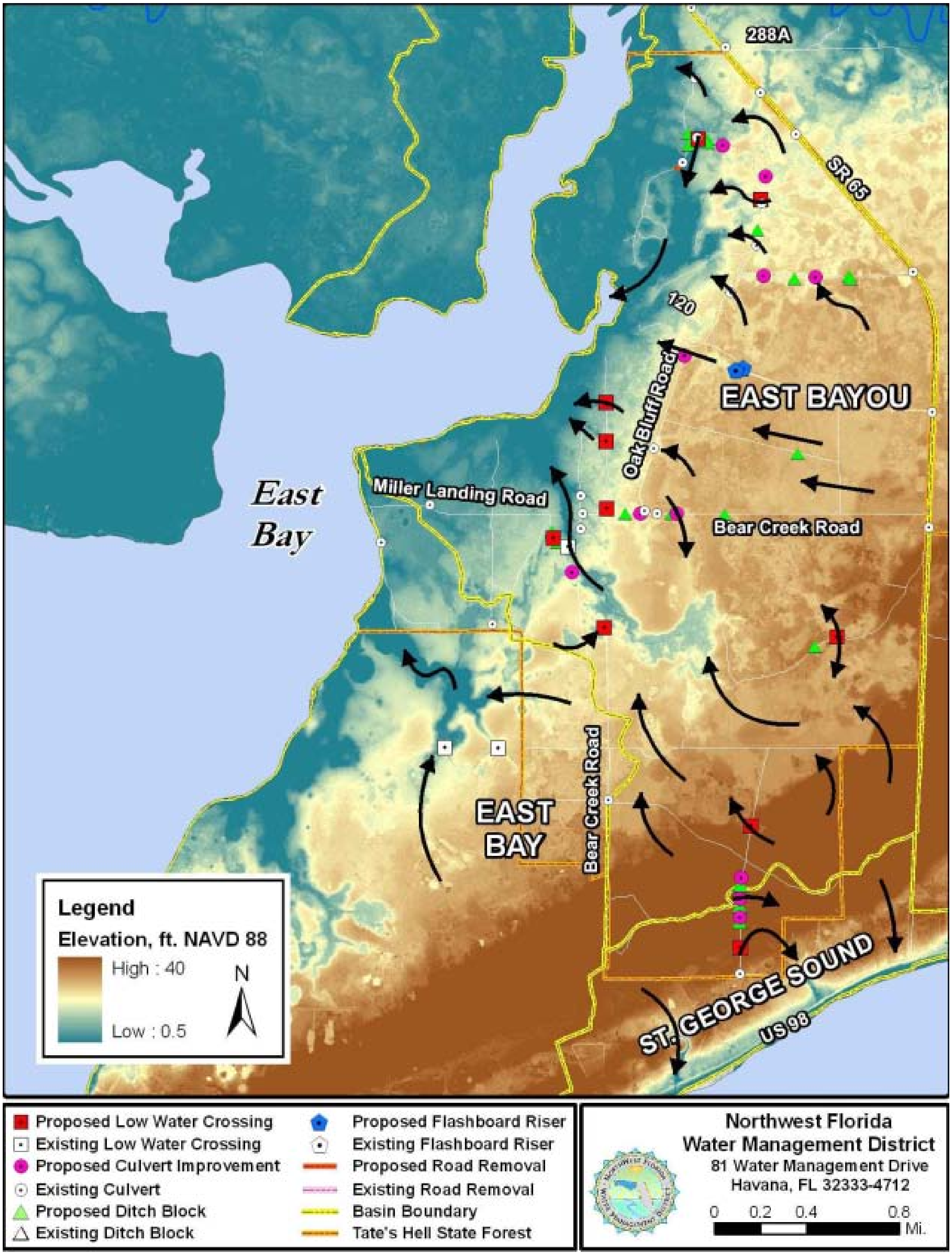

Figure 35. LiDAR elevation data, proposed hydrologic improvements and post-restoration drainage patterns in the East Bayou, East Bay, and western St. George Sound basins.

Cash Creek and Eastern St. George Sound Basins

Restoration Priority: High

Basin Area: 8,800 acres (Cash Creek) and 4,900 acres (St. George Sound basin)

Description: Surface water runoff in the Cash Creek basin flows generally north and west through a series of interconnected basin swamps and discharges to Cash Creek and the surrounding marshes. Cash Creek then flows west where it receives inflows from High Bluff Creek, Rake Creek, and Sandbank Branch Creek prior to discharging to the East Bayou of East Bay (Figure 38). Due to the importance of East Bay as a nursery area for the Apalachicola Bay system, Cash Creek and other tributary basins are high priorities for restoration.

Yent Bayou is a large marsh area located in the eastern portion of the St. George Sound basin (Figure 37). The general direction of surface water flow in this basin is toward the coast. A large drainage canal and berm bisect the marshes of Yent Bayou. The drainage canal extends inland more than a mile and was cut through remnant coastal ridges. This canal has significantly altered local drainage patterns in this area.

Historical ecological communities in the Cash Creek and Yent Bayou areas included mesic flatwoods, marshes, and numerous interconnected basin swamps, with sand pine scrub communities located along the coastal ridges (Figures 36 and 37). Many of the smaller dirt logging roads in this area are one-lane roads that are at or near natural grade. Many of these roads either do not have adjacent roadside ditches or the ditches are very shallow. Some of these roads are "non-system" roads that are not maintained by the Division of Forestry and may be used as hiking trails. During periods of heavy rainfall, some of the roads may be overtopped with water in low areas.

2010 – 2020 Hydrologic Restoration Plan: Hydrologic improvements in the Cash Creek basin are aimed at restoring historical drainage patterns and improving stream and wetland road crossings. In the northern portion of the Cash Creek basin, four low water crossings along Road 36 are proposed to improve water quality, reconnect wetlands, and restore surface water drainage to north (Figures 36, 38 and 40). Two flashboard risers are needed to reduce flow in roadside ditches and prevent flow across the basin boundary (northernmost riser). Along Road 42, a new low water crossing, two culverts, and several ditch blocks will enhance surface water drainage south towards Cash Creek. Two culvert replacements and five new culverts are also proposed in the northern part of the basin. Several ditch blocks are recommended to be installed to restore local topographic divides.

In the southern portion of the Cash Creek basin, recommended improvements include installation of a small bridge and four new culverts on Road Camp Road to improve surface water drainage to the north (Figures 37, 39, and 41). Six low water crossings are proposed along Road 32 to reconnect basin swamps, restore historical surface water drainage to the north, and improve water quality. A 0.25 mi. road segment that extends into a basin swamp is proposed to be removed. A number of ditch blocks also are proposed in conjunction with the culverts and low water crossings.

In the Yent Bayou area, two low water crossings are proposed to reconnect historical wetland areas and restore surface water drainage patterns (Figures 37, 39, and 41). Three flashboard risers are proposed to be constructed to reduce flow in the large drainage canal; however field verification is needed to confirm the feasibility of these proposed improvements. Ditch blocks would be preferable to flashboard risers if they are feasible. However, the drainage canal is relatively deep (~5 ft or more) and may be tidally influenced. A culvert replacement is also needed on Road 73.

Estimated Construction Cost for Hydrologic Improvements: $ 530,000

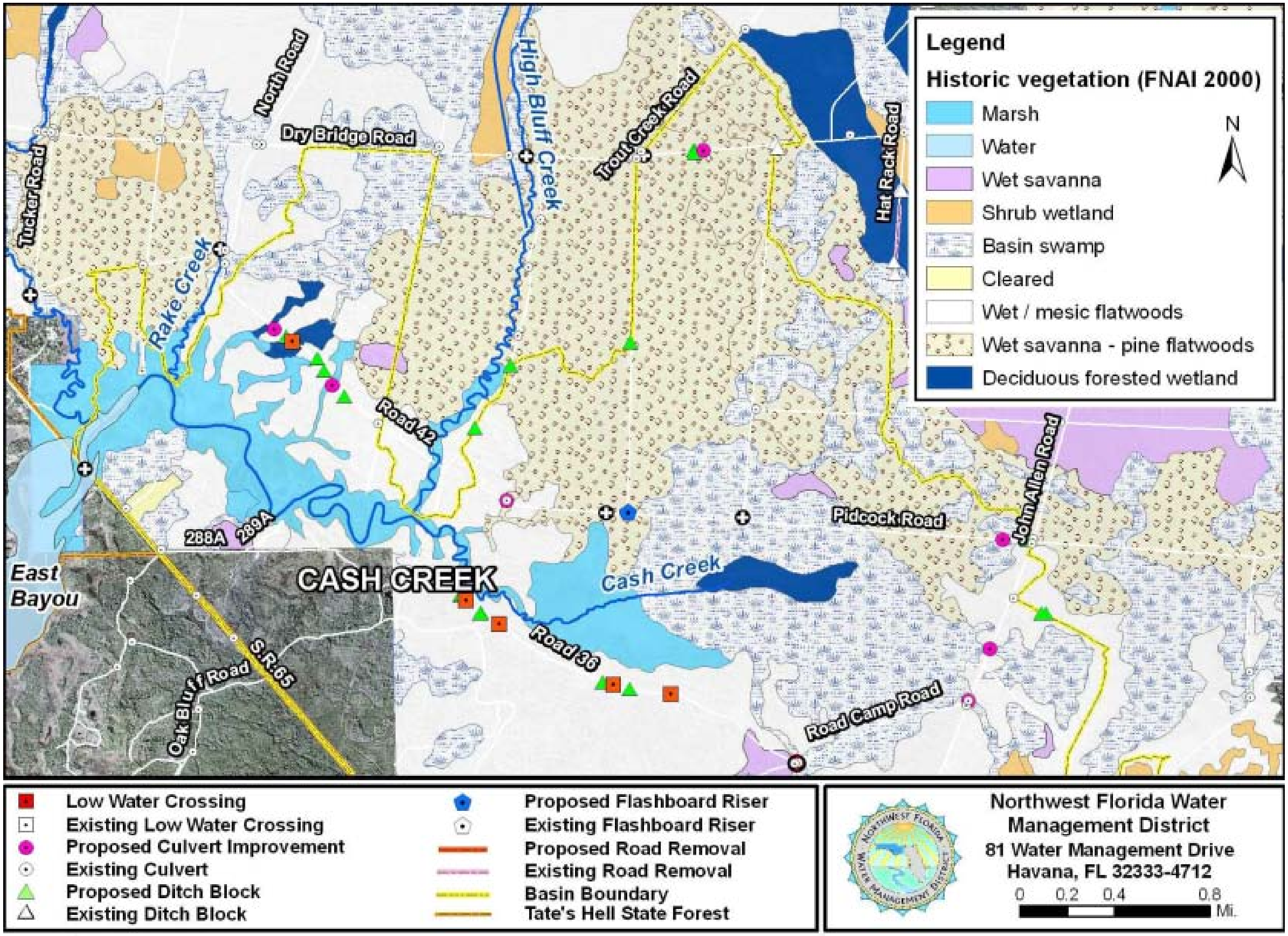

Figure 36. Historical ecological communities and proposed hydrologic improvements in the northern portion of the Cash Creek basin.

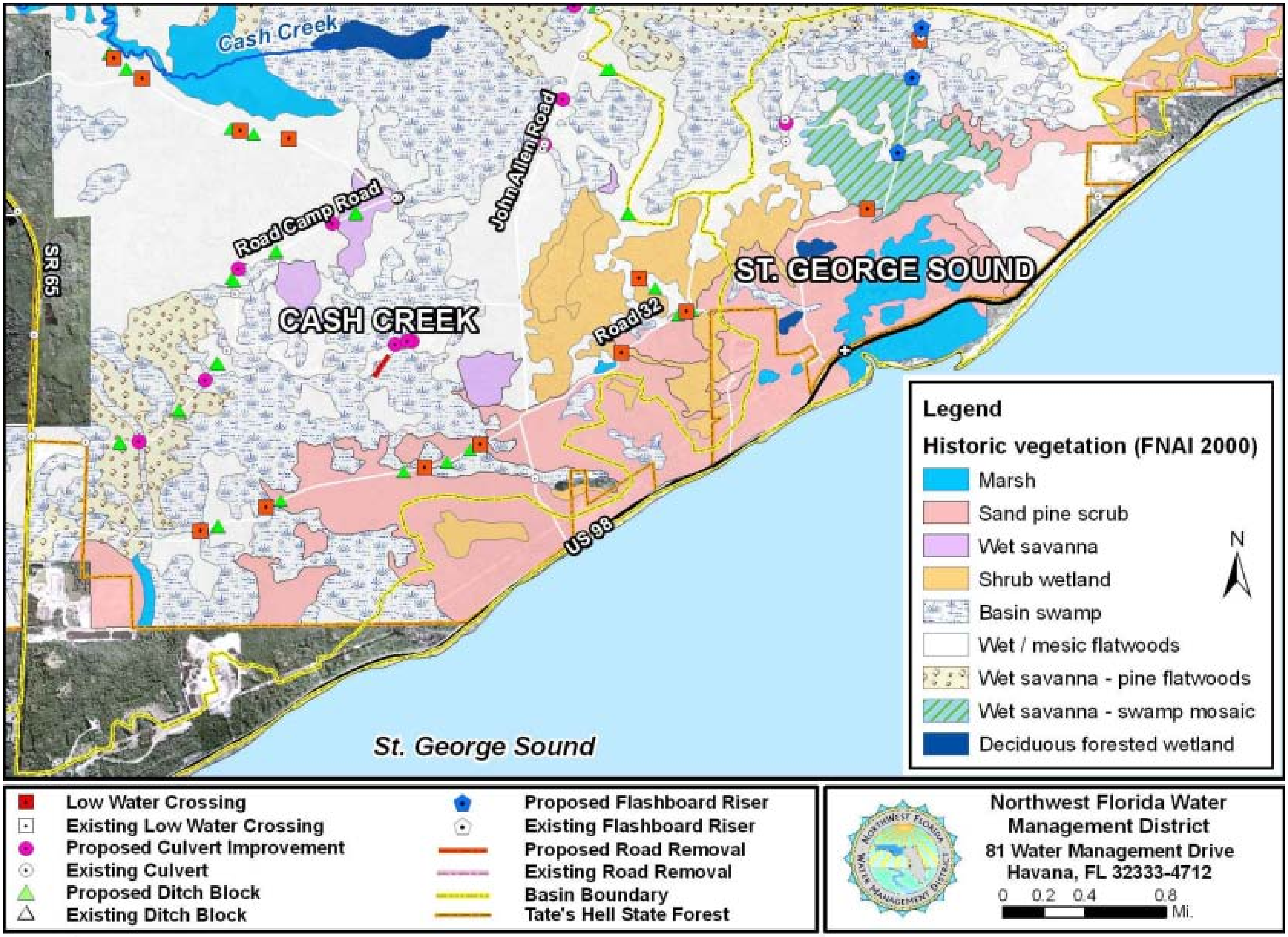

Figure 37. Historical ecological communities and proposed hydrologic improvements in the southern portion of the Cash Creek basin and the eastern St. George Sound basin.

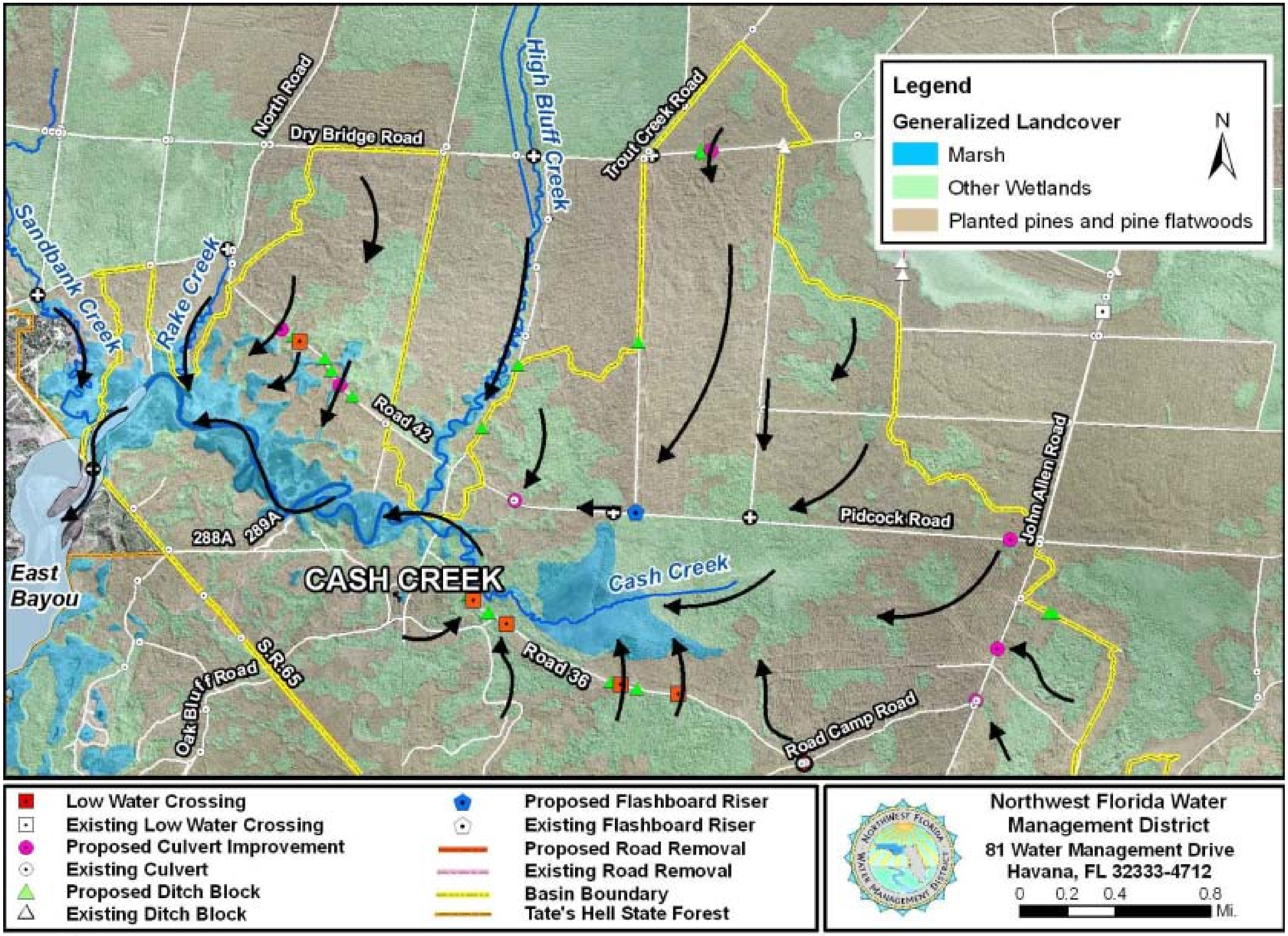

Figure 38. Proposed hydrologic improvements and post-restoration drainage patterns in the northern portion of the Cash Creek basin.

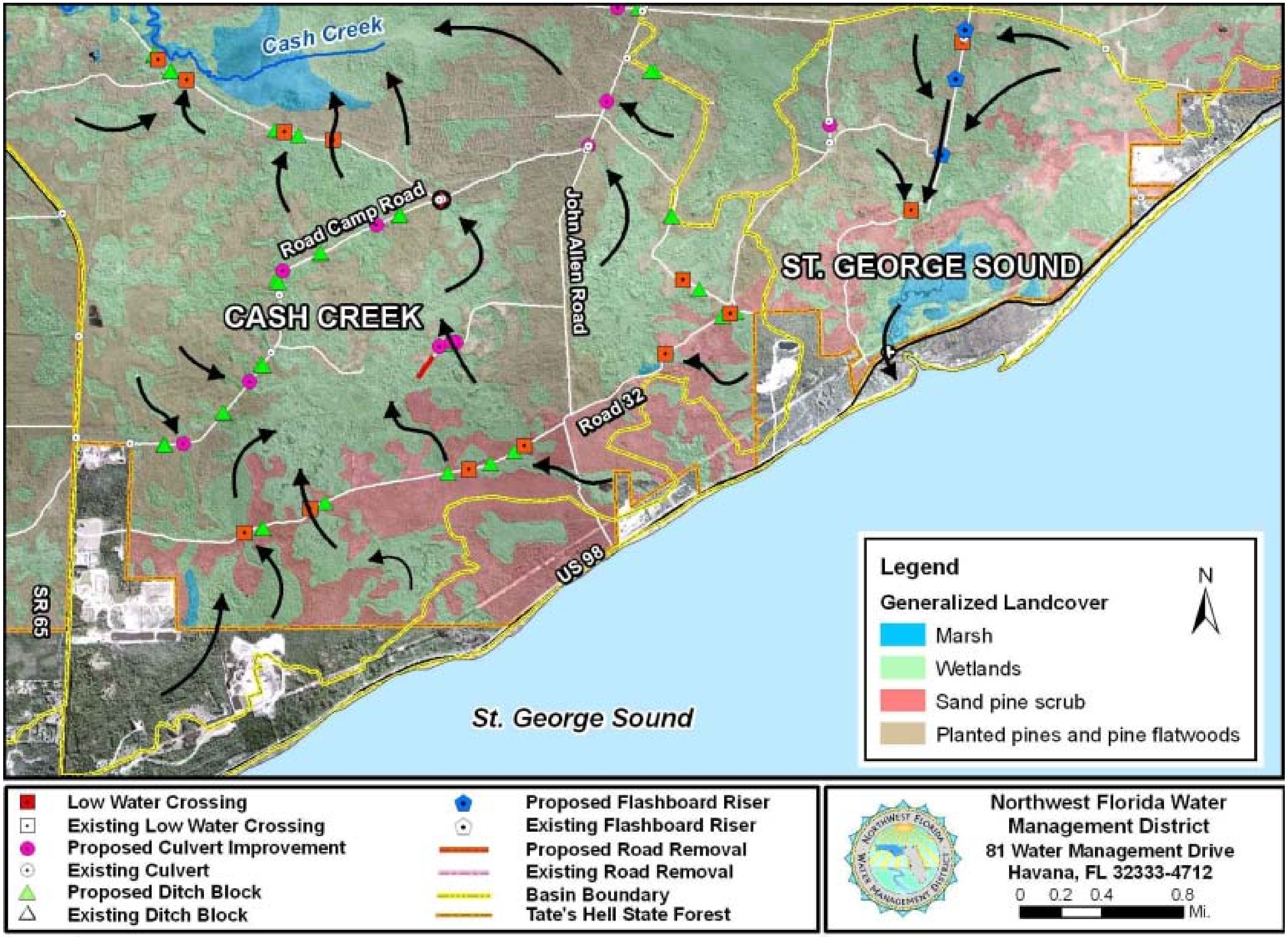

Figure 39. Proposed hydrologic improvements and post-restoration drainage patterns in the southern portion of the Cash Creek basin and the eastern St. George Sound basin.

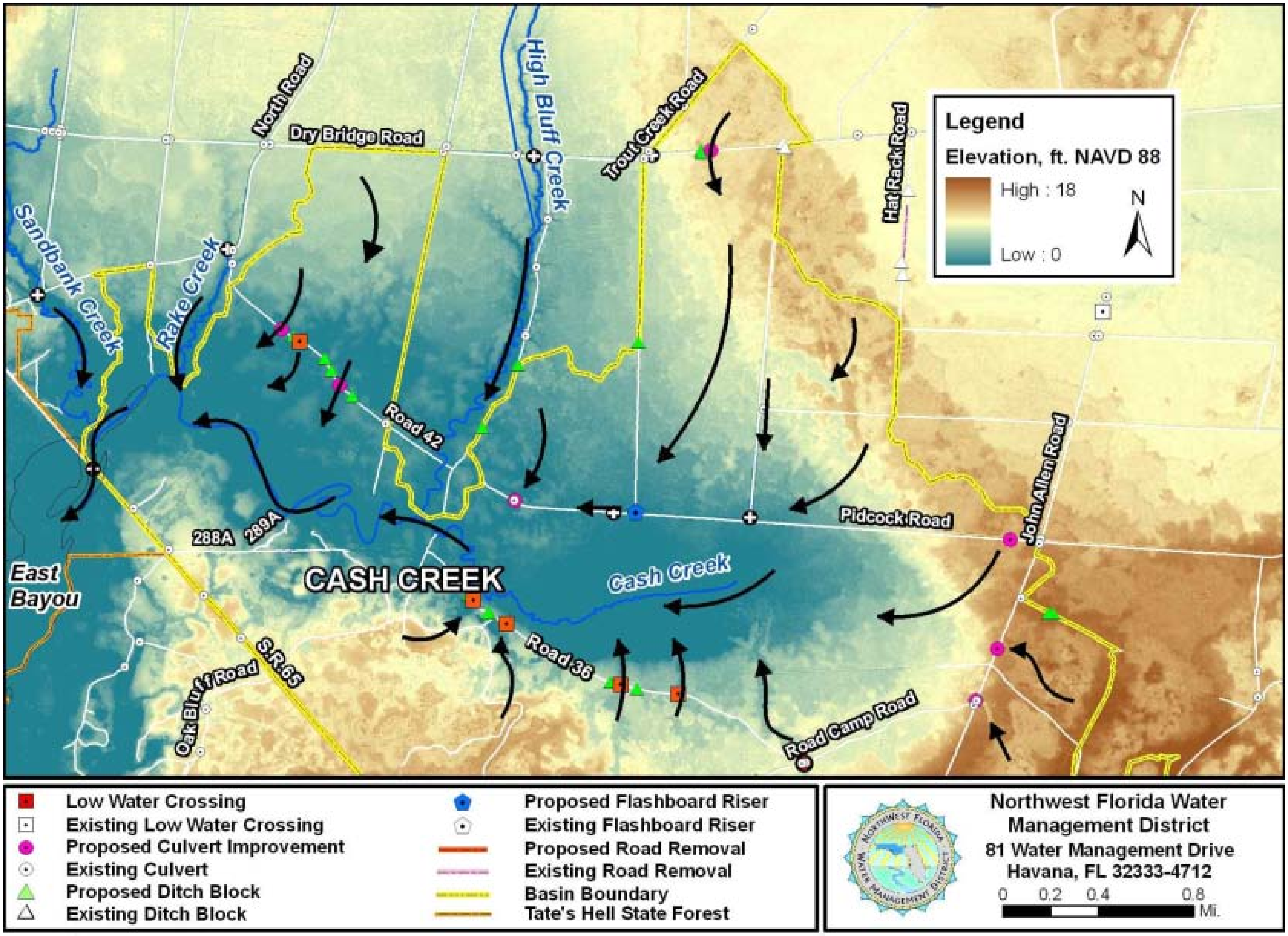

Figure 40. LiDAR elevation data, proposed hydrologic improvements and post-restoration drainage patterns in the northern portion of the Cash Creek basin.

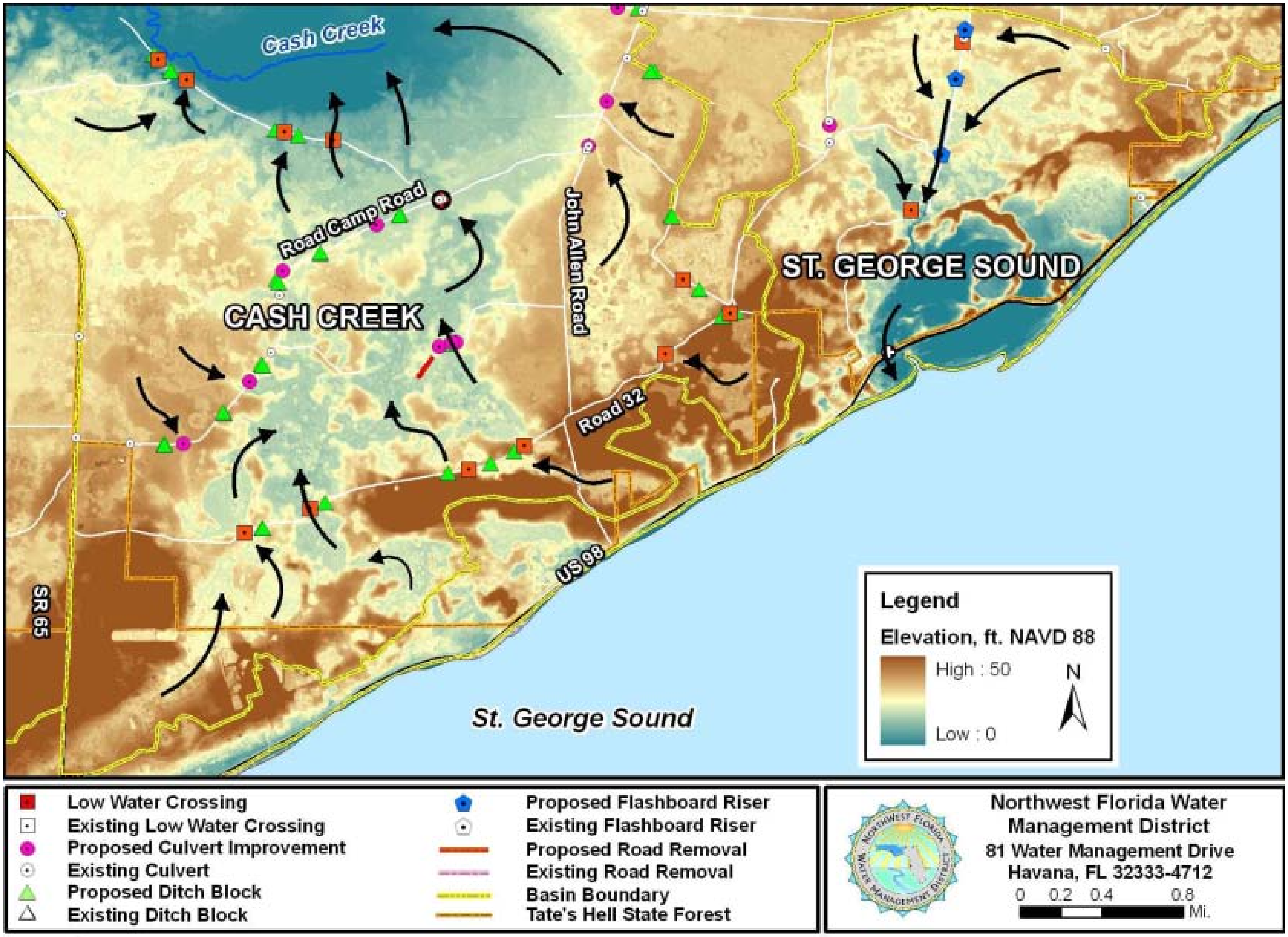

Figure 41. LiDAR elevation data, proposed hydrologic improvements and post-restoration drainage patterns in the southern portion of the Cash Creek basin and the eastern St. George Sound basin.

Sandbank Branch Creek and Rake Creek Basins

Restoration Priority: High

Basin Areas: 8,600 acres (Sandbank Branch) and 4,800 acres (Rake Creek)

Description: The Sandbank Branch and Rake Creek basins are relatively large, parallel drainage basins that drain to the south and discharge into Cash Creek. In the northern and much of the southern half of both basins, there is no defined stream channel. Historically, surface water runoff in these basins flowed south through a series of basin swamps, wet savannas, and cypress flats (Figure 42). In the southernmost portion of each basin, there was a relatively short stream channel that received inflow from the upstream wetlands prior to discharging to Cash Creek (Figure 43). Surface water drainage in both of these basins has been significantly altered by the construction of roads and large ditches.

<u>Sandbank Branch</u>

North of West Double Bridge Road in the Sandbank Branch Basin, a large remnant basin swamp continues to convey surface water runoff towards the south where it flows through an existing low water crossing on West Double Bridge Road (Figure 44). South of West Double Bridge Road, much of the surface water runoff is now conveyed south in roadside ditches, particularly the large ditches adjacent to Tucker Road (Figures 44 and 45).

Between Buck Siding Road and Dry Bridge Road, a large cypress slough marked the last of a series of interconnected wetlands that once drained south to the Sandbank Branch stream (Figures 43 and 45). The slough is now considerably smaller in size and the northern half has been planted in pines. The Sandbank Branch stream channel originates at the southern end of this slough system on the north side of Dry Bridge Road. Streamflow is conveyed south across Dry Bridge Road through two culverts. From here, a portion of the water is conveyed south into another large cypress slough and the remainder flows into the ditch on the west side of Tucker Road. From the slough, the Sandbank Branch stream flows south where it merges with the Tucker Road drainage ditch. Sandbank Branch then flows south across North Road, through an estuarine marsh and into Cash Creek.

Some minor hydrologic restoration activities have been performed in the Sandbank Branch basin. A small low water crossing was installed on West Double Bridge Road. A 0.4-mile road segment north of West Double Bridge Road was removed and restored to natural grade by the NWFWMD in 2009 to restore an Atlantic white cedar swamp (Figure 44). South of West Double Bridge Road near the western edge of the basin, several road segments were removed by the NWFWMD as part of the Whiskey George Savannas restoration project in 2009.

Rake Creek

The surface water drainage basin for Rake Creek has been significantly altered by the construction of roads and ditches and currently extends farther north than it did historically. The 1953 aerial photography and historical vegetation map (FNAI 2001) suggest that the area north of Buck Siding Road previously drained east towards High Bluff Creek (Figure 42). However, most of the surface water runoff from this area is now conveyed south in the large drainage ditch adjacent to North Road. The ditch discharges into Rake Creek south of Dry Bridge Road. However, there are two culverts at the intersection of North Road and Buck Siding Road that may continue to convey some of the surface water runoff east into the High Bluff Creek basin.

2010 – 2020 Hydrologic Restoration Plan: Future hydrologic improvements are aimed at reducing flow in ditches, re-establishing hydrologic connections, enhancing wetland hydroperiods, and restoring historical surface water drainage patterns.

Sandbank Branch

In the northern portion of the Sandbank Branch basin, two low water crossings and six culverts are proposed to restore more natural surface water drainage patterns. To reduce the flow in roadside ditches and restore natural drainage divides, 11 flashboard risers and six ditch blocks are also proposed (Figures 42, 44, and 46).

In the southern portion of the basin, five new culverts are proposed to enhance southerly flow and three culvert removals are proposed to reduce surface water flow across basin boundaries. Two additional culverts are proposed to be removed on Dry Bridge Road and replaced with a low water crossing (Figures 43, 45, and 47). A relatively long low water crossing will be needed because a large section of the road is periodically flooded during wet conditions. Six flashboard risers are proposed to decrease flow in roadside ditches and reduce flow across basin boundaries. Five ditch blocks will redirect runoff towards new low water crossings and culverts, restore local topographic divides, and reduce surface water flow across basin boundaries.

On Tucker Road about 0.6 miles north of Dry Bridge road, a box culvert is proposed where the former cypress slough would have crossed the road (yellow octogon on Figures 43, 45, and 47). A flashboard riser is proposed at the road intersection located immediately to the south to help retain water in the former slough and reduce flow in the ditch.

There are no road removals proposed in the Sandbank Branch basin at this time. However, logging roads should be considered for removal following future tree thinning and habitat restoration activities.

Rake Creek

In the northern portion of the Rake Creek basin, four low water crossings are proposed to restore surface water drainage patterns and flow between historical wetland areas (Figures 42, 44, and 46). Seven ditch blocks will redirect flow towards the new low water crossings and restore local topographic divides. A new culvert will convey surface water runoff south across Buck Siding Road. Two new culverts are also proposed to convey surface water runoff across Dry Bridge Road and provide a hydrologic connection between wetlands on the north and south sides of the road (Figures 43, 45, and 47). South of Dry Bridge Road, an existing culvert that brings water into Rake Creek from the east is proposed to be replaced with a larger box culvert (yellow octogon on Figures 43, 45, and 47).

Estimated Construction Cost for Hydrologic Improvements: $ 430,000

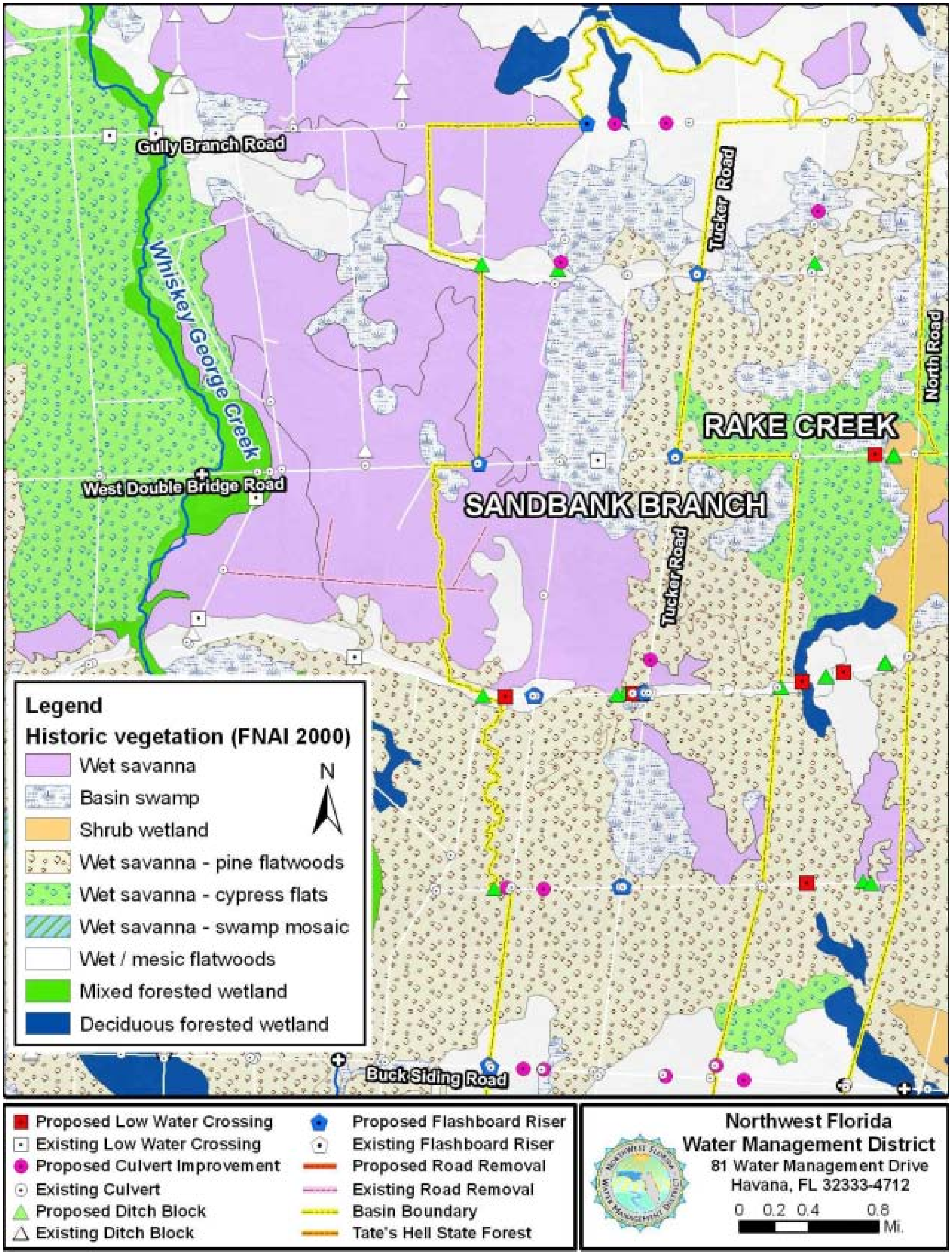

Figure 42. Historical ecological communities and proposed hydrologic improvements in the northern portion of the Sandbank Branch and Rake Creek basins.

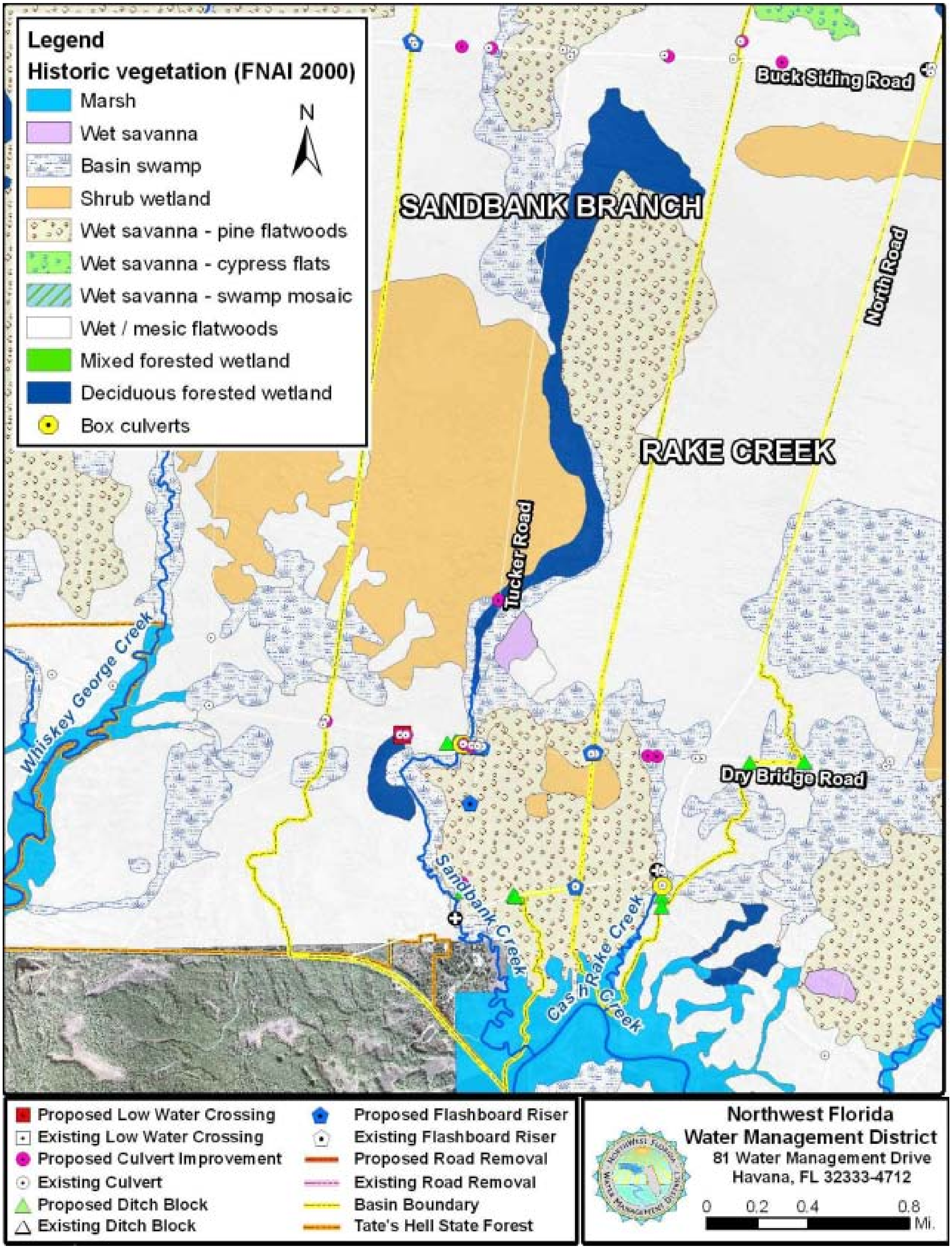

Figure 43. Historical ecological communities and proposed hydrologic improvements in the southern portion of the Sandbank Branch and Rake Creek basins.

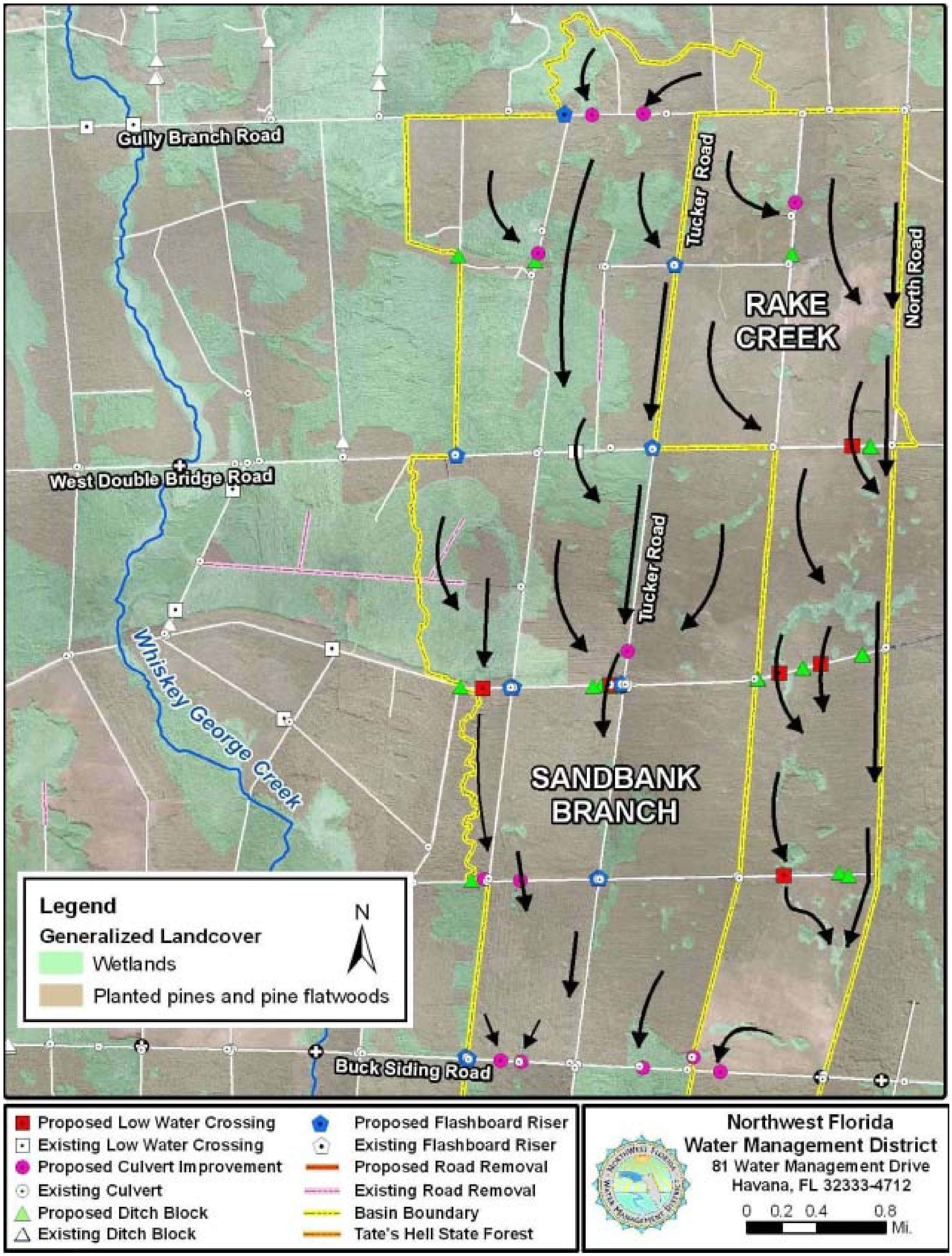

Figure 44. Proposed hydrologic improvements and post-restoration drainage patterns in the northern portion of the Sandbank Branch and Rake Creek basins.

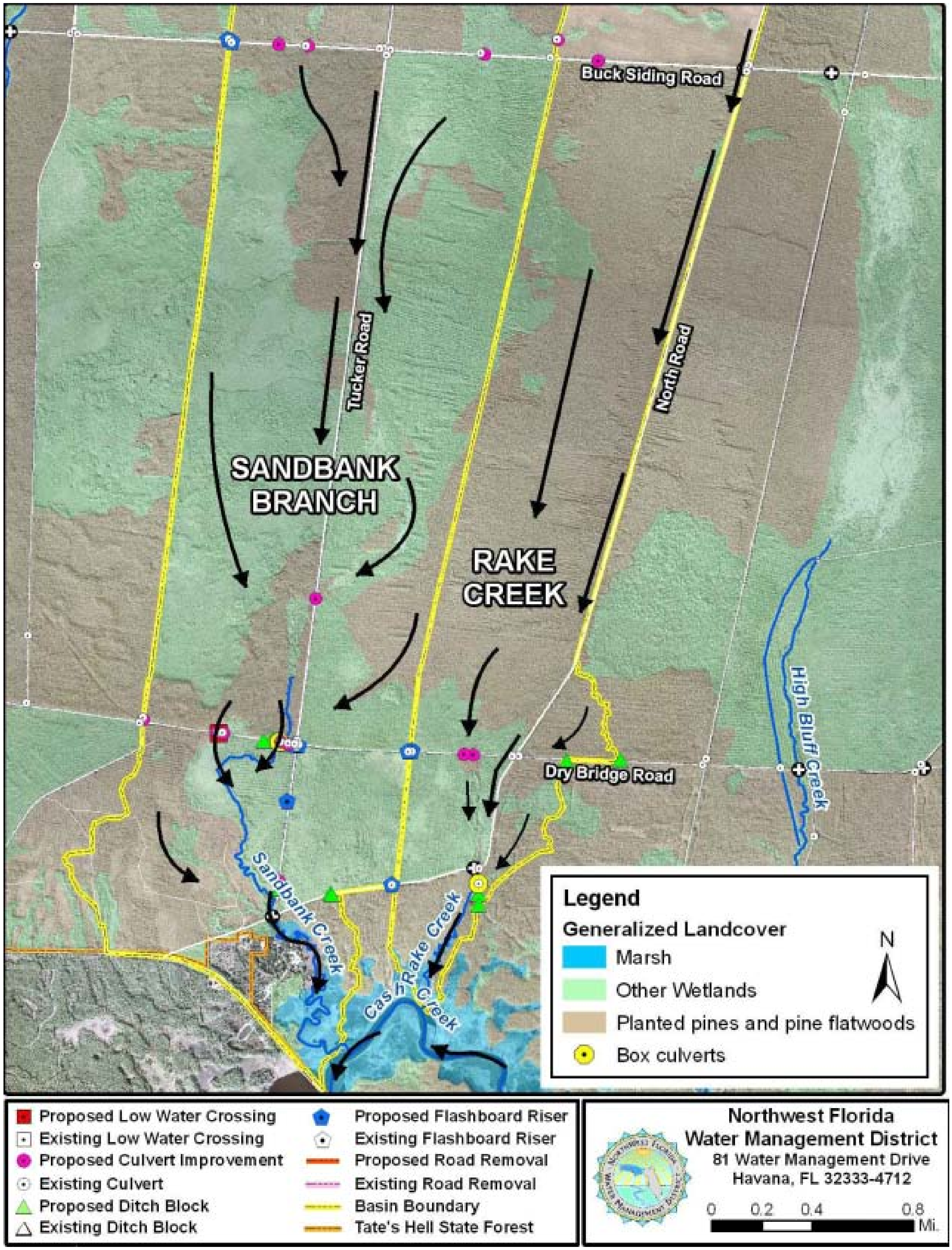

Figure 45. Proposed hydrologic improvements and post-restoration drainage patterns in the southern portion of the Sandbank Branch and Rake Creek basins.

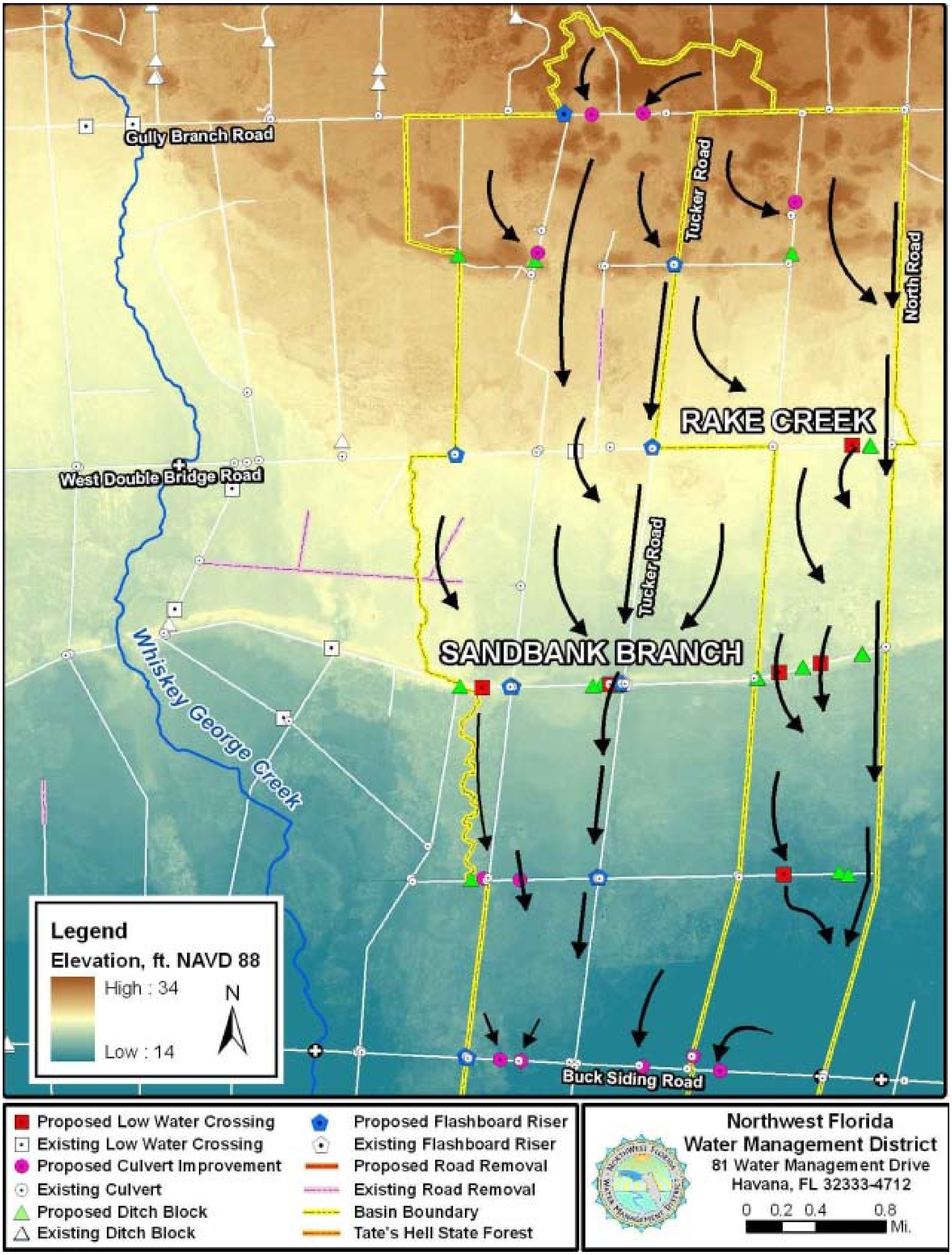

Figure 46. LiDAR elevation data, proposed hydrologic improvements and post-restoration drainage patterns in the northern portion of the Sandbank Branch and Rake Creek basins.

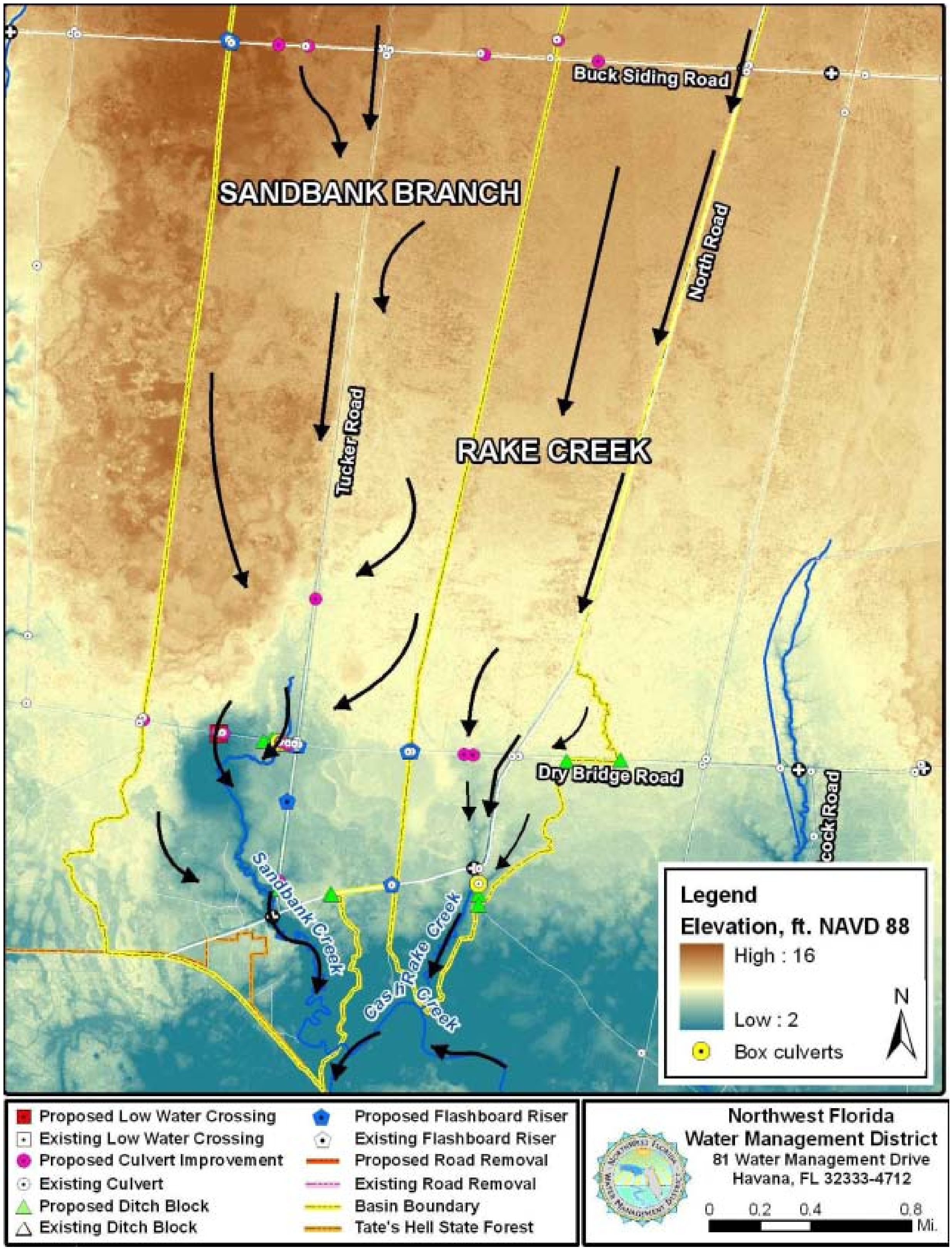

Figure 47. LiDAR elevation data, proposed hydrologic improvements and post-restoration drainage patterns in the southern portion of the Sandbank Branch and Rake Creek basins.

High Bluff Creek Basin

Restoration Priority: High

Basin Area: 9,500 acres

Description: The High Bluff Creek basin is a long and relatively narrow watershed located east of Whiskey George Creek. In the northern portion of the basin, surface water historically drained in a southerly direction through a series of scattered wetlands, eventually flowing into a large cypress wetland near the present day intersection of North Road and Buck Siding Road (Figures 48 through 51). From the cypress wetland, High Bluff Creek flows south and eventually discharges into Cash Creek. Immediately north of Dry Bridge Road, a large drainage ditch conveys water parallel to the creek (Figure 51). The ditch flows into High Bluff Creek on the south side of Dry Bridge Road. In the lower portion of the basin, the stream and adjacent basin swamp transitions into a marsh (Figures 49 and 51). The stream meanders through the marsh before discharging into Cash Creek.

The 1953 aerial photography indicates that Dry Bridge Road, Trout Creek Road, and Buck Siding Road existed and North Road had been partially constructed. The construction of these and subsequent roads and the conversion of wetland habitats to pine plantation significantly altered drainage patterns and ecological communities in the basin. Only scattered wetlands remain north of Buck Siding Road (Figure 50). Much of the surface water runoff is now conveyed through drainage ditches along North Road, West Double Bridge Road, Buck Siding Road, and Dry Bridge Road and in the large ditch that parallels the creek in the southern part of the basin.

2010 – 2020 Hydrologic Restoration Plan: Proposed hydrologic improvements will reduce ditch flow, redirect surface water runoff towards former wetlands areas and High Bluff Creek, and improve wetland hydrology. In the northern portion of the basin, six flashboard risers will reduce ditch flow across basin boundaries (Figures 48, 50, and 52). A new culvert on West Double Bridge Road will reconnect a former wetland (Figure 48) and enable surface water runoff to flow south at this location. The two low water crossings and associated ditch blocks will restore flow through a former basin swamp system (Figures 48 and 50). An existing culvert will be removed when the low water crossings are installed (e.g. culvert modification). Farther to the south, a proposed new culvert will enable surface water runoff to flow to the southwest across a logging road (Figure 50).

In the southern portion of the basin, a 0.5 mile road segment located north of Buck Siding Road is proposed for removal once the pines are thinned (Figures 49, 51, and 53). Although this area is now planted in pines, the historical vegetation map indicates that this was formerly a shrub wetland. Immediately south of the road removal, an existing culvert is proposed to be replaced with a long low water crossing. Two ditch blocks will direct surface water flow through the crossing and prevent water from continuing to flow south in the ditch.

Four new culverts and two culvert removals are proposed in the southern portion of the basin to facilitate surface water flow west towards High Bluff Creek and restore historical basin boundaries (Figures 49, 51, and 53). Six flashboard risers and multiple additional ditch blocks will also help to restore historical surface water drainage patterns. Although it would be desirable to fill the large canal that parallels High Bluff Creek, the cost of the fill material and associated earth moving activities would be very high. It may be possible instead to remove part of the berm on the eastern side of the canal to reestablish a more natural flow path for water to drain towards High Bluff Creek. Removing planted pines to restore the large cypress slough located on both sides of Buck Siding Road also should be considered.

Estimated Construction Cost for Hydrologic Improvements: $ 220,000

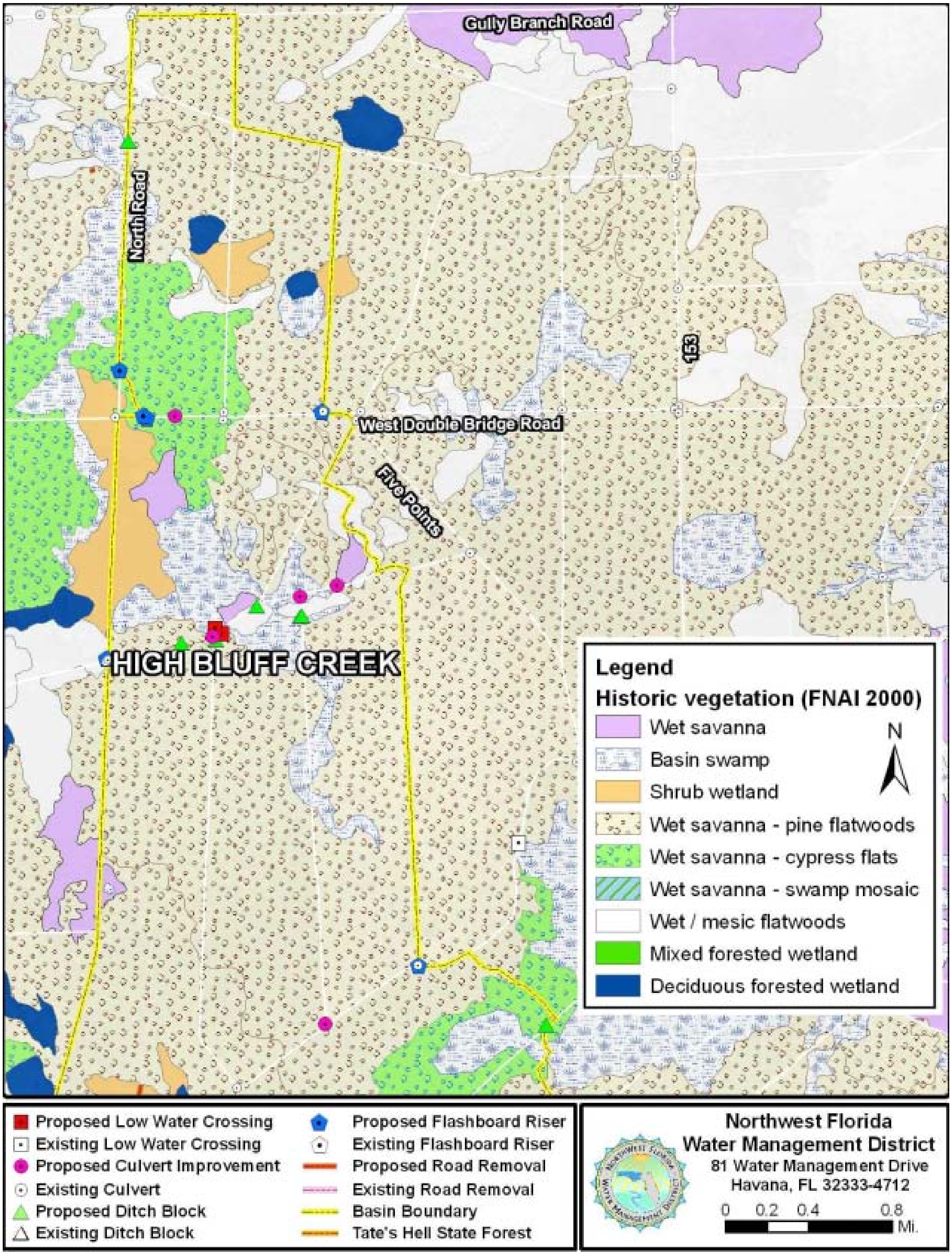

Figure 48. Historical ecological communities and proposed hydrologic improvements in the northern portion of the High Bluff Creek basin.

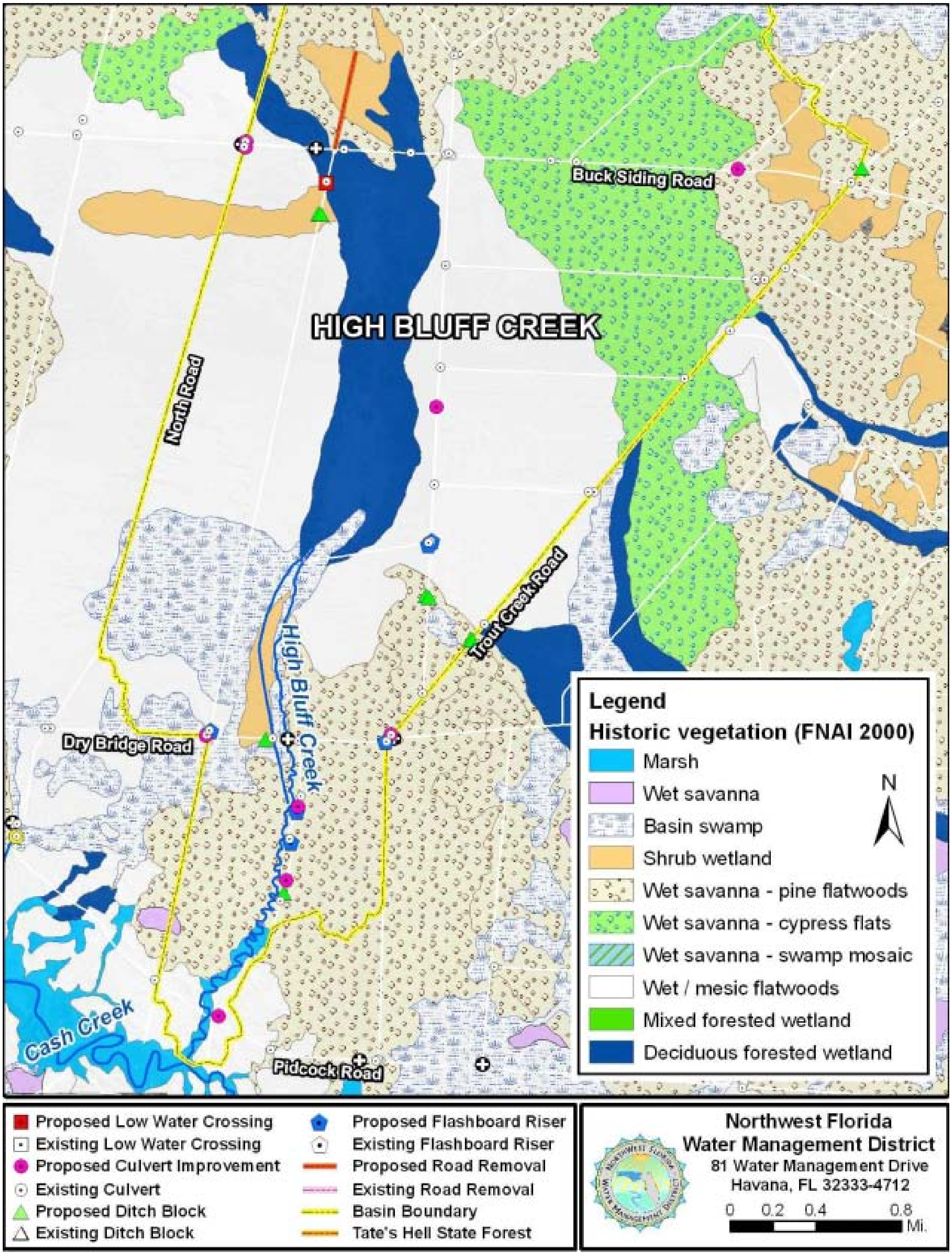

Figure 49. Historical ecological communities and proposed hydrologic improvements in the southern portion of the High Bluff Creek basin.

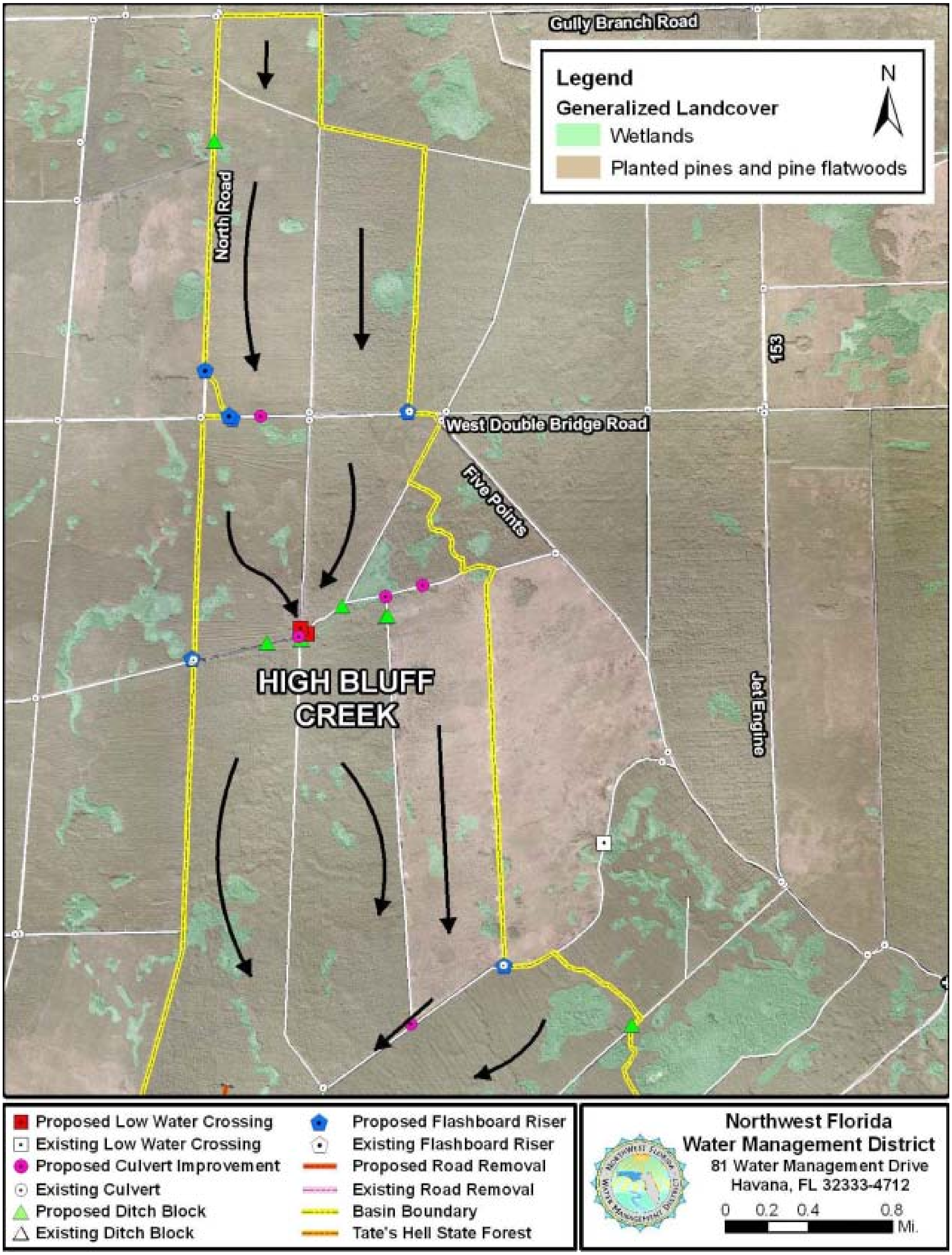

Figure 50. Proposed hydrologic improvements and post-restoration drainage patterns in the northern portion of the High Bluff Creek basin.

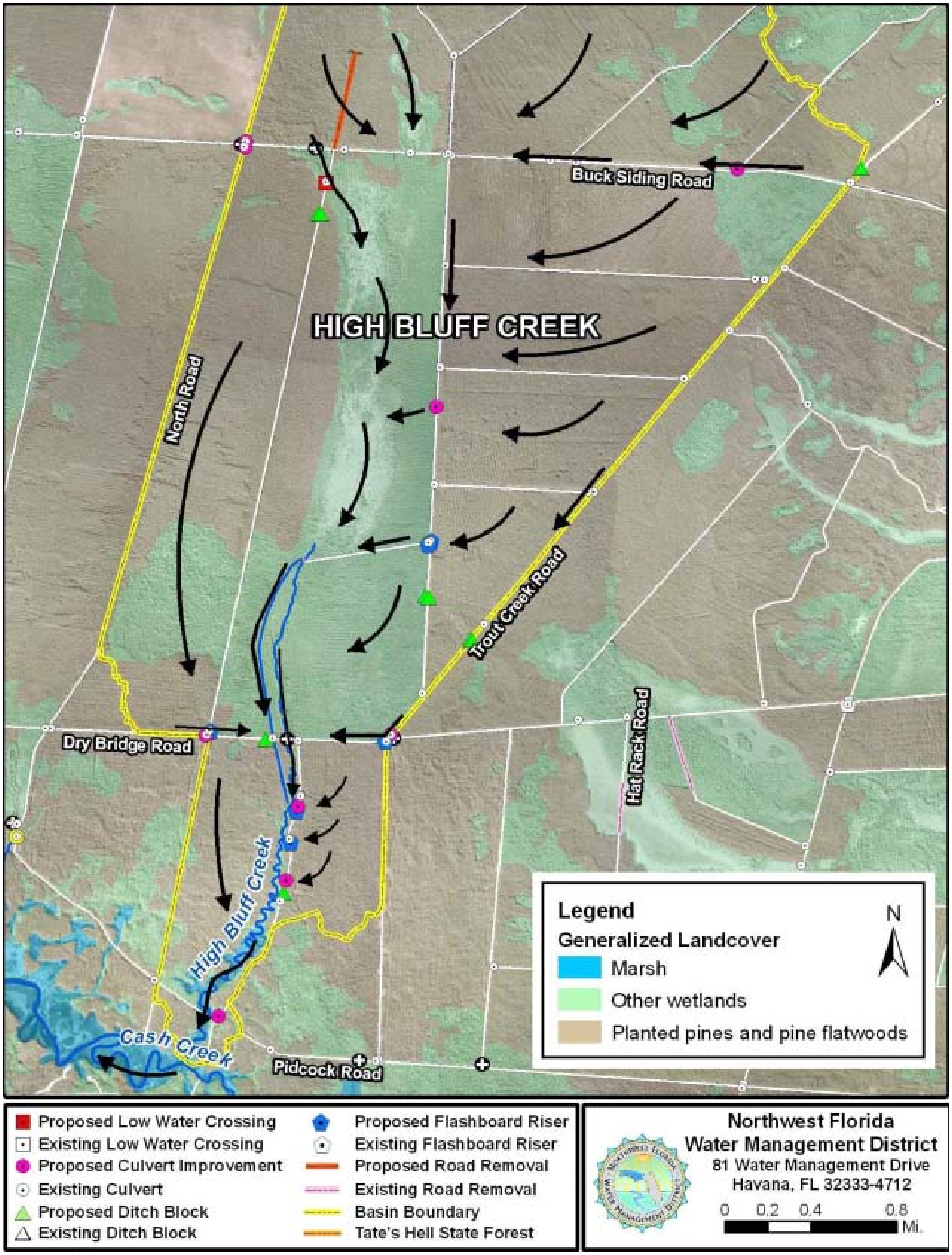

Figure 51. Proposed hydrologic improvements and post-restoration drainage patterns in the southern portion of the High Bluff Creek basin.

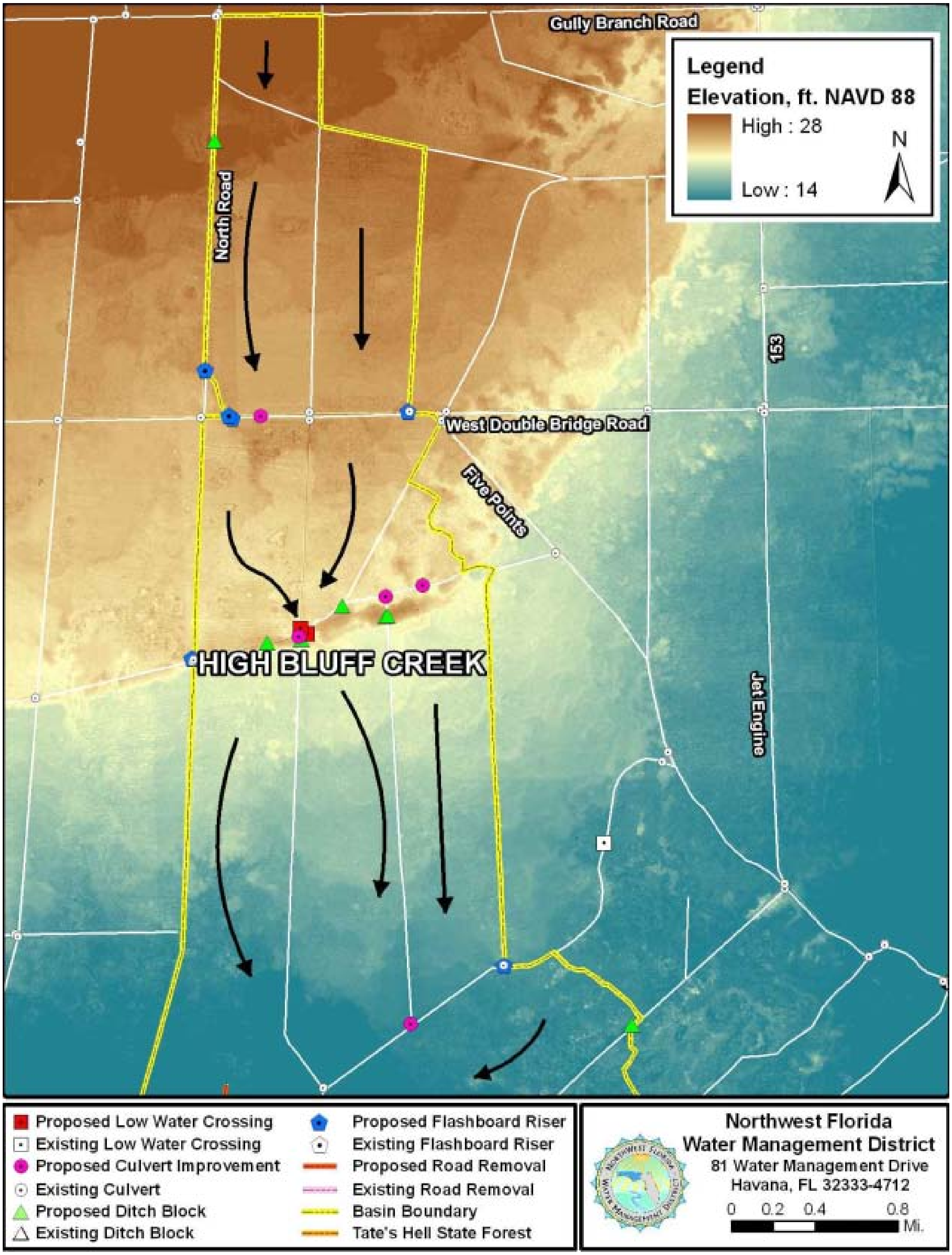

Figure 52. LiDAR elevation data, proposed hydrologic improvements and post-restoration drainage patterns in the northern portion of the High Bluff Creek basin.

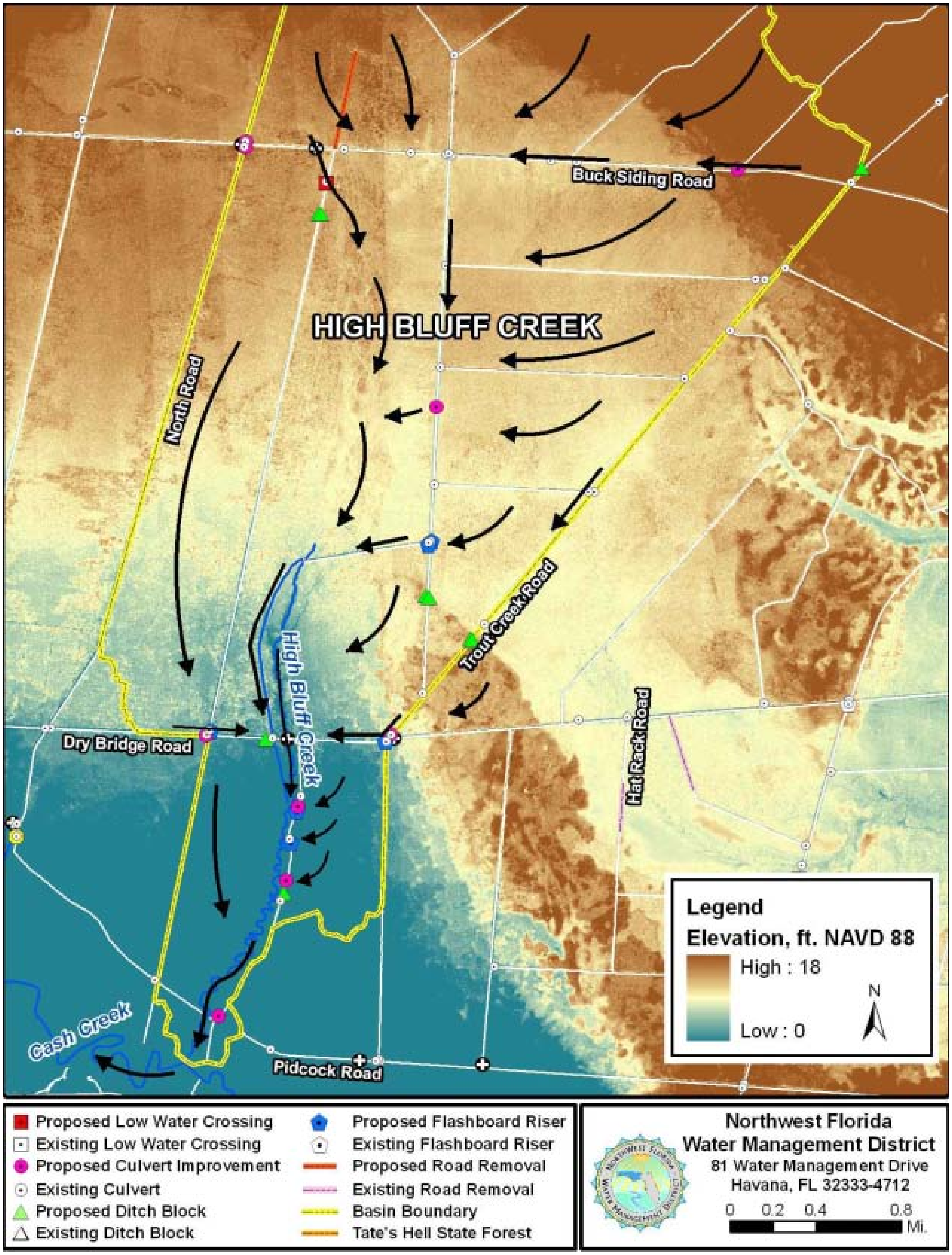

Figure 53. LiDAR elevation data, proposed hydrologic improvements and post-restoration drainage patterns in the southern portion of the High Bluff Creek basin.

Trout Creek

Restoration Priority: Medium

Basin Area: 15,100 acres

Description: The Trout Creek watershed is located in the central portion of Tate's Hell State Forest. The crescent-shaped dwarf cypress swamps are a distinguishing characteristic of this basin (Figures 54 and 55). In the northern and western portions of the basin, surface water runoff historically collected in basin swamps, shrub wetlands, and dwarf cypress swamps before draining to the north towards Trout Creek and its tributaries (Figure 54). In the southern portion of the basin, surface water runoff flowed north through a series of interconnected basin swamps (Figure 55). Trout Creek flows north and drains into the New River.

By 1953, Trout Creek Road, Buck Siding Road, Jet Engine Road, and Carbody Road had already been constructed. Despite the extensive road network that has been present for more than 50 years, the dwarf cypress swamps are largely intact, although some have been bisected by roads. In the northern portion of the basin, portions of many of the former shrub wetlands and wet savanna pine flatwoods habitats have been converted to pine plantation (Figures 54 and 56). Roadside ditches now convey most of the surface water runoff towards Trout Creek. In the southern portion of the basin, most of the surface water runoff still flows through the network of basin swamps (Figures 55 and 57). The logging roads in the southern portion of the basin are frequently sandy and narrow. Many of these roads are at or near natural grade and relatively few have roadside ditches. During periods of high water, sections of these roads can be overtopped with water.

The first restoration project implemented in Tate's Hell State Forest by the NWFWMD was the Dwarf Cypress / Trout Creek Restoration Project. The project involved removing a 0.24-mile section of road that bisected a dwarf cypress swamp and installing several ditch blocks and three new culverts in the western portion of the basin (Figures 55 and 57). There is now a short boardwalk and educational kiosk at the northern end of the former roadway, which is located south of Dry Bridge Road and west of Carbody Road.

A second wetland restoration project was implemented in the vicinity of Dry Bridge Road and Carbody Road by Carrabelle Ventures in 2006. The project included the removal of approximately 2,000 feet of logging roads and the installation of a flashboard riser, several ditch blocks, and multiple culverts to restore natural surface water drainage towards the creek (Figures 55 and 57).

2010 – 2020 Hydrologic Restoration Plan: Future restoration activities will build on previous efforts to restore historical surface water drainage patterns and enhance wetland hydrology. In the northern portion of the basin (Figures 54, 56, and 58), nine low water crossings, together with 15 culverts and numerous ditch blocks, will restore surface water flow through historical wetland systems and towards Trout Creek. To improve the conveyance and stream channel habitat, three existing culverts that convey stream flow across roads are proposed to be replaced with small bridges or box culverts. Two road segments are proposed to be removed and recontoured to natural grade. One segment, approximately 300 ft in length, bisects the western end of a dwarf cypress swamp. The other segment, approximately 2900 ft in length, parallels Airport Road (Figures 54, 56, and 58).

In the southern portion of the basin (Figures 55, 57, and 59), an existing low water crossing on John Allen Road is proposed to be improved and relocated about 150 ft. north of its current location. The low water crossing provides a hydrologic connection for a dwarf cypress swamp that is bisected by the road. In the southeast portion of the basin, eight additional low water crossings and associated ditch blocks are proposed to be constructed to restore hydrologic surface water flow paths between and among historical basin swamps (Figures 55, 57, and 59). These crossings will also improve vehicle access as many of these roads are likely overtopped with water during periods of high rainfall. Several new culverts are proposed to be installed to improve drainage through historical basin swamps bisected by Dry Bridge Road. Three sections of forest roads, totaling 1.9 miles are proposed to be taken out of service and restored to natural grade. One of these road sections bisects a former wet savanna, one bisects a dwarf cypress swamp, and the third bisects a basin swamp that has a mixed tree canopy of cypress, slash pine, and titi (Figure 55).

In all, a total of 19 low water crossings, two flashboard risers, 33 culvert modifications, 79 ditch blocks, and 1.95 miles of road removal are proposed in the Trout Creek basin.

Estimated Construction Cost for Hydrologic Improvements: $ 970,000

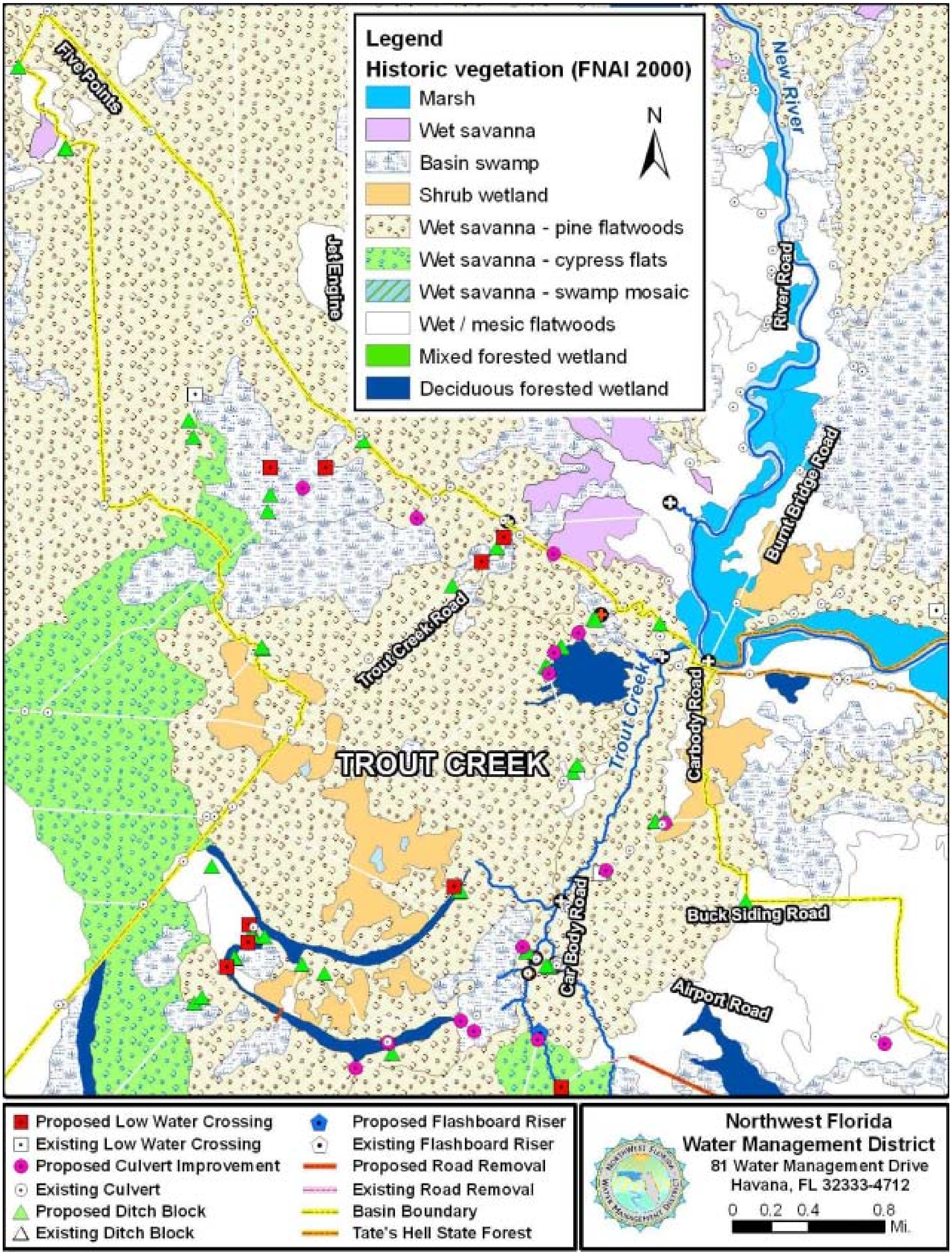

Figure 54. Historical ecological communities and proposed hydrologic improvements in the northern portion of the Trout Creek basin.

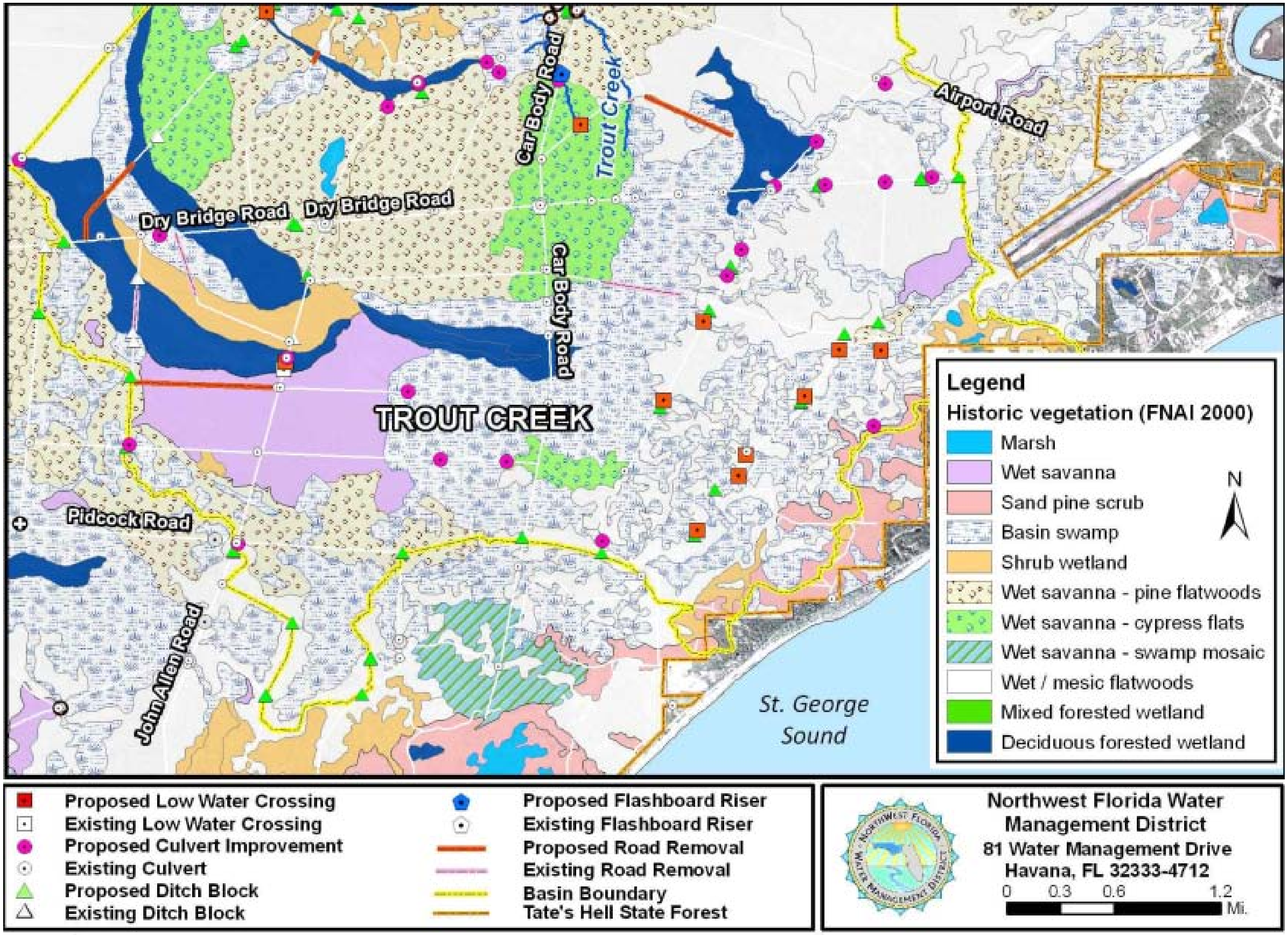

Figure 55. Historical ecological communities and proposed hydrologic improvements in the southern portion of the Trout Creek basin.

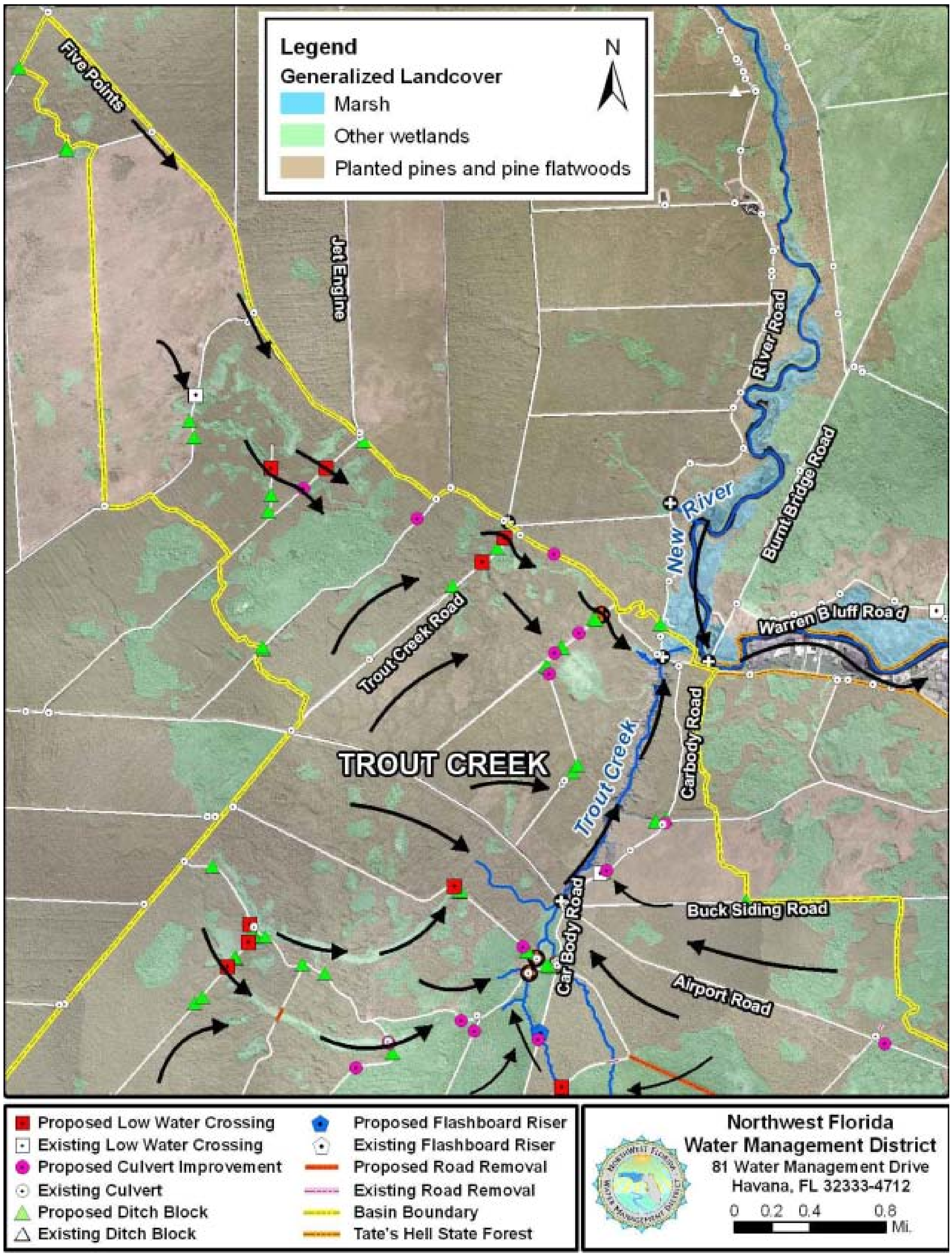

Figure 56. Proposed hydrologic improvements and post-restoration drainage patterns in the northern portion of the Trout Creek basin.

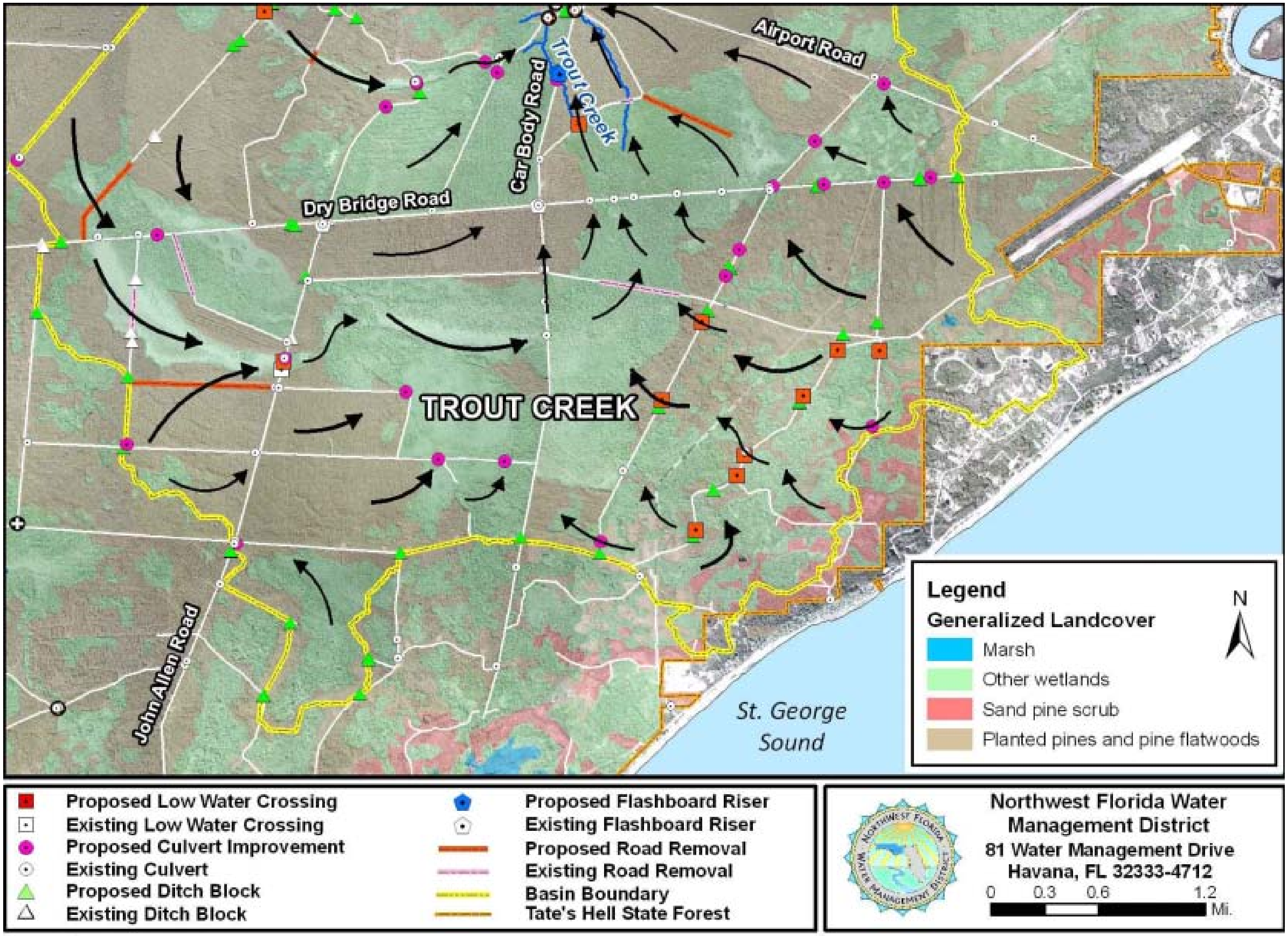

Figure 57. Proposed hydrologic improvements and post-restoration drainage patterns in the southern portion of the Trout Creek basin

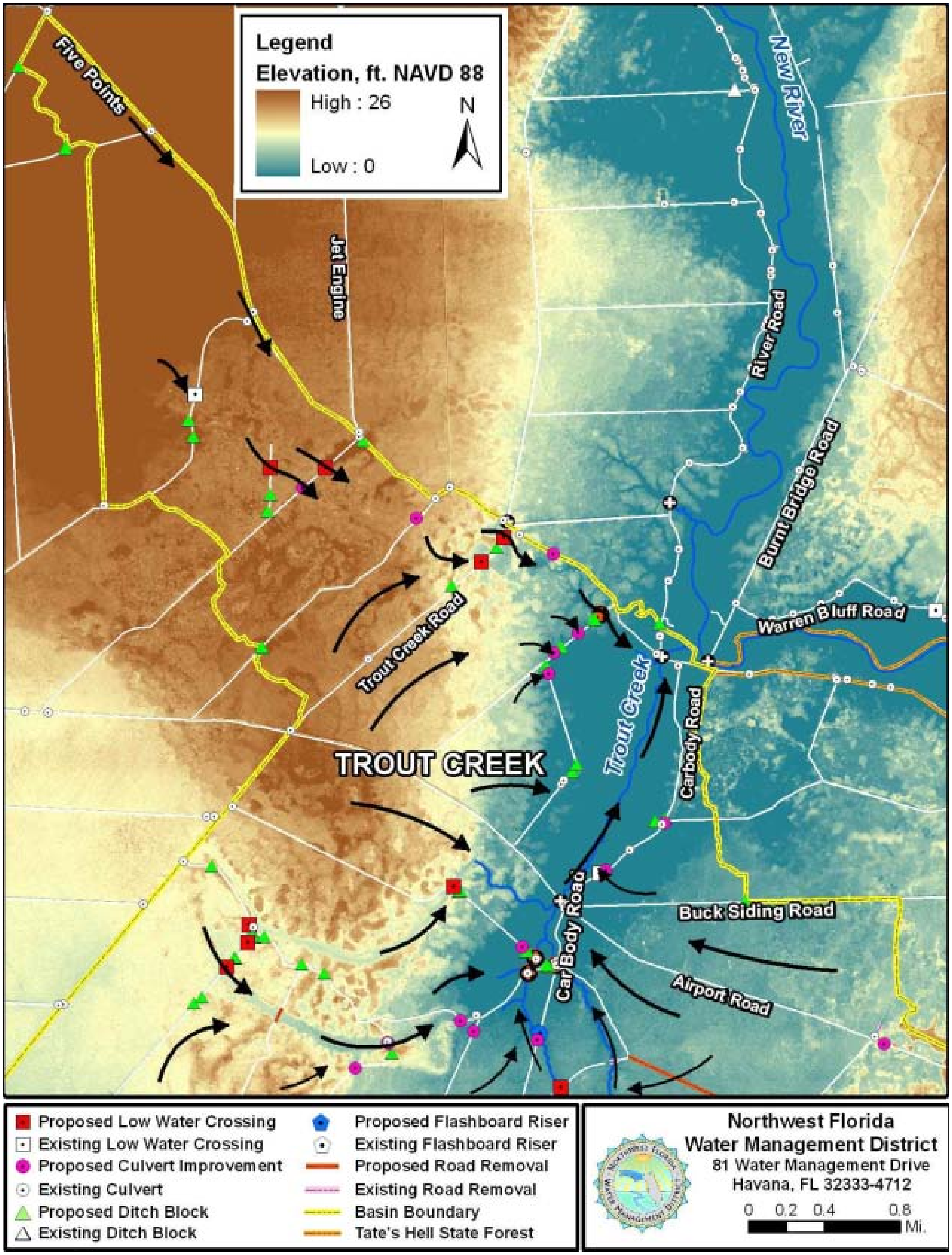

Figure 58. LiDAR elevation data, proposed hydrologic improvements and post-restoration drainage patterns in the northern portion of the Trout Creek basin.

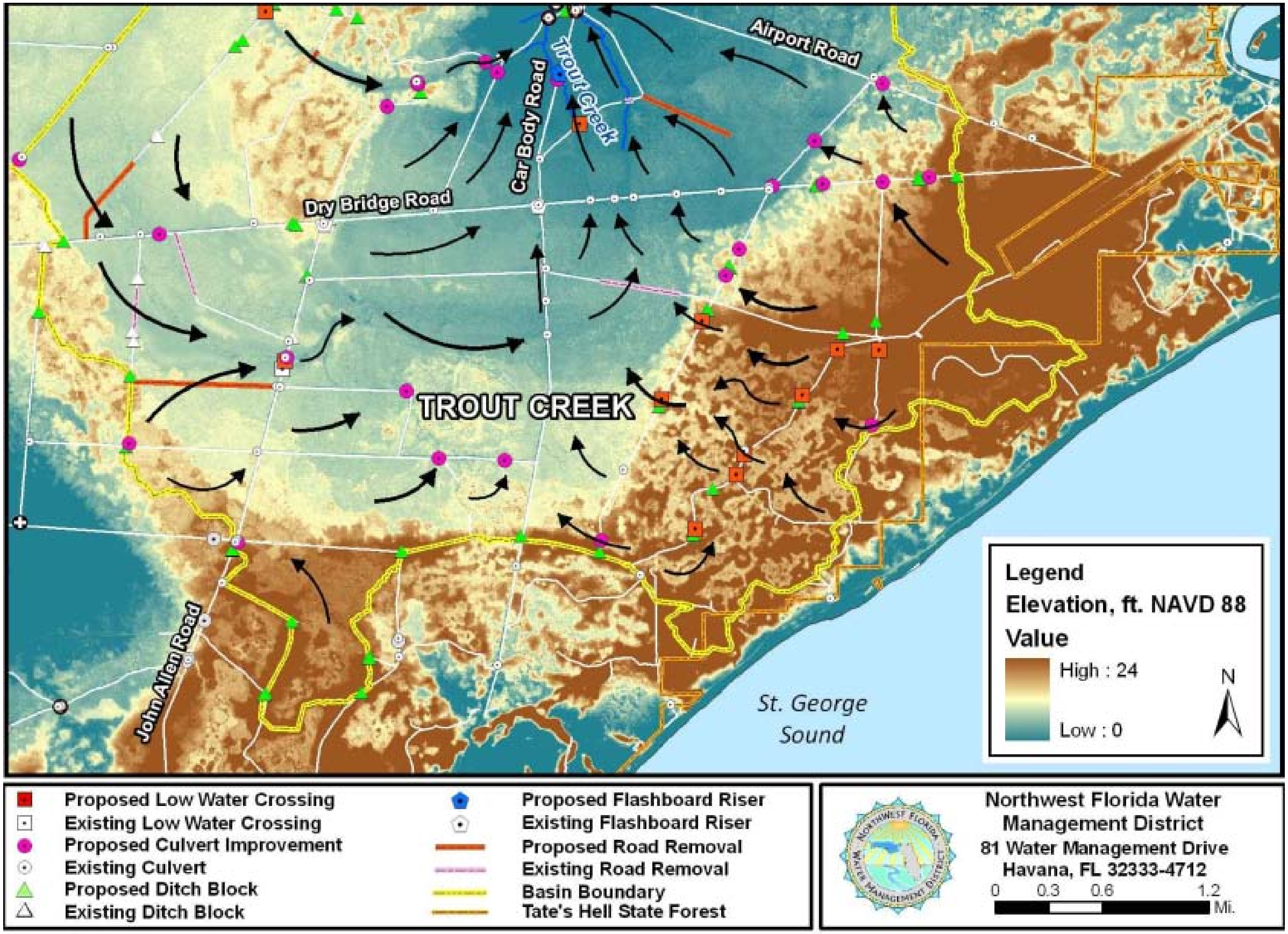

Figure 59. LiDAR elevation data, proposed hydrologic improvements and post-restoration drainage patterns in the southern portion of the Trout Creek basin

Nero Branch and Unnamed Creek Basins

Restoration Priority: High

Basin Area: 10,000 acres (both basins)

Description: This area is comprised of the Nero Branch and Unnamed Creek drainage basins located in the northwest region Tate's Hell State Forest (Figures 60 and 61). A small section of the New River basin is also included in this hydrologic restoration plan.

This Unnamed Creek drainage basin totals approximately 8,400 acres and is located entirely within Tate's Hell State Forest. Surface water runoff generally flows to the northeast where the creek drains into the New River. The historical vegetation consisted of large interconnected wetland systems surrounded by areas of wet savanna and mesic flatwoods. Road construction during the 1960s and 1970s altered surface water drainage patterns and bisected many of the wetland systems. The former wet savannas were converted to pine plantation. A large ditch on the north side of Sumatra Road now conveys much of the surface water runoff. Sections of the Unnamed Creek have been channelized.

The Nero Branch drainage basin encompasses approximately 1,500 acres and is located almost entirely within Tate's Hell State Forest. Historically, Nero Branch consisted of a series of interconnected cypress sloughs that drained east into the New River. Surrounding habitats consisted of wet savannas and mesic flatwoods. Sometime after 1953, a large ditch was excavated through the cypress sloughs. Nero Branch is now channelized along most of its length and the surrounding wetland habitats have been bisected by logging roads.

There has been little hydrologic restoration in either basin. In 1998, two low water crossings and several ditch blocks were installed in the southern portion of the Unnamed Creek basin as part of the Big Slough Restoration Project. A road segment in the northwest corner of the Unnamed Creek basin has been removed from service by the Division of Forestry and is no longer maintained. Shrubs have recolonized the roadway. However, the road has not been recontoured and the adjacent roadside ditches are still present.

2010 – 2020 Hydrologic Restoration Plans: Proposed restoration activities are aimed at reconnecting the cypress slough system, reconnecting contributing drainage areas to streams, and reducing flows in roadside ditches (see Figures 60 through 65).

In the section of the New River basin shown in the northwest corner of Figures 60, 62, and 64, three low water crossings are proposed along with a new large diameter (48-in) culvert. These improvements will reconnect this subarea of the drainage basin to the larger New River basin located to the north and east.

In the Unnamed Creek basin, several road segments are proposed to be removed (1.8 miles total) west of Cut-thru Road and the adjacent ditches are proposed to be filled to restore a 770-acre area (Figures 60, 62, and 64). Historically, this area was a mosaic of wet savanna, mesic flatwoods, and basin swamp habitats. Remnant wet savanna vegetation is evident along the edges of the roads.

In the northwest corner of this area, a low water crossing and two associated ditch blocks will restore surface water flows into a former deciduous forested wetland. The southern half of this wetland was mapped as mesic flatwoods by FNAI (2000) but the 1953 aerial photography suggests that this was a wetland. Water has been observed flowing across the road at this location. In the southeast corner of this area, three 24-in diameter culverts are proposed to reconnect a large deciduous forested wetland located on the south end of Cut-thru Road. A low water crossing would be preferable; however Cut-thru Road is a primary road that is needed for year-round vehicle access. The elevation of Cut-thru Road is close to the natural grade and additional fill material will be needed to build up the road and achieve 18" of cover over the proposed culvert pipes. North of the proposed culverts, two ditch blocks are recommended to be installed to prevent ditch flow to the north. Farther west in the basin, two culverts are in poor condition and need to be replaced.

Along Zig Zag Road, which is located immediately east of Cut-thru Road, the culvert that conveys the Unnamed Creek across the road should be replaced with a low water crossing to restore a shallow and broad stream channel (Figures 60, 62, and 64). Ditch blocks should be installed to facilitate flow through this crossing. Toward the southern end of Zig Zag Road, a low water crossing and new culvert are needed to restore surface water drainage toward the east. The southernmost culvert (across Road 56) should be removed or relocated to the bend in the road (about 0.3 miles to the east). There is a remnant ditch that begins at the southern end of Zig Zag road (Figures 61, 63, and 65) and extends east into a cypress wetland. It is recommended that several ditch blocks be installed to reduce the flow of water in this ditch and restore historical surface water drainage patterns.

On the eastern end of Sumatra Road, a series of culverts are proposed to restore surface water flow to and within this large cypress slough system (Figures 61, 63, and 65). It would be preferable to remove this section of road; however it is a secondary road that is needed for forest management activities. Slightly to the west, an existing culvert on Sumatra Road is proposed to be replaced with a low water crossing. West of the low water crossing, a culvert replacement, a new culvert, and a small bridge are proposed to restore the conveyance of surface water flows into this large wetland system. There is a large ditch that was excavated through the wetland south of the proposed bridge.

Between Sumatra Road and Nero Road, three low water crossings are proposed to reconnect a large deciduous forested wetland system (Figures 61, 63, and 65). At the eastern end of Nero Road, a new culvert and a culvert replacement are proposed to reconnect a former basin swamp. An existing culvert on Nero Road is proposed to be replaced with a small bridge. The culvert does not have sufficient conveyance capacity and the road is eroding in this area. Farther west, a second small bridge is proposed to reconnect the historical channel of the Unnamed Creek. Currently the historical stream channel is severed by the road and the stream flow is conveyed east in a large roadside ditch and then to the north through an existing culvert.

In the southeast corner of the Unnamed Creek basin (Figures 61, 63, and 65), two low water crossings are proposed to reconnect a large cypress slough system south of Whiskey George Road. A low water crossing is also recommended on Tucker Road to enable surface water runoff to be conveyed to the east. Several additional ditch blocks are proposed throughout the Unnamed Creek basin to restore local topographic features and drainage divides.

In the western portion of the Nero Branch basin (Figures 61, 63, and 65), a low water crossing and associated ditch blocks are proposed to be constructed to restore surface water flow paths through a former wetland system. On the northern edge of the basin, an existing culvert is proposed to be removed to prevent surface water runoff from flowing across the basin boundary.

Estimated Construction Cost for Hydrologic Improvements: $ 750,000

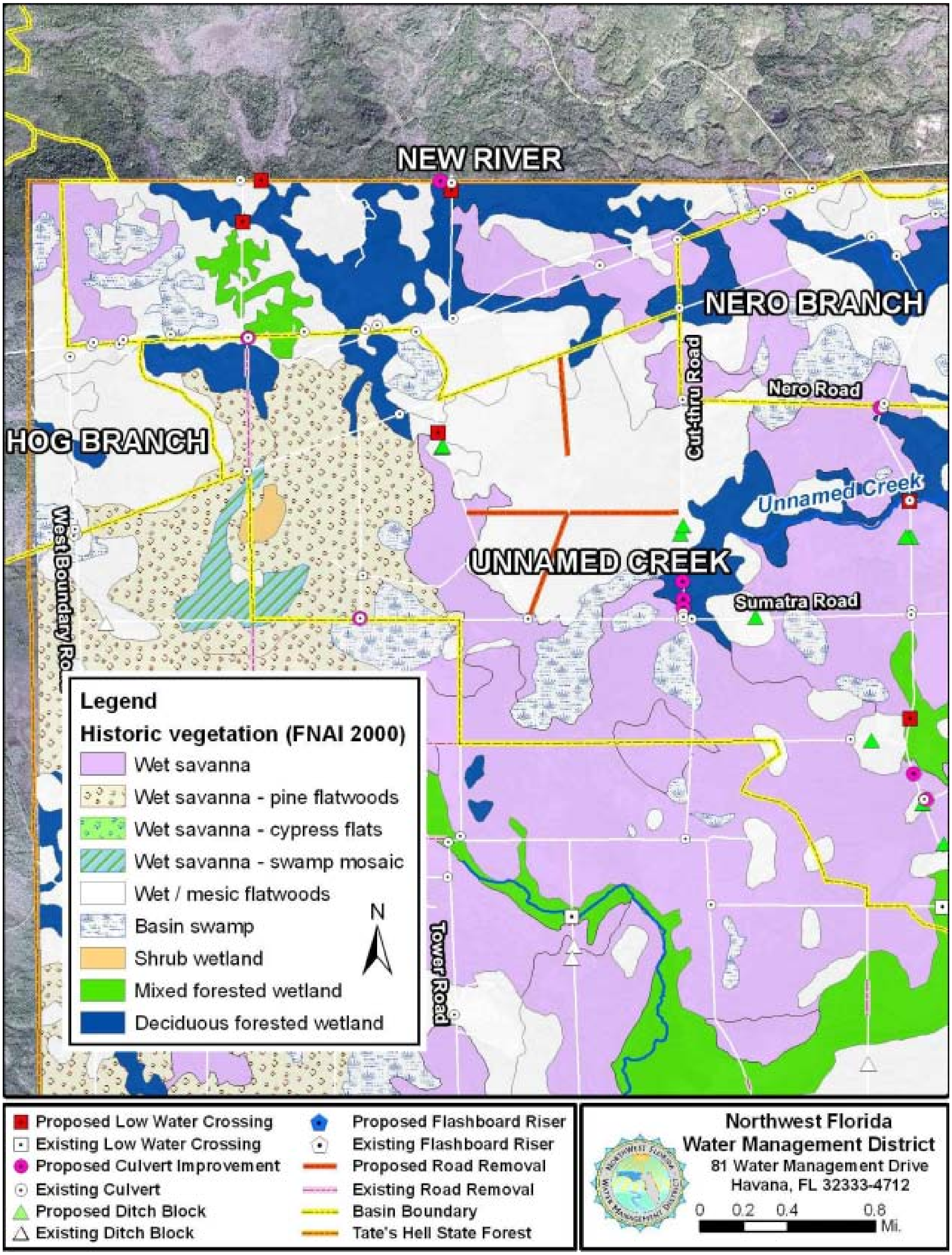

Figure 60. Historical ecological communities and proposed hydrologic improvements in the western portions of the Nero Branch and Unnamed Creek basins

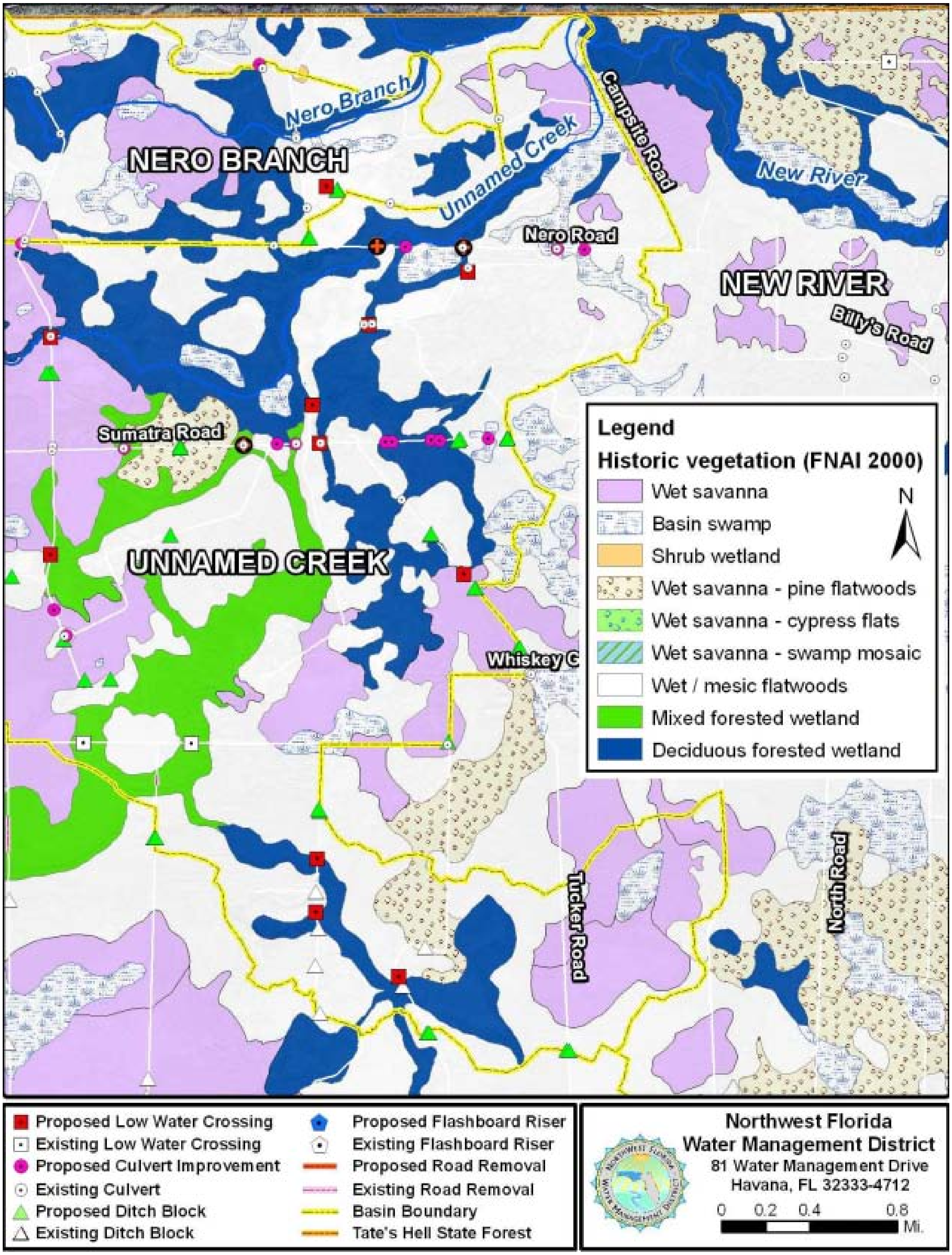

Figure 61. Historical ecological communities and proposed hydrologic improvements in eastern portions of the Nero Branch and Unnamed Creek basins

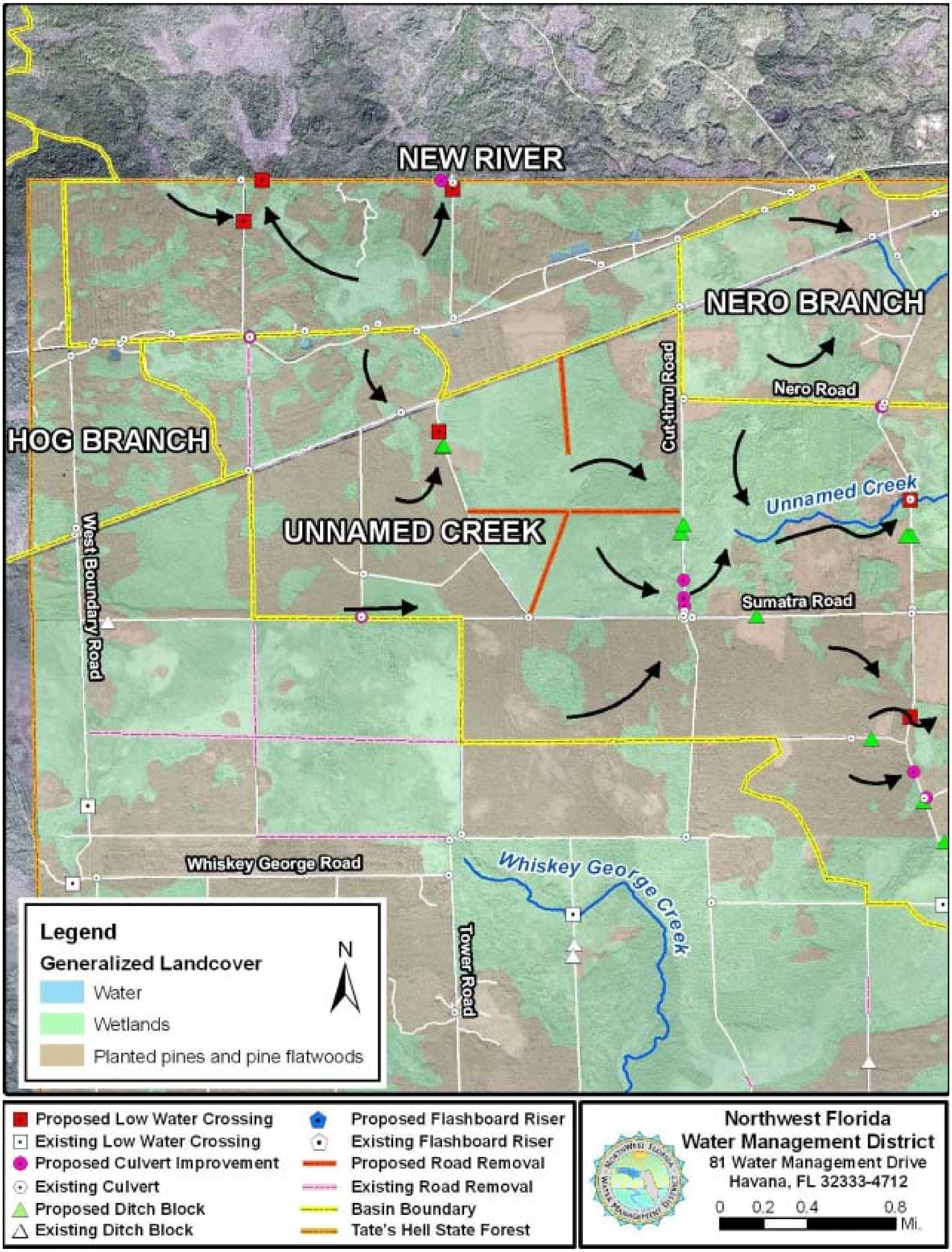

Figure 62. Proposed hydrologic restoration activities, current landcover, and post-restoration drainage patterns in the western portions of the Nero Branch and Unnamed Creek basins.

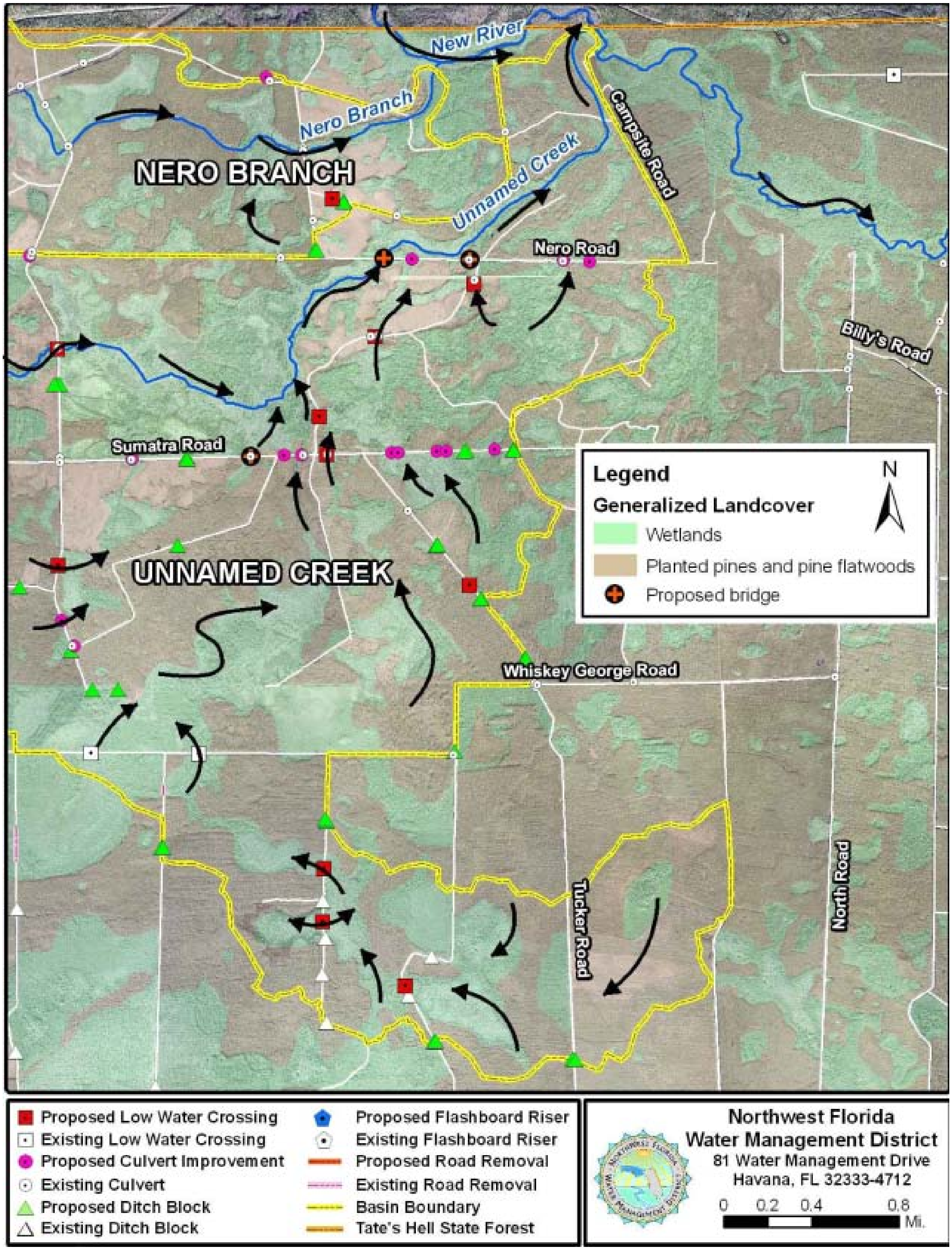

Figure 63. Proposed hydrologic restoration activities, current landcover, and post-restoration drainage patterns in the eastern portions of the Nero Branch and Unnamed Creek basins.

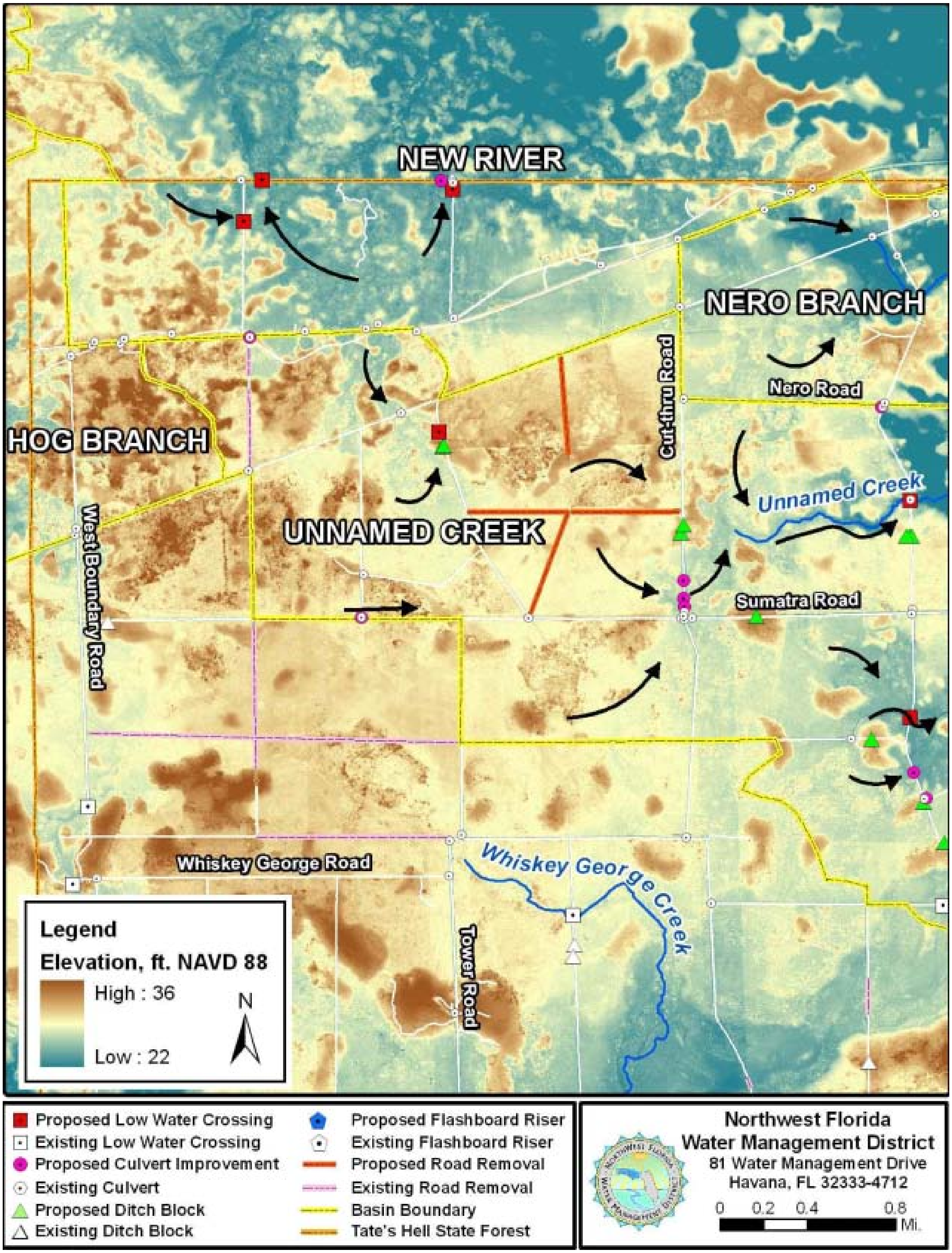

Figure 64. LiDAR elevation data, proposed hydrologic improvements and post-restoration drainage patterns in the western portion of the Nero Branch and Unnamed Creek basins.

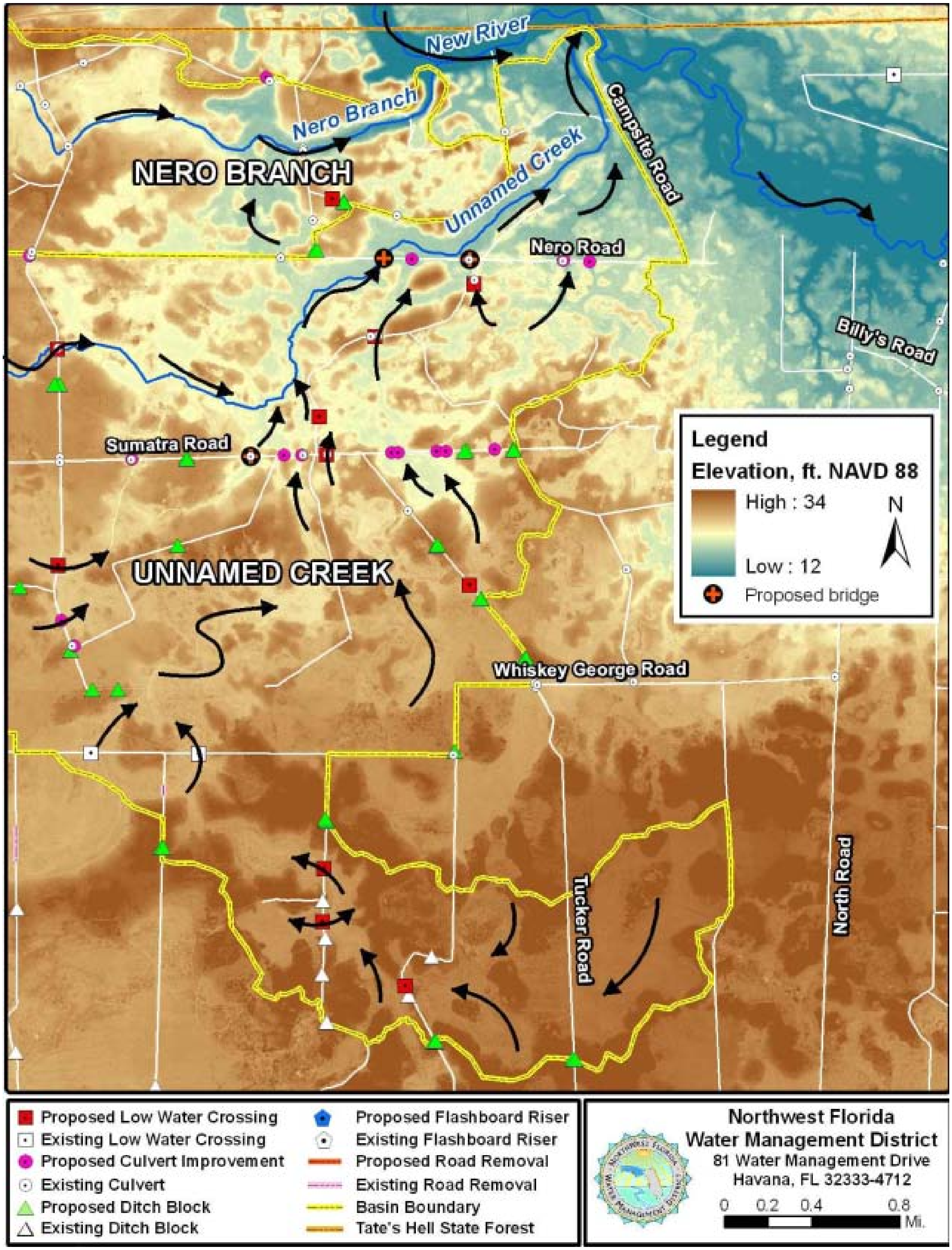

Figure 65. LiDAR elevation data, proposed hydrologic improvements and post-restoration drainage patterns in the eastern portion of the Unnamed Creek, Hog Branch, Nero Branch, and Unnamed Stream basins.

New River Basin

Restoration Priority: Medium

Basin Area: More than 110,000 acres (including the Juniper Creek, Gator Creek and Gully Branch subbasins)

Description: The New River basin encompasses more than 170 square miles and is the largest watershed in the Tate's Hell State Forest. The New River flows south and merges with the Crooked River to form the Carrabelle River. The Carrabelle River flows into St. George Sound. Tributaries to the New River include Juniper Creek, Nero Branch, Unnamed Creek, Gator Creek, Gully Branch, and Trout Creek. Historical ecological communities in the watershed include mesic and wet flatwoods, basin swamps, wet savannas, and scattered cypress wetlands. Much of native habitat has been converted to pine plantation. Approximately 37,350 acres in the northern part of the basin were previously owned by Profundus Holdings Inc. and were acquired by the State of Florida in 2003.

2010 – 2020 Hydrologic Restoration Plan: Due to the large size of this watershed, separate maps and restoration plans are presented for the northwest, northeast, central, and southern portions of the New River watershed. The northeast portion of the watershed includes the Juniper Creek, Gator Creek, and Gully Branch subbasins.

<u>Northwest New River Basin</u>

In the northwest portion of the watershed, six low water crossings, several culverts, and associated ditch blocks are proposed to restore surface water flow through a former cypress slough located north of the river in the vicinity of County Line Road (Figures 66 through 68). South of the river, a series of low water crossings and ditch blocks are proposed along Billy's Road and Road 120. Road 120 is at or below the natural grade and portions of the road are overtopped with water during large storm events.

A short segment of road is proposed for removal south of Billy's Road to enable surface water runoff to flow to the north. Although the historical vegetation along this road segment was delineated by FNAI (2000) as mesic flatwoods, this is currently a very wet area. Several flashboard risers are proposed to decrease flow in the large ditches that convey water to the north along North Road.

To the west of Tucker Road, a low water crossing is proposed to reestablish historical surface water drainage patterns and rehydrate a former wetland that was converted to pine plantation. East of the intersection of Whiskey George Road and North Road, four additional low water crossings, a culvert, and several ditch blocks are proposed to restore historical surface water flow patterns among wetlands. Finally, there is a series of flashboard risers and culverts proposed along Jet

Engine Road (Figures 67 and 68) to reduce north-south ditch flow and enable surface water runoff to flow towards the east.

Northeast New River Basin

The northeast portion of the New River watershed includes the Juniper Creek, Gator Creek, and Gully Branch subbasins as well as areas that discharge surface water runoff directly to the New River (Figures 69, 70, and 71). In the Juniper Creek subbasin, three low water crossings and associated ditch blocks are proposed to facilitate surface water runoff towards the creek. Near the eastern boundary of the Juniper Creek basin, an additional low water crossing is proposed to restore surface water flow in a wetland that has been bisected by the road.

Between the Juniper Creek and Gator Creek basins is an area where surface water runoff flows directly to the New River (Figures 69, 70, and 71). To enhance surface water drainage among wetlands and restore historical surface water flow patterns towards the New River, two flashboard risers, three low water crossings, three new culverts, three culvert replacements (along River Road), and numerous ditch blocks are proposed in this area.

In the Gator Creek and Gully Branch subbasins, a large-scale hydrologic restoration project was implemented by the NWFWMD in 2000. The project included the construction of two bridges, four low water crossings, one flashboard riser, 21 ditch blocks and the removal of approximately 0.5 miles of logging roads. Future restoration opportunities in the Gator Creek include the installation of two new low water crossings, a culvert, and several ditch blocks to restore hydrologic connections in the upper portion of the basin (Figures 69, 70, and 71). Several ditch blocks are proposed along County Line Road to redirect flow through the series existing culverts that convey Gator Creek flow to the south. A short segment of road (470 ft.) that bisects a forested wetland is also proposed for removal in this area.

Further south in the Gator Creek basin, two new ditch blocks are proposed to facilitate surface water flow through an existing low water crossing. In the central portion of the Gator Creek basin, two new low water crossings and associated ditch blocks are proposed to restore historical flow patterns through remnant wetland systems. Along Rock Landing Road, two large diameter culverts and a road removal are proposed to reconnect the northern and southern halves of a large forested wetland system. A low water crossing is also proposed to reconnect the eastern tip of this forested wetland, which is bisected by a road. To the west of this wetland, four new culverts and several ditch blocks are proposed.

In the Gully Branch basin (Figures 69 through 74), approximately 3.1 miles of logging roads are proposed for removal that bisect historical wet savannas or basin swamps. Some of these roads are no longer used or maintained by the Division of Forestry. To restore natural drainage patterns, the roadbeds should be recontoured to match natural grade and the adjacent ditches should be filled where feasible. Two low water crossings and associated ditch blocks are proposed in the upper Gully Branch basin to restore surface water drainage towards the creek.

On the western side of the New River just north of Gully Branch Road and east of Jet Engine Road (Figures 69, 70, and 71), three culvert improvements, two low water crossings, and two flashboard risers are also proposed to increase surface water conveyance along the southernmost section of Billy's Road.

Central New River Basin

On the western side of the New River south of Gully Bridge Road, the historical ecological communities were comprised primarily of wet savanna – pine flatwood mosaics, with large areas of mesic flatwoods and wet savannas. Closer to the New River, there were also scattered basin swamps (Figures 72, 73, and 74). Proposed hydrologic improvements include the construction of six low water crossings and associated ditch blocks to restore historical surface water drainage patterns towards basin swamps. As mentioned previously, several flashboard risers are proposed along Jet Engine Road to decrease north-south flows in the large roadside ditches. Several new culverts are also proposed to facilitate surface water runoff to flow towards the east. Between Gully Branch Road and West Double Bridge Road, 1.4 miles of logging roads that bisect existing wetland systems are proposed to be removed and restored to natural grade. Although some of these segments are shown as being located in historical mesic flatwoods (Figure 72), a review of site conditions and topography indicates that wetlands are present in these areas (Figure 73).

On the east side of the New River to the east of Burnt Bridge Road, there is a 3,500-acre basin swamp referred to as Pickett Bay (Figure 72). A portion of the swamp drains towards the New River while the remainder drains towards the southeast. To restore historical surface water drainage patterns in the area draining towards the New River, nine new culverts are proposed along Burnt Bridge Road, River Road, and East Double Bridge Road. A low water crossing and a t-shaped road removal are proposed southwest of East Double Bridge Road to restore surface water flow through historical basin swamps and towards the river (Figures 72 through 74).

Southern New River Basin (including part of the Carrabelle River basin)

This area includes the southernmost reach of the New River and a small portion of the Carrabelle River Basin (Figures 75 though 77). Between Jet Engine Road and Burnt Bridge Road on the west of the New River, a low water crossing, three culverts, and several ditch blocks are proposed to restore easterly surface water flow towards the river. North of the river in the vicinity of Warren Bluff Road, six low water crossings and associated ditch blocks are proposed to facilitate southerly flow. A flashboard riser is also proposed in this area. South of the river toward Buck Siding Road, an additional low water crossing is proposed to restore historical surface water drainage through a large basin swamp. There are no hydrologic improvements proposed in the Carrabelle River basin.

In total, hydrologic improvements in the New River basin include 60 low water crossings, 29 flashboard risers, 55 new or replacement culverts, 13 culvert removals, 189 ditch blocks, one bridge, and approximately 7 miles of road removals.

Estimated Construction Cost for Hydrologic Improvements: Approximately $ 1,940,000

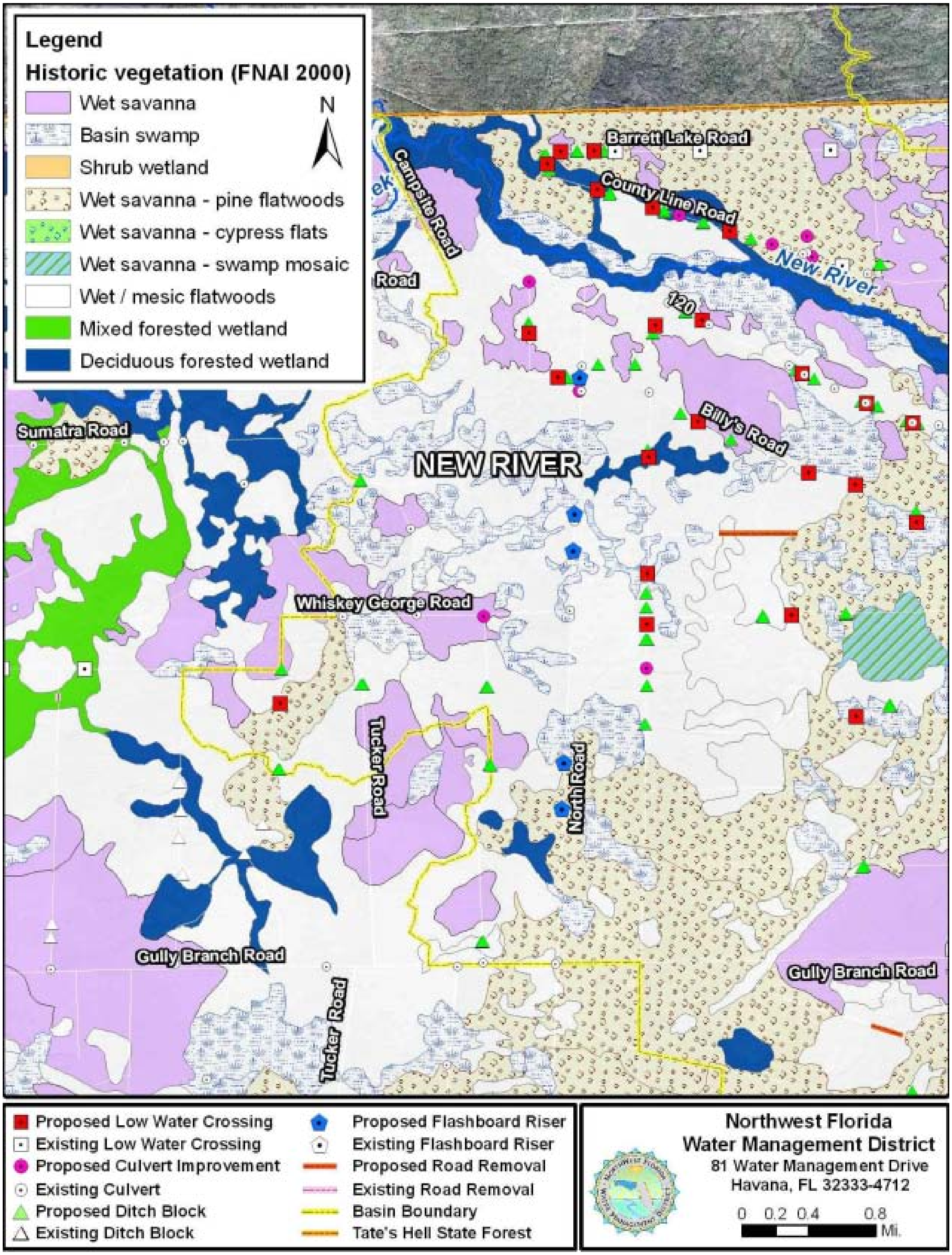

Figure 66. Historical ecological communities and proposed hydrologic improvements in the northwest portion of the New River basin

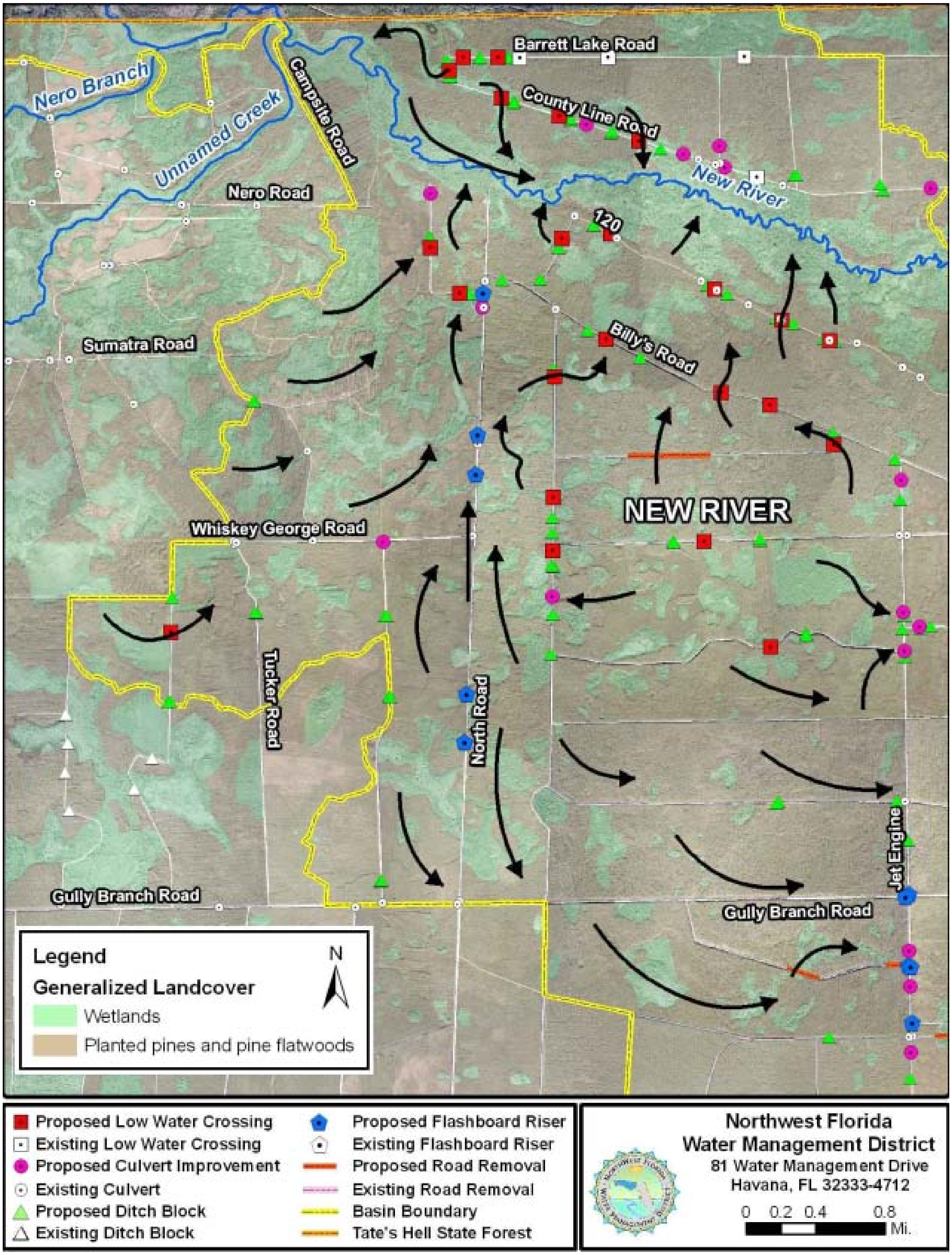

Figure 67. Proposed hydrologic improvements and post-restoration drainage patterns in the northwest portion of the New River basin

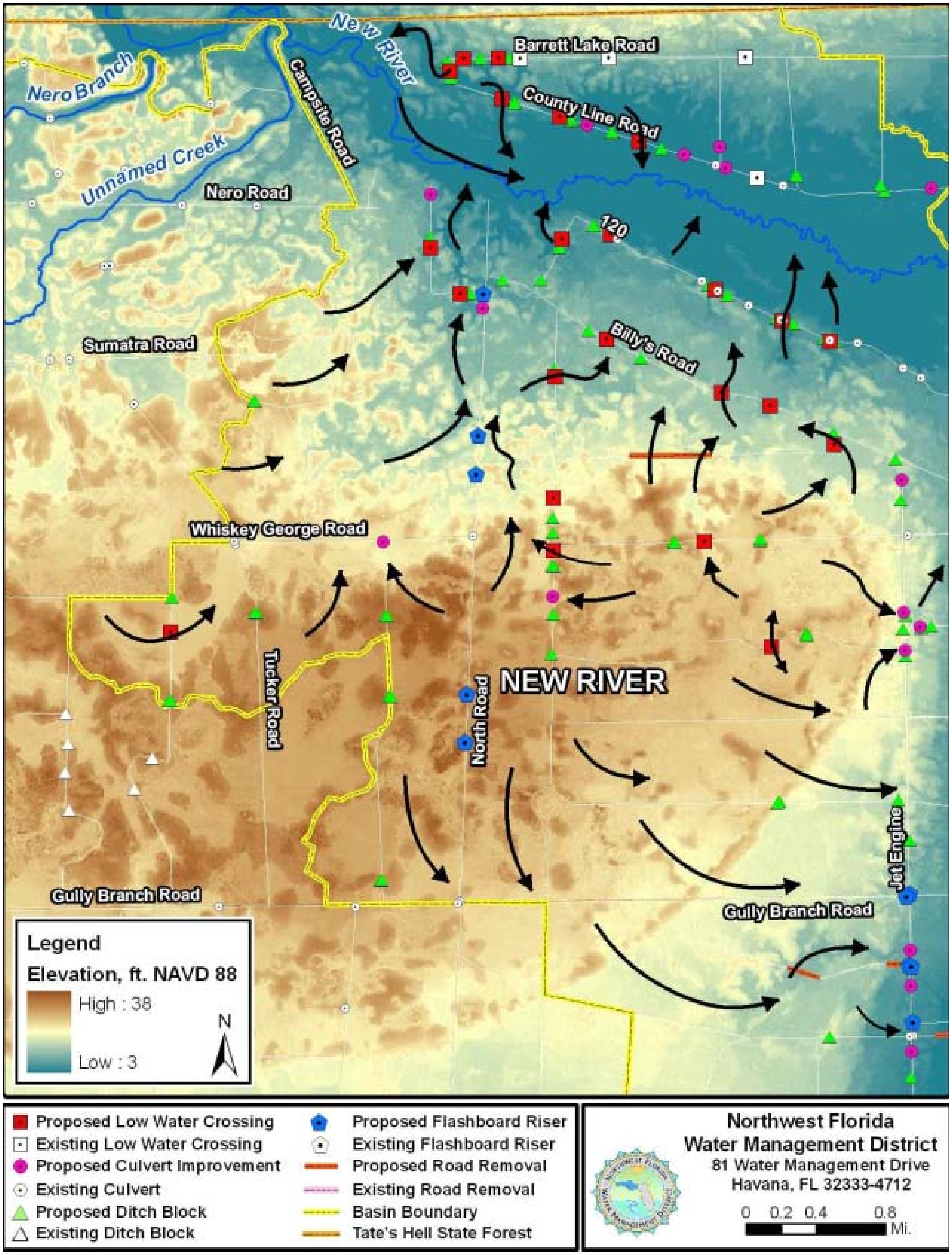

Figure 68. LiDAR elevation data, proposed hydrologic improvements and post-restoration drainage patterns in the northwest portion of the New River basin.

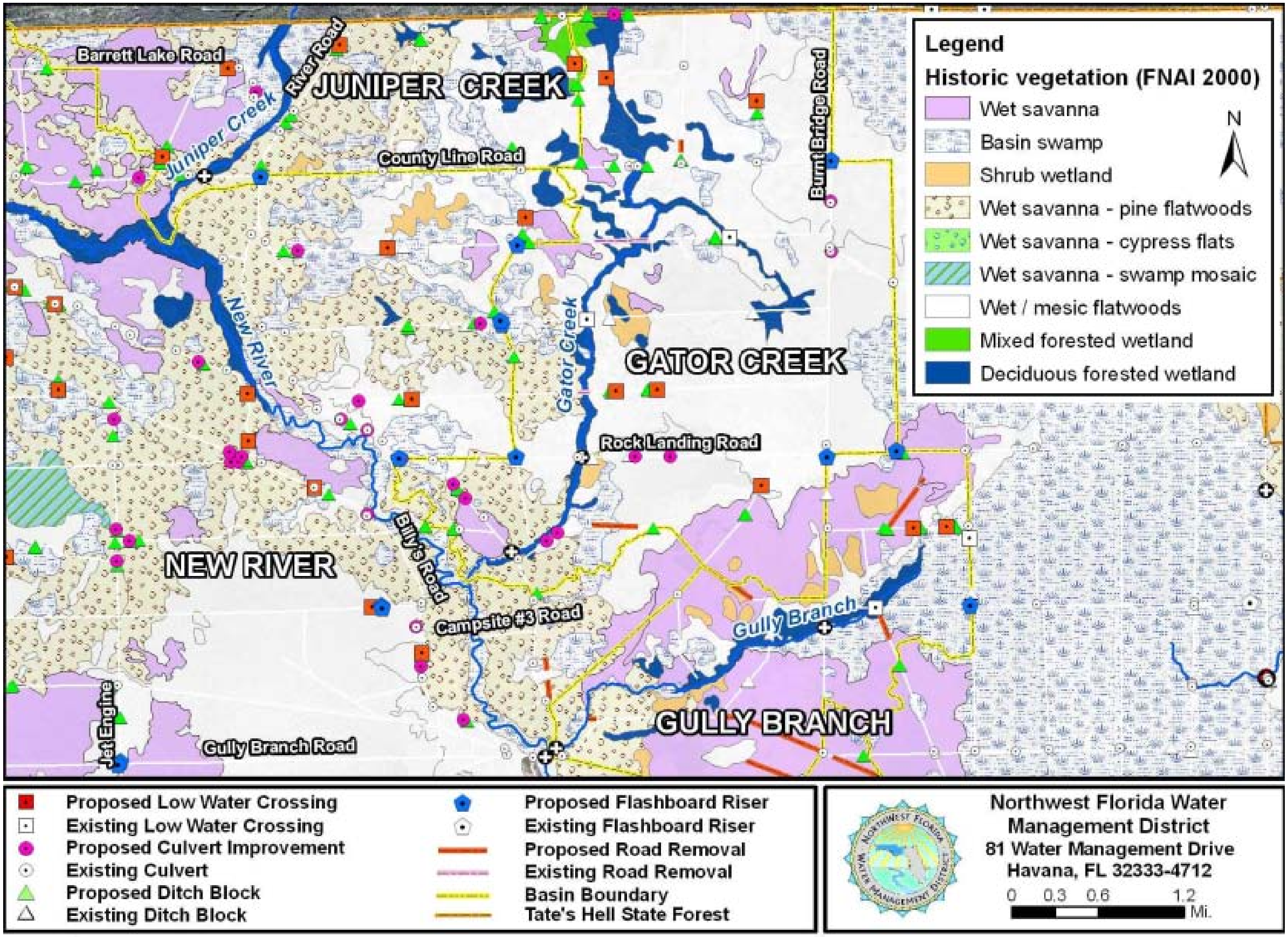

Figure 69. Historical ecological communities and proposed hydrologic improvements in the northeast portion of the New River basin

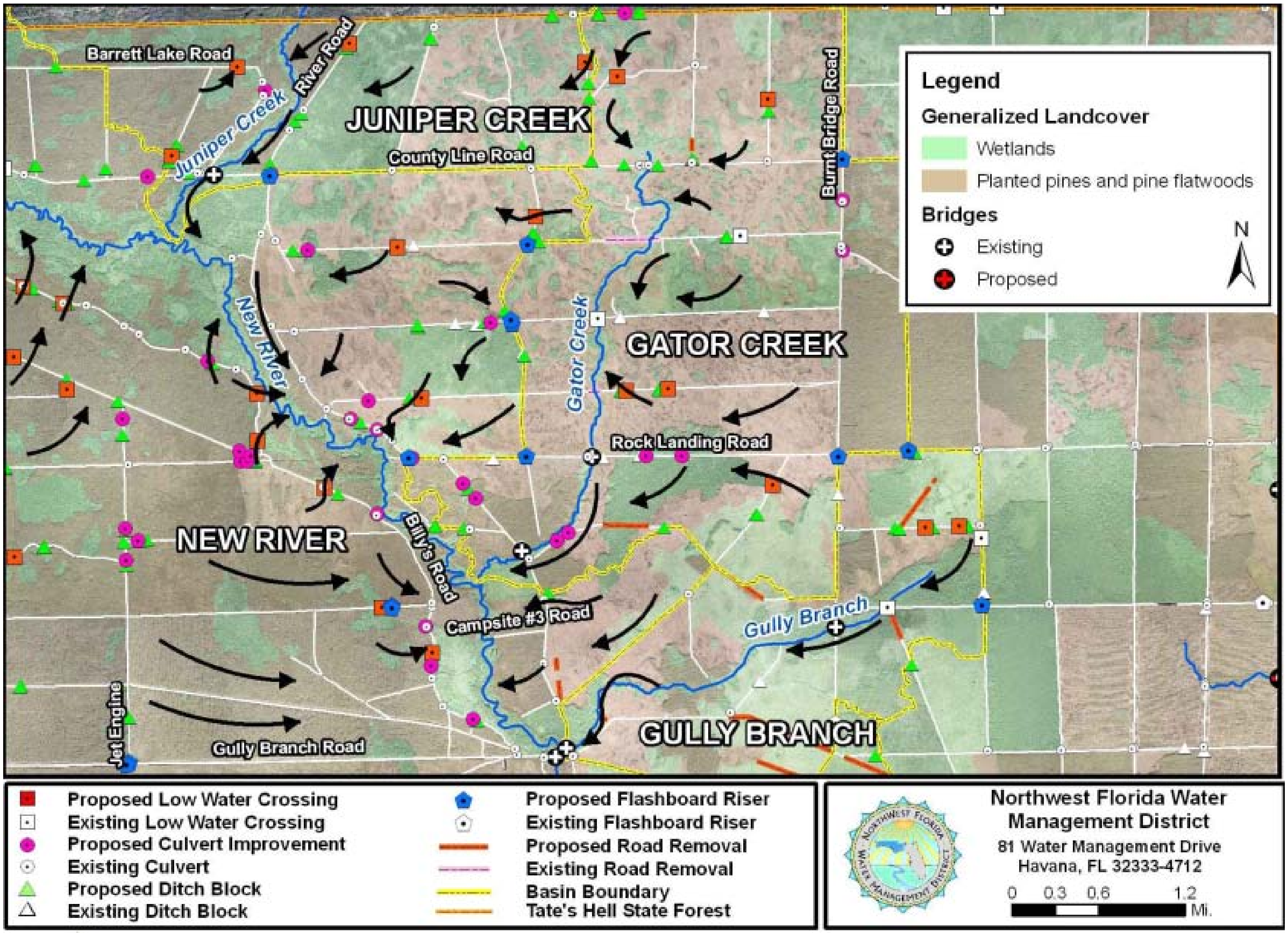

Figure 70. Proposed hydrologic improvements and post-restoration drainage patterns in the northeast portion of the New River basin

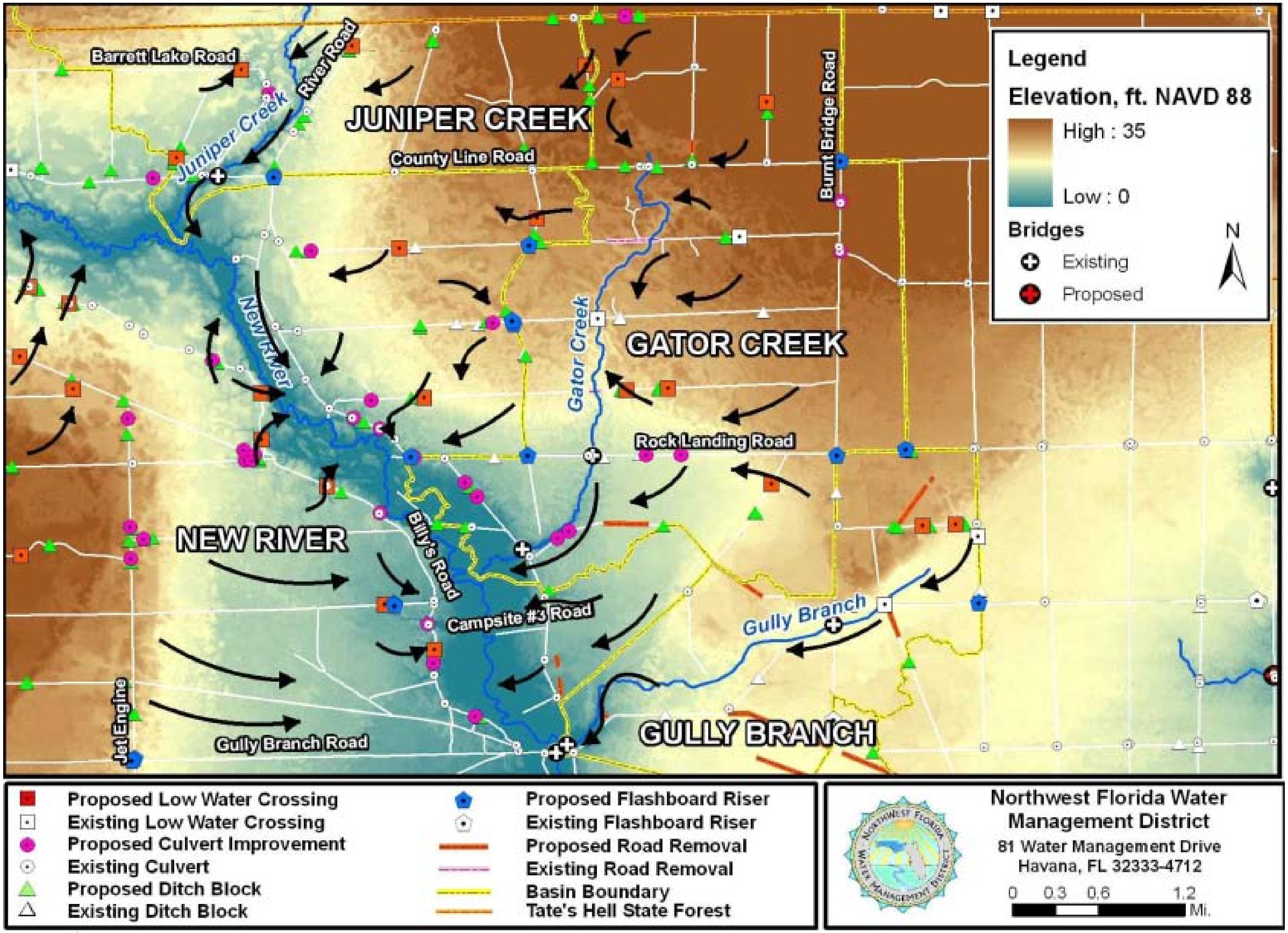

Figure 71. LiDAR elevation data, proposed hydrologic improvements and post-restoration drainage patterns in the northeast portion of the New River basin

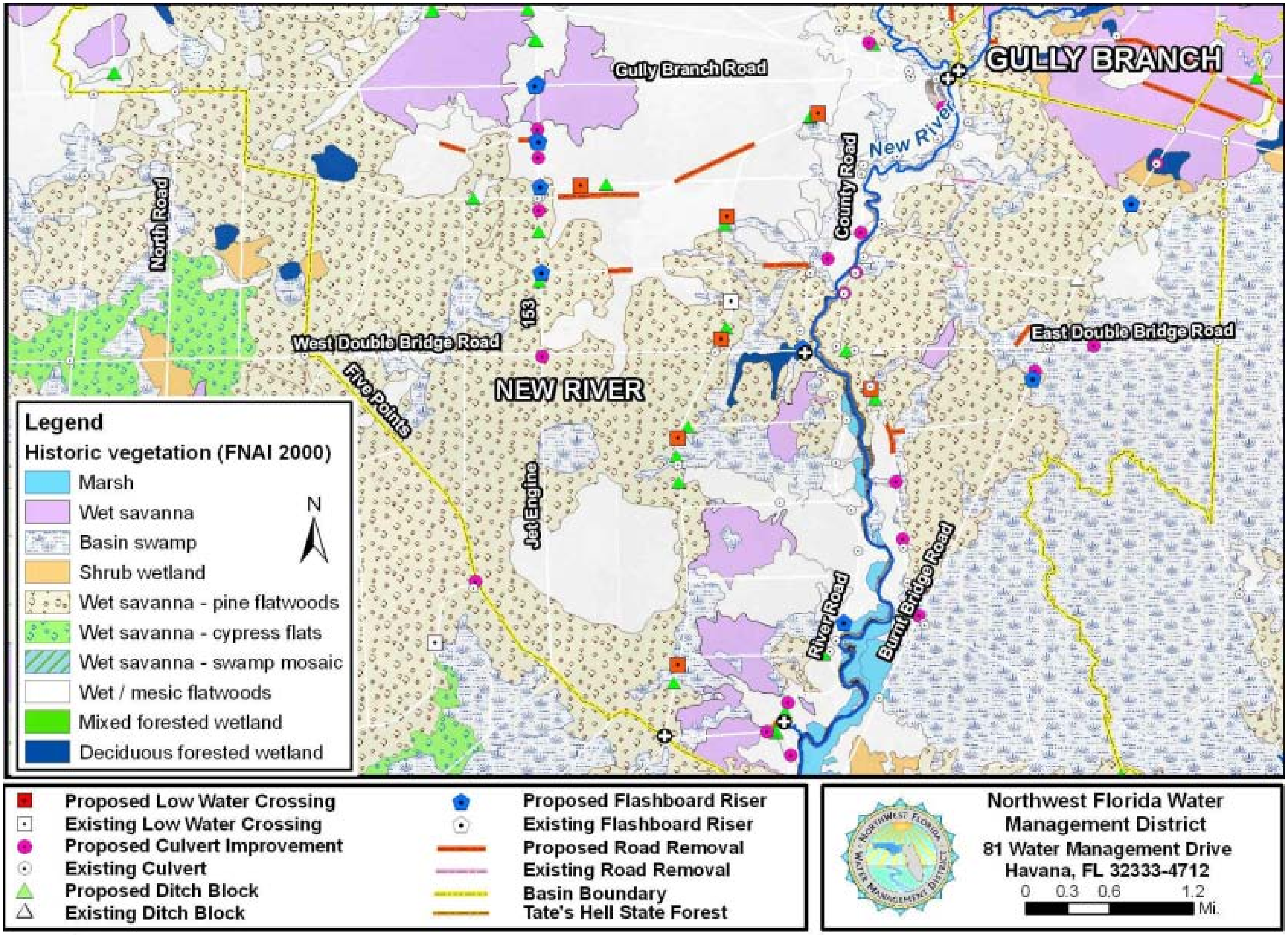

Figure 72. Historical ecological communities and proposed hydrologic improvements in the central portion of the New River basin

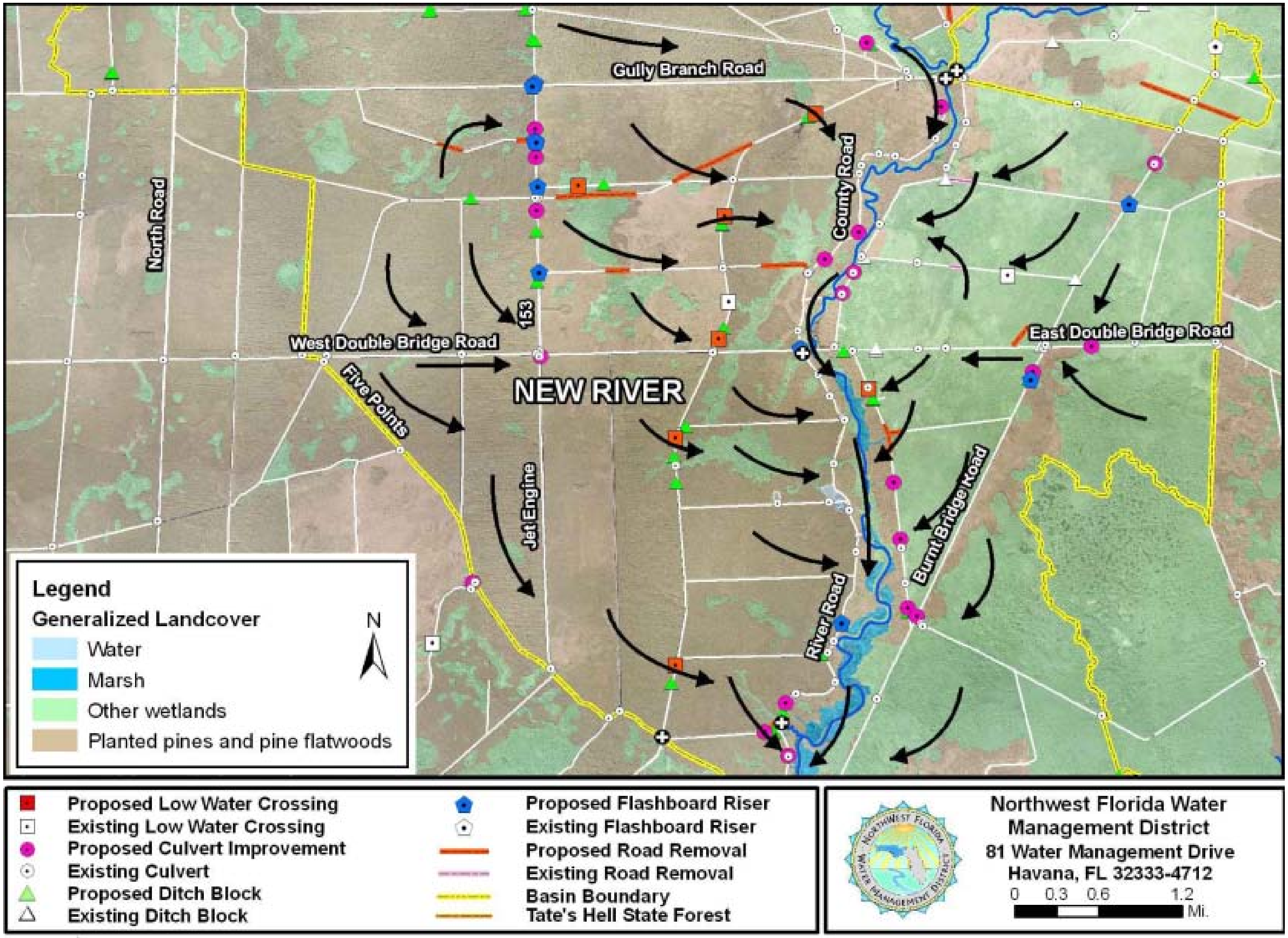

Figure 73. Proposed hydrologic improvements and post-restoration drainage patterns in the central portion of the New River basin

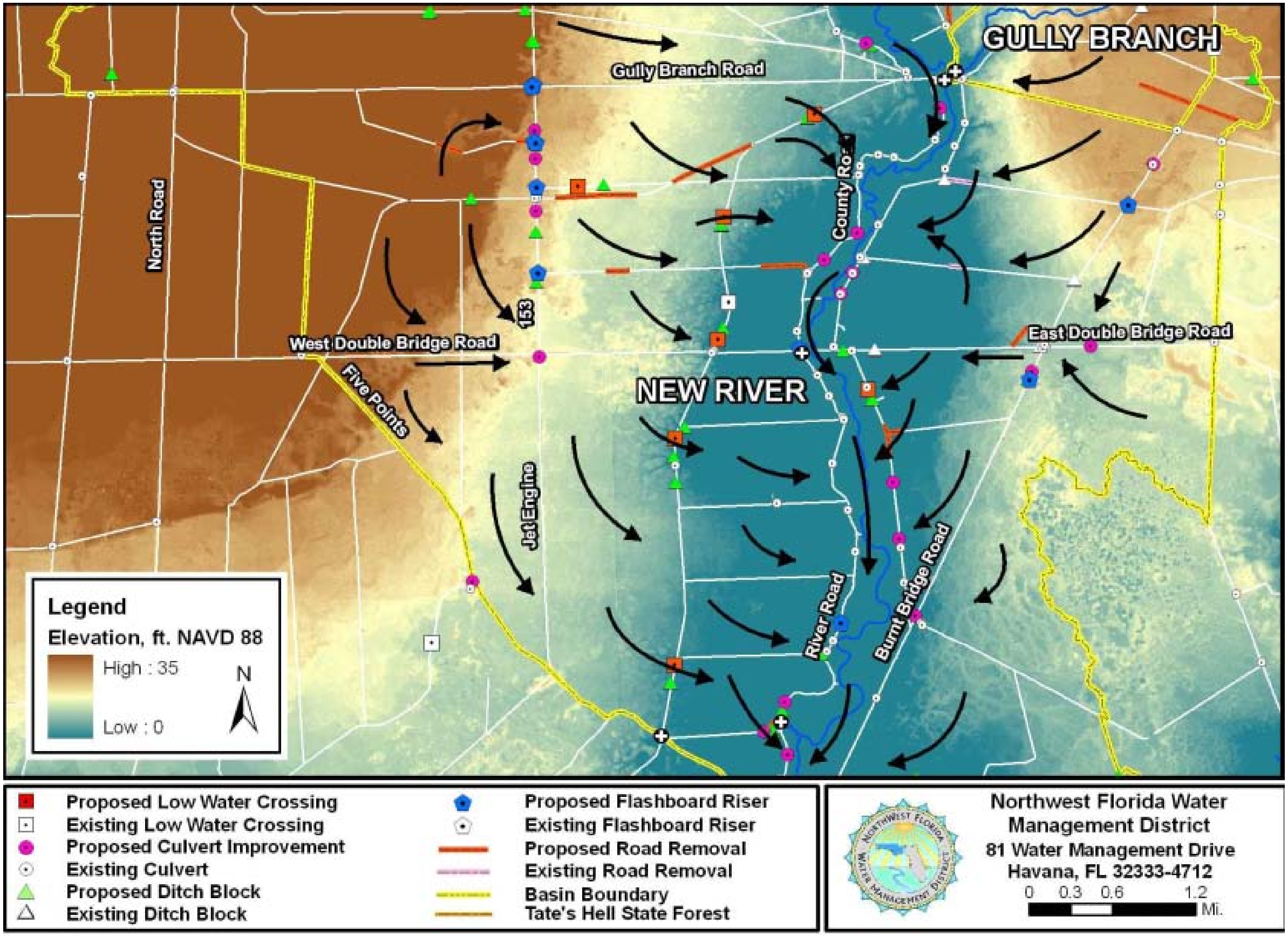

Figure 74. LiDAR elevation data, proposed hydrologic improvements and post-restoration drainage patterns in the central portion of the New River basin

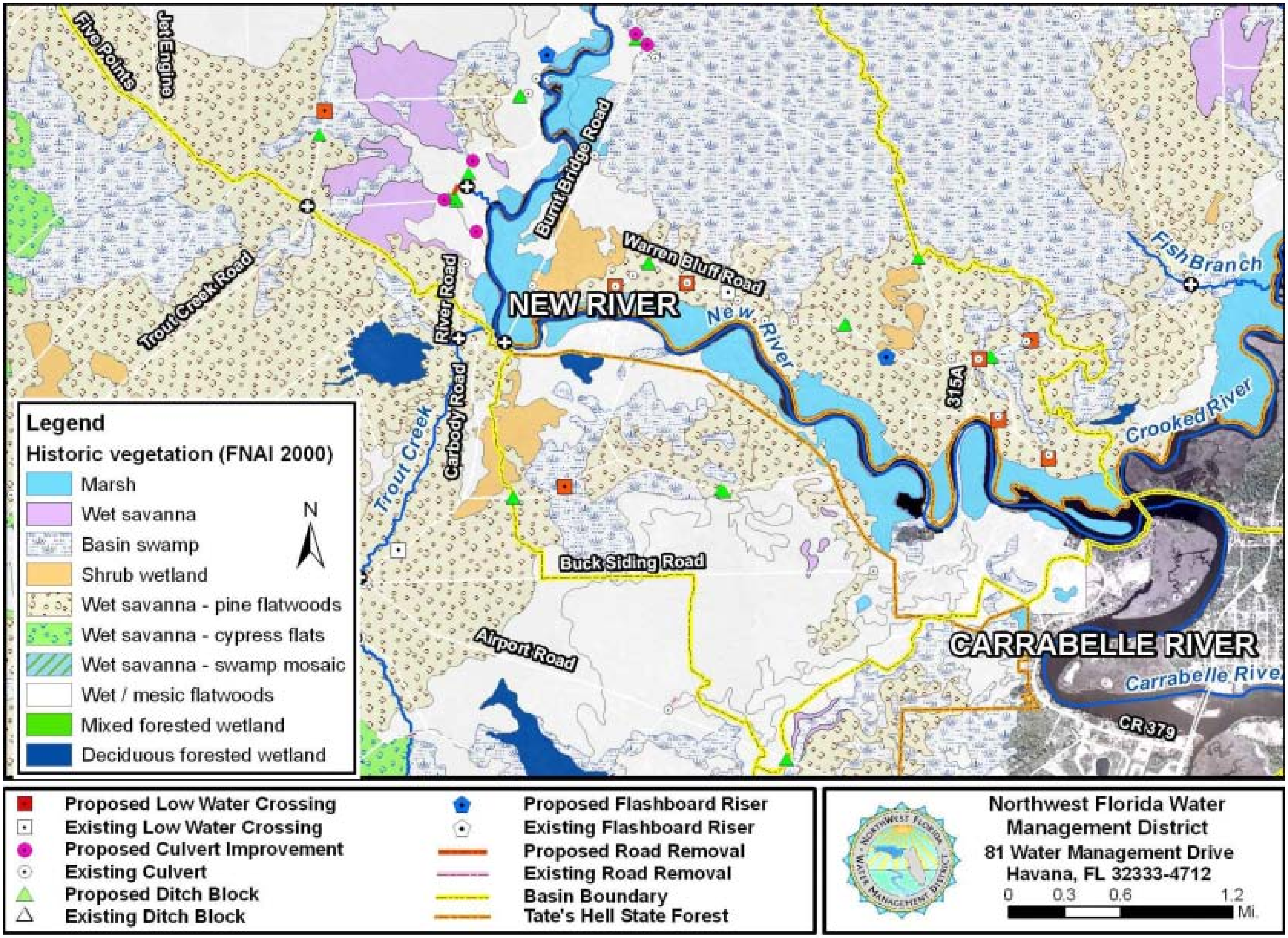

Figure 75. Historical ecological communities and proposed hydrologic improvements in the southern portion of the New River basin

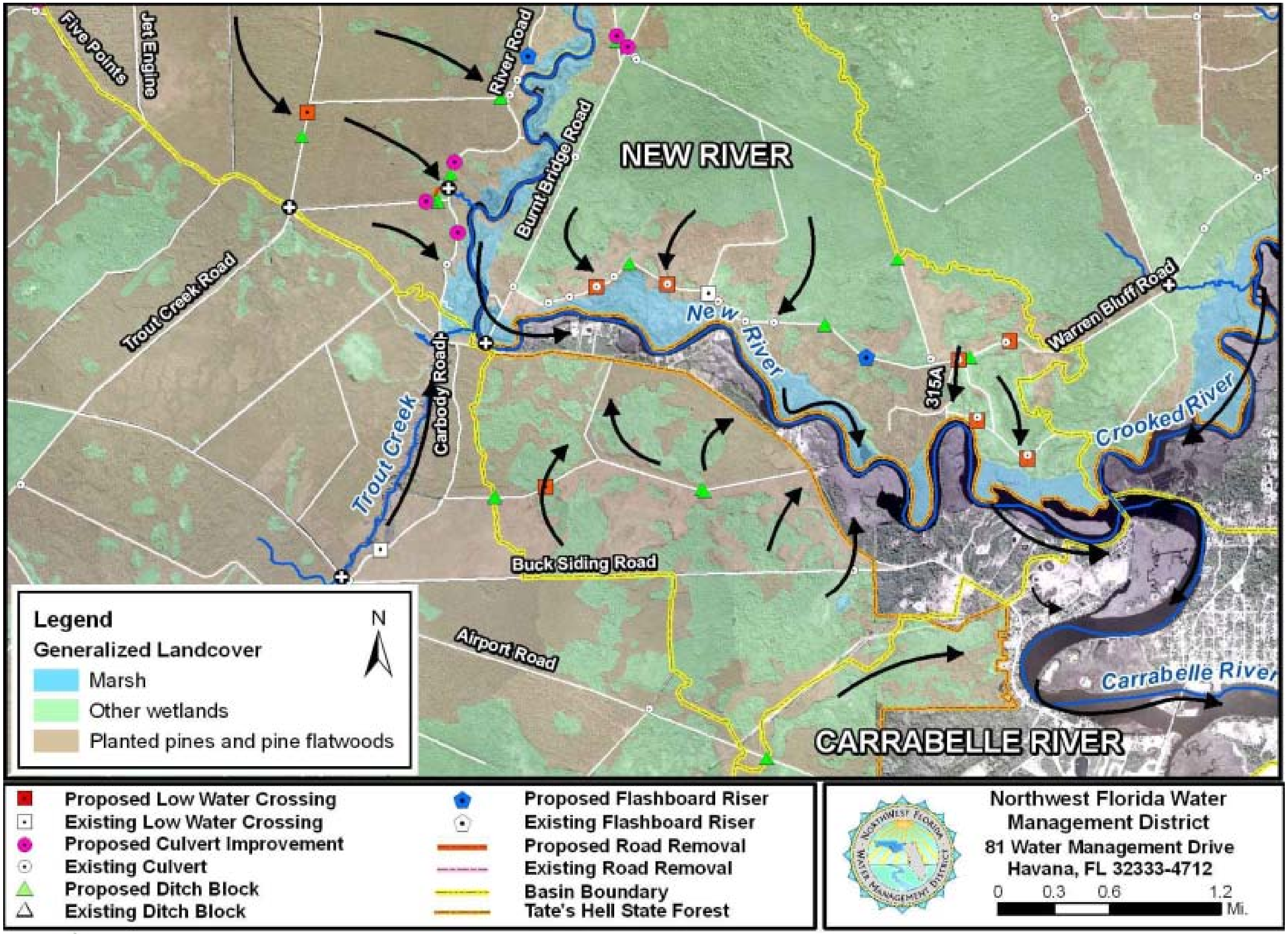

Figure 76. Proposed hydrologic improvements and post-restoration drainage patterns in the southern portion of the New River basin

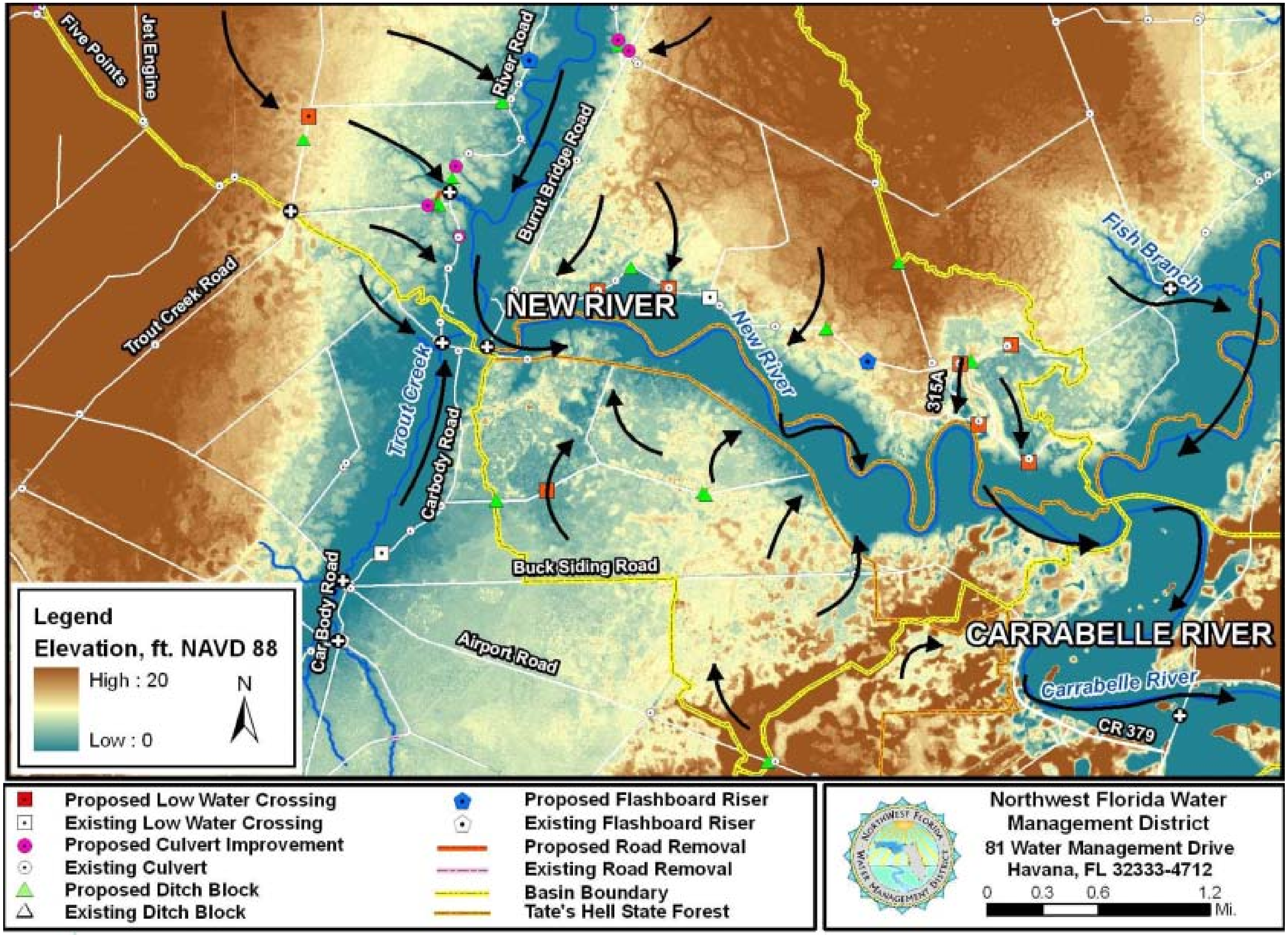

Figure 77. LiDAR elevation data, proposed hydrologic improvements and post-restoration drainage patterns in the southern portion of the New River basin

Crooked River

Restoration Priority: Medium / Low

Basin Area: 40,200 acres

Description: The Crooked River basin is one of the largest watersheds in the Tate's Hell State Forest. The watershed is situated in the eastern half of the forest in a low-lying area between the Ochlockonee and New Rivers. Most of the time, part of the stream flow in the Crooked River is conveyed east towards the Ochlockonee River while the remaining flow is conveyed to the west. To the west, the Crooked River merges with the New River to form the Carrabelle River, which discharges to St. George Sound. Because the Crooked River is tidally influenced at both ends, the divide between easterly and westerly flow varies with time. The divide between easterly and westerly flow in the Crooked River is located in the area where the Crooked River crosses SR 67 or perhaps just slightly east of this location. However, when the Ochlockonee River is at flood stage, it releases streamflow to the Crooked River and the Crooked River flows west along its entire length.

Due to the large watershed area, separate sets of maps have been created for the eastern and western portions of the Crooked River basin. Note that the historical ecological communities were not delineated for all areas of the watershed within Tate's Hell State Forest. Aerial photography is shown as the background in the areas where the historical ecological communities were not mapped.

Eastern Crooked River basin

The eastern portion of the Crooked River includes the stream reach bordered by the confluence of Pine Log Creek on the west and the Ochlockonee River on the east (Figures 78, 79, 82, 83, 86, and 87). The direction of flow is generally towards the east except during periods when the Ochlockonee River is at flood stage. In addition to Pine Log Creek, other tributary streams include Brandy Creek and Tom Hahn Creek. Culverts have been installed along Jeff Sanders Road, Crooked River Road and McIntyre Road but there haven't been any other hydrologic improvements in this area.

Historical ecological communities were comprised of basin swamps, shrub wetlands, wet savanna – pine flatwoods mosaics, and mesic flatwoods (Figures 78 and 79). There are also some small wet savannas. Although some of the historical basin swamps have been converted to pine plantation, many basin swamps and shrub wetlands remain. Most of these wetlands are dominated by titi shrubs. Between the basin swamps, the soils are generally sandy. Although there are scattered stands of older slash pine plantation, many areas have been harvested or cleared and replanted in longleaf pine during the 1990s.

Western Crooked River basin

The western portion of the Crooked River basin includes the tributaries of Roberts Creek, Sunday Rollaway Creek, Cypress Slough, and Fish Branch (Figures 80, 81, 84, 85, 88, and 89). A large basin swamp (Pickett Bay) is the predominant feature in this area. Marshes exist along the lower sections of the Crooked River. Other historical plant communities included wet savannas, mesic flatwoods and wet savanna pine flatwood mosaics (Figures 80 and 81). Most historical pine flatwoods communities and wet savannas have been converted to planted pines. Except for culverts and several small low water crossings in the vicinity of Cypress Slough (Figure 85), no hydrologic improvements have been made in this area.

2010 – 2020 Hydrologic Restoration Plan: Proposed hydrologic restoration activities in the Crooked River watershed are aimed at restoring historical surface water flow patterns through wetlands, redirecting surface water runoff towards tributary streams and reducing flow in roadside ditches.

<u>Eastern Crooked River basin</u>

In the eastern portion of the basin north of the Crooked River, several culvert replacements are recommended on Jeff Sanders Road and additional new culverts are needed on Loop Road (Figures 82 and 86). South of the Crooked River, in the vicinity of Brandy Creek, three low water crossings and associated ditch blocks are recommended to reconnect wetlands and restore the natural drainage patterns towards the streams. Southwest of Brandy Creek, a short segment of road bisecting a wetland is proposed for removal. Northwest of McIntyre Road, three new low water crossings and two culverts are proposed to restore surface water drainage towards the Crooked River (Figures 82 and 86).

Further south in the eastern portion of the Crooked River basin (Figures 83 and 87), four new culverts and two culvert replacements are proposed. Ditch blocks are recommended to be installed in conjunction with some of culverts to direct flow into the adjacent wetlands. Without the ditch blocks, water would continue to flow in the ditches because the bottom of the ditch is lower than the natural wetland grade. Farther to the southwest, two box culverts (yellow octagons on figures) are proposed to convey surface water through large wetland sloughs and towards a small tributary of the Crooked River (Figures 83 and 87). Six low water crossings and associated ditch blocks are also proposed in this area to restore the historical surface water drainage patterns among these wetland systems.

<u>Western Crooked River basin</u>

In the western portion of the Crooked River basin north of Warren Bluff Road, numerous culverts are proposed to facilitate surface water runoff towards the Crooked River and Roberts Creek (Figures 84 and 88). There are approximately 2.5 miles of proposed road removals also shown on the figures. These roads are no longer maintained by the Division of Forestry but the remnant roadbeds and ditches inhibit southeasterly flow towards the Crooked River. Where feasible, these remnant roadbeds should be lowered to match the natural wetland grade and the roadside ditches should be filled.

Sunday Rollaway Creek has been bisected by roads 319A and 320A (Figures 84 and 88). Two low water crossings and associated ditch blocks are proposed to reconnect the former stream channel on the west side of Warren Bluff Road. A new culvert is also proposed to reconnect an adjacent wetland. Two box culverts (yellow octagons on figures) are proposed to replace the existing culverts that convey the streamflow in Sunday Rollaway Creek across Warren Bluff Road and Road 319A. Box culverts will help to restore a more natural stream channel and increase the conveyance capacity to support the additional flows that may result from the proposed upstream hydrologic improvements. Ditch blocks are recommended in conjunction with the box culverts to prevent surface water from short-circuiting the stream channel and flowing into the Crooked River via the roadside drainage ditches. West of Sunday Rollaway Creek, a section of road removal and a low water crossing are recommended to restore the historical surface water drainage patterns from a former basin swamp towards Sunday Rollaway Creek.

South of Sunday Rollaway Creek, several new culverts, three low water crossings, and associated ditch blocks are proposed to restore natural drainage to Fish Branch (Figures 85 and 89). Lastly, a low water crossing is proposed south of Fish Creek to reconnect a wetland slough to the Crooked River. The LiDAR elevation data suggests that surface water may already be crossing the road at this location.

In all, hydrologic improvements proposed in the Crooked River basin include 27 low water crossings, four flashboard risers, 3.5 miles of road removals, 41 new and replacement culverts, 12 culvert removals, and 138 ditch blocks.

Estimated Construction Cost for Hydrologic Improvements: $ 1,200,000

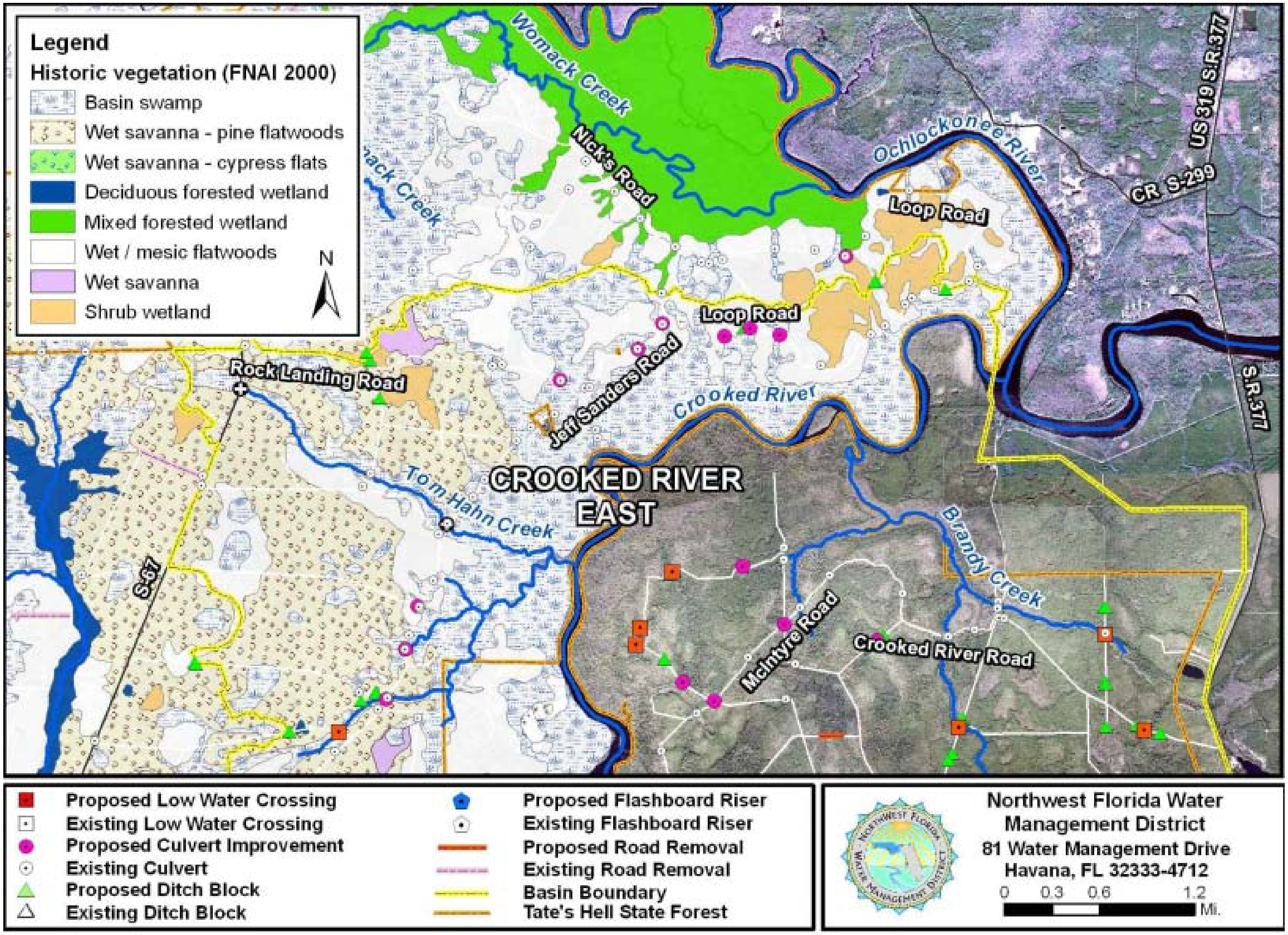

Figure 78. Historical ecological communities and proposed hydrologic improvements in the northern portion of the eastern Crooked River basin

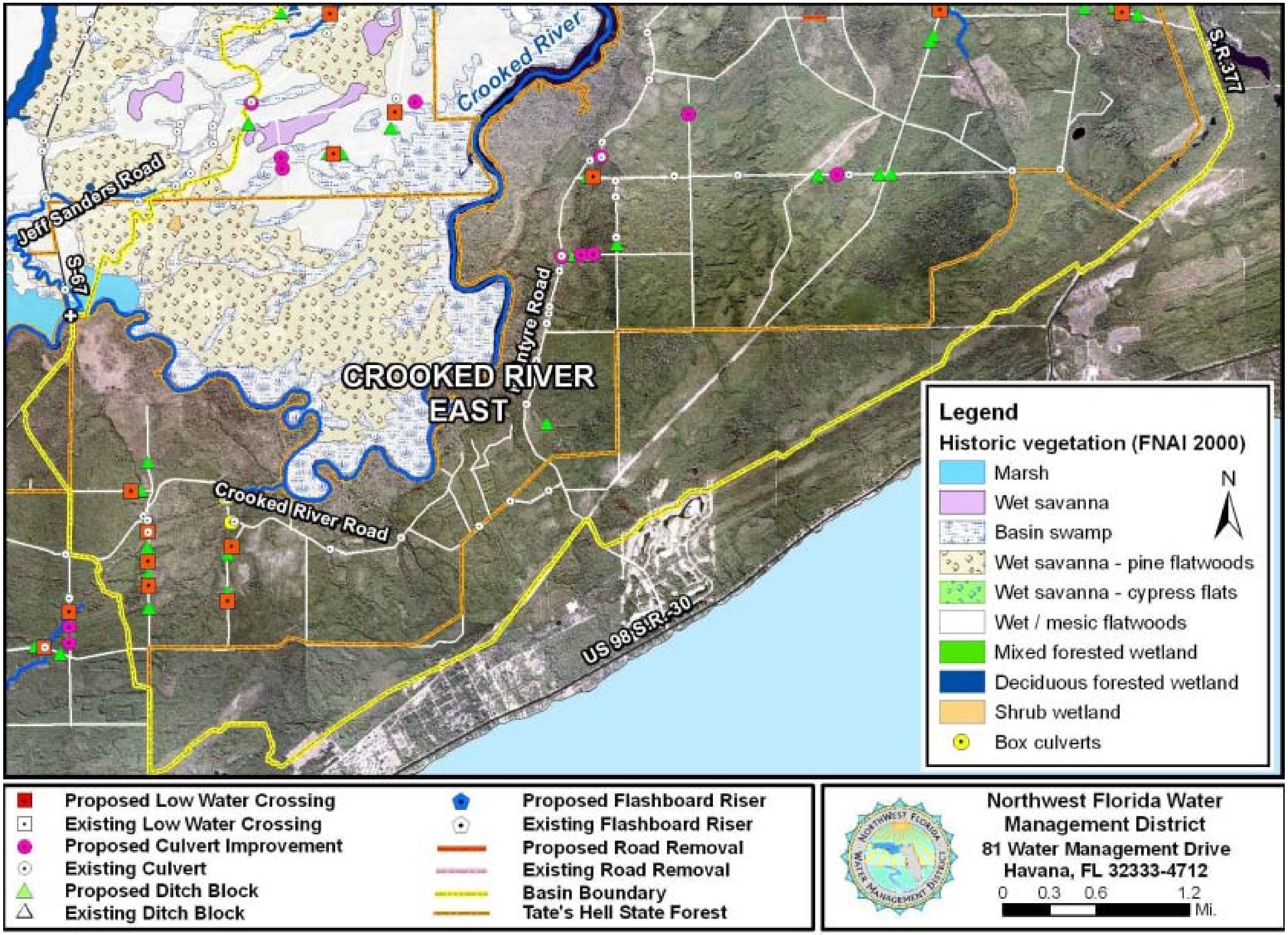

Figure 79. Historical ecological communities and proposed hydrologic improvements in the southern portion of the eastern Crooked River basin

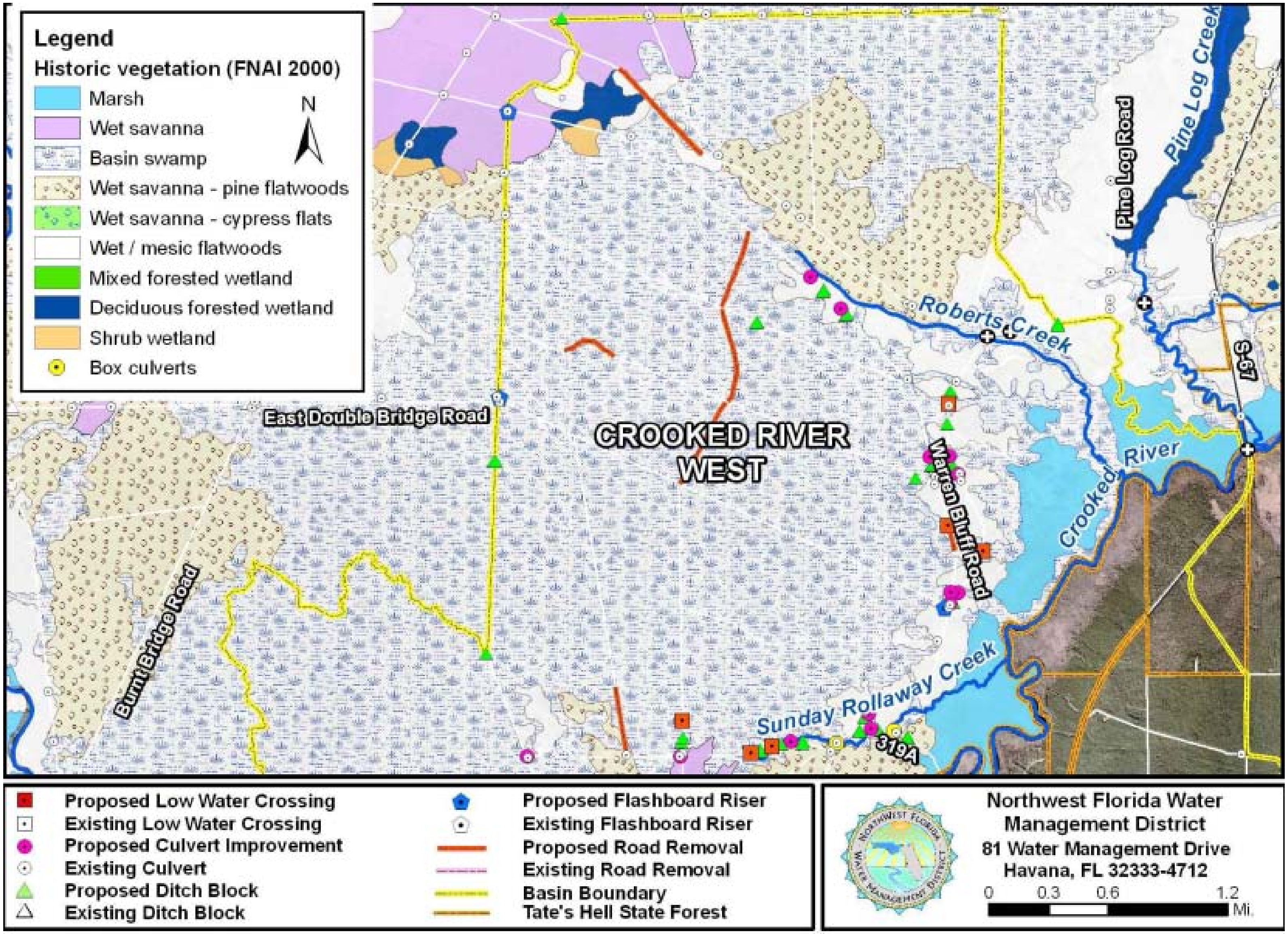

Figure 80. Historical ecological communities and proposed hydrologic improvements in the northern portion of the western Crooked River basin.

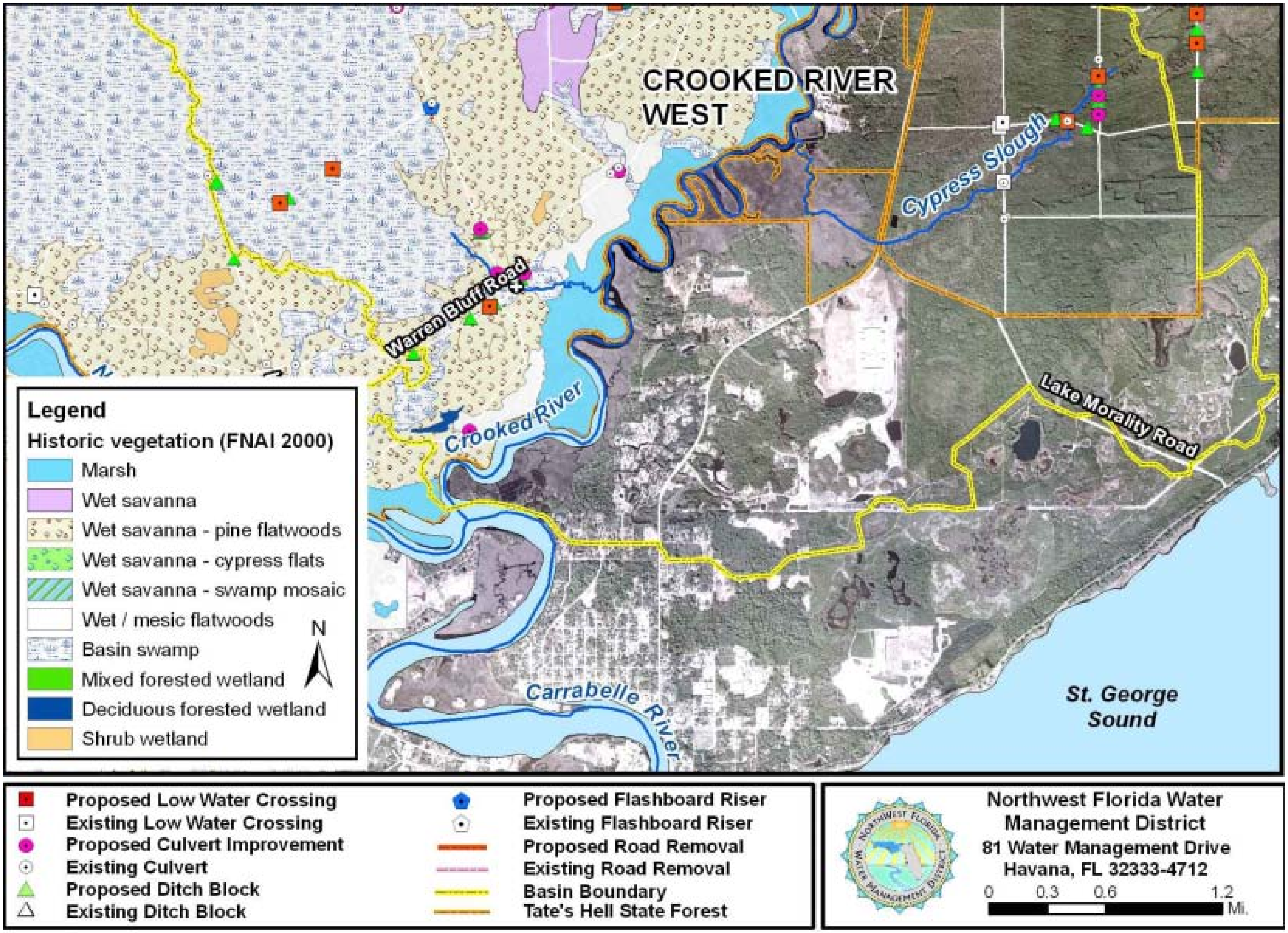

Figure 81. Historical ecological communities and proposed hydrologic improvements in the southern portion of the western Crooked River basin.

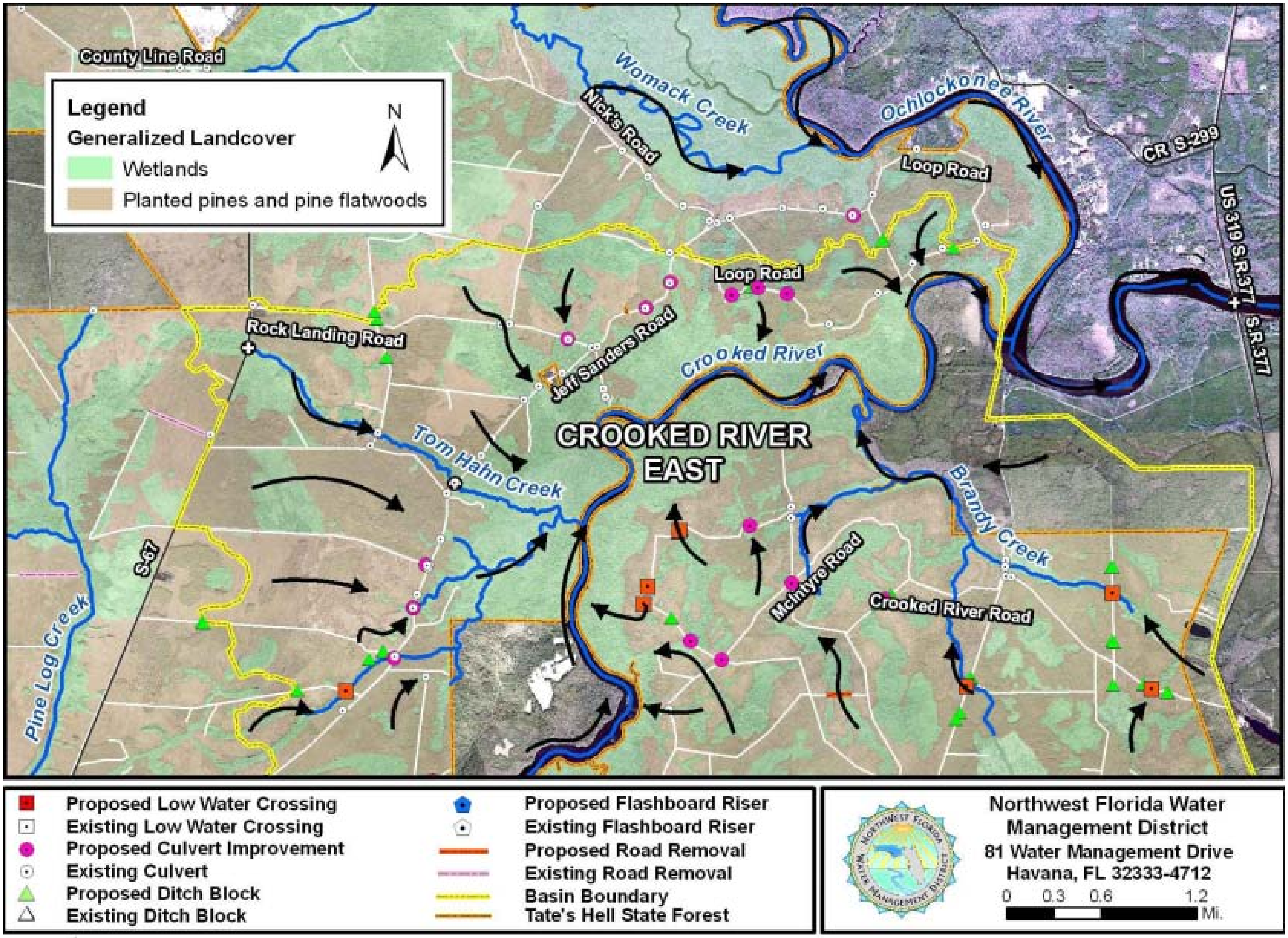

Figure 82. Proposed hydrologic improvements and post-restoration drainage patterns in the northern portion of the eastern Crooked River basin.

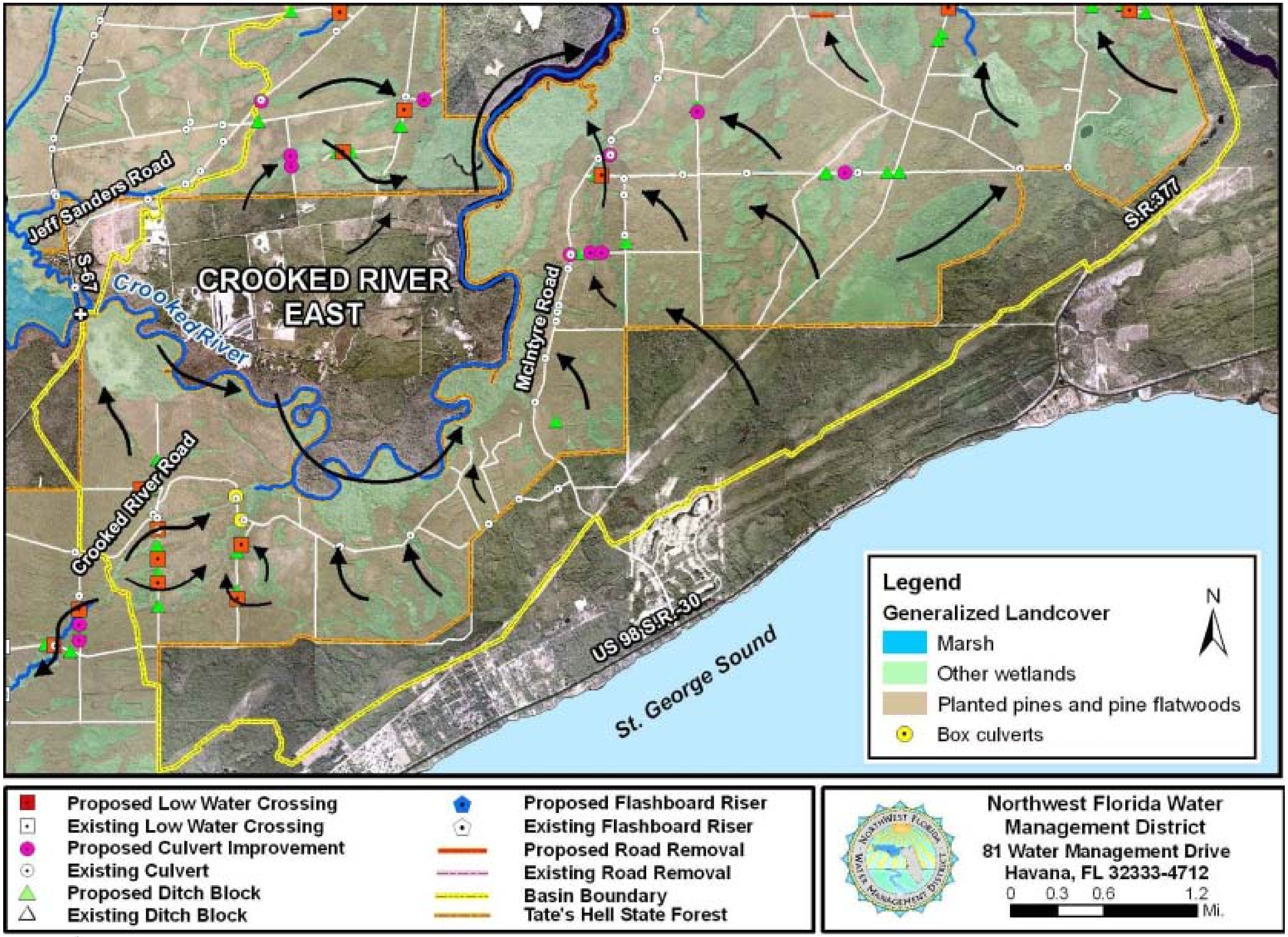

Figure 83. Proposed hydrologic improvements and post-restoration drainage patterns in the southern portion of the eastern Crooked River basin.

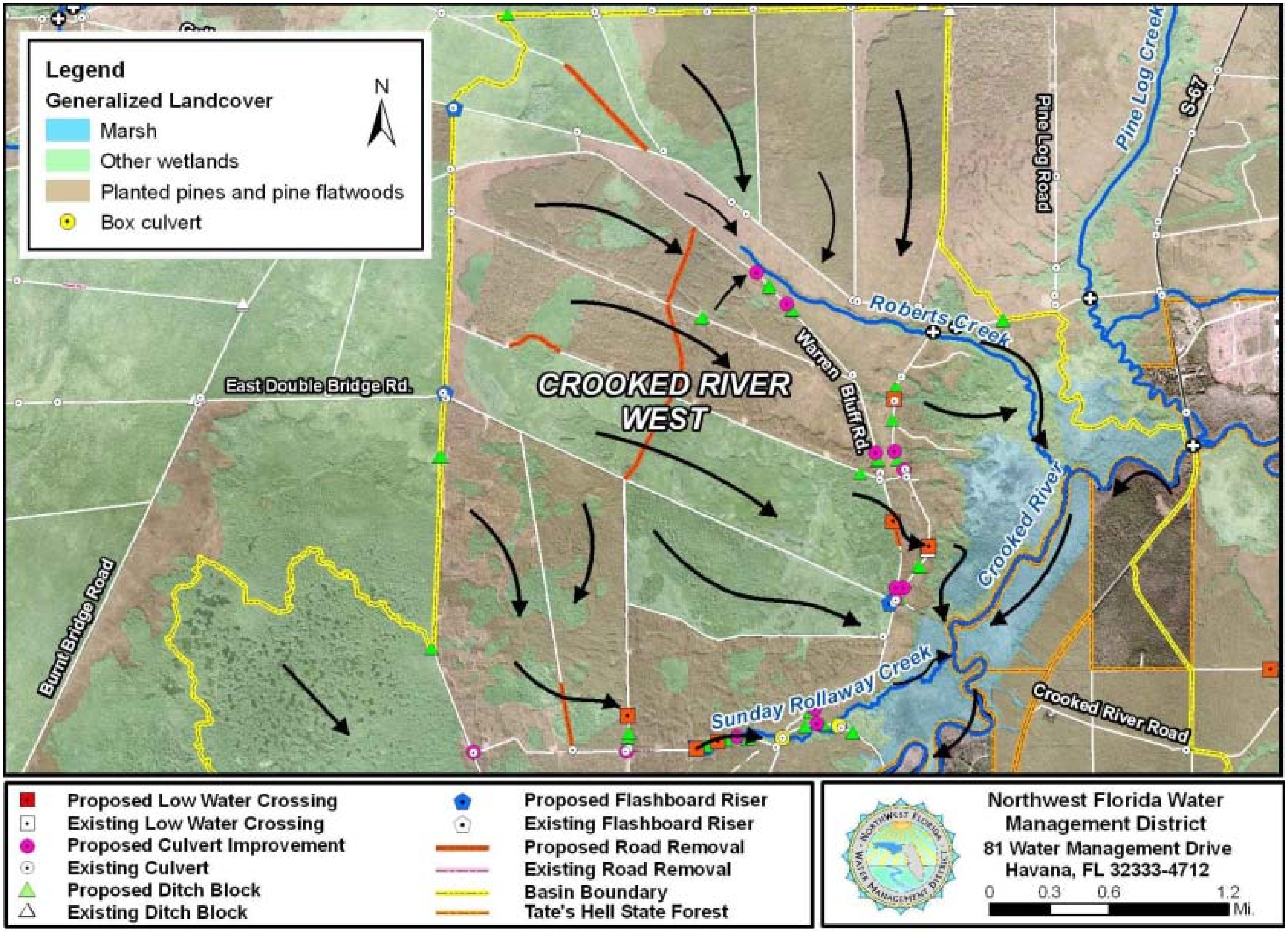

Figure 84. Proposed hydrologic improvements and post-restoration drainage patterns in the northern portion of the western Crooked River basin.

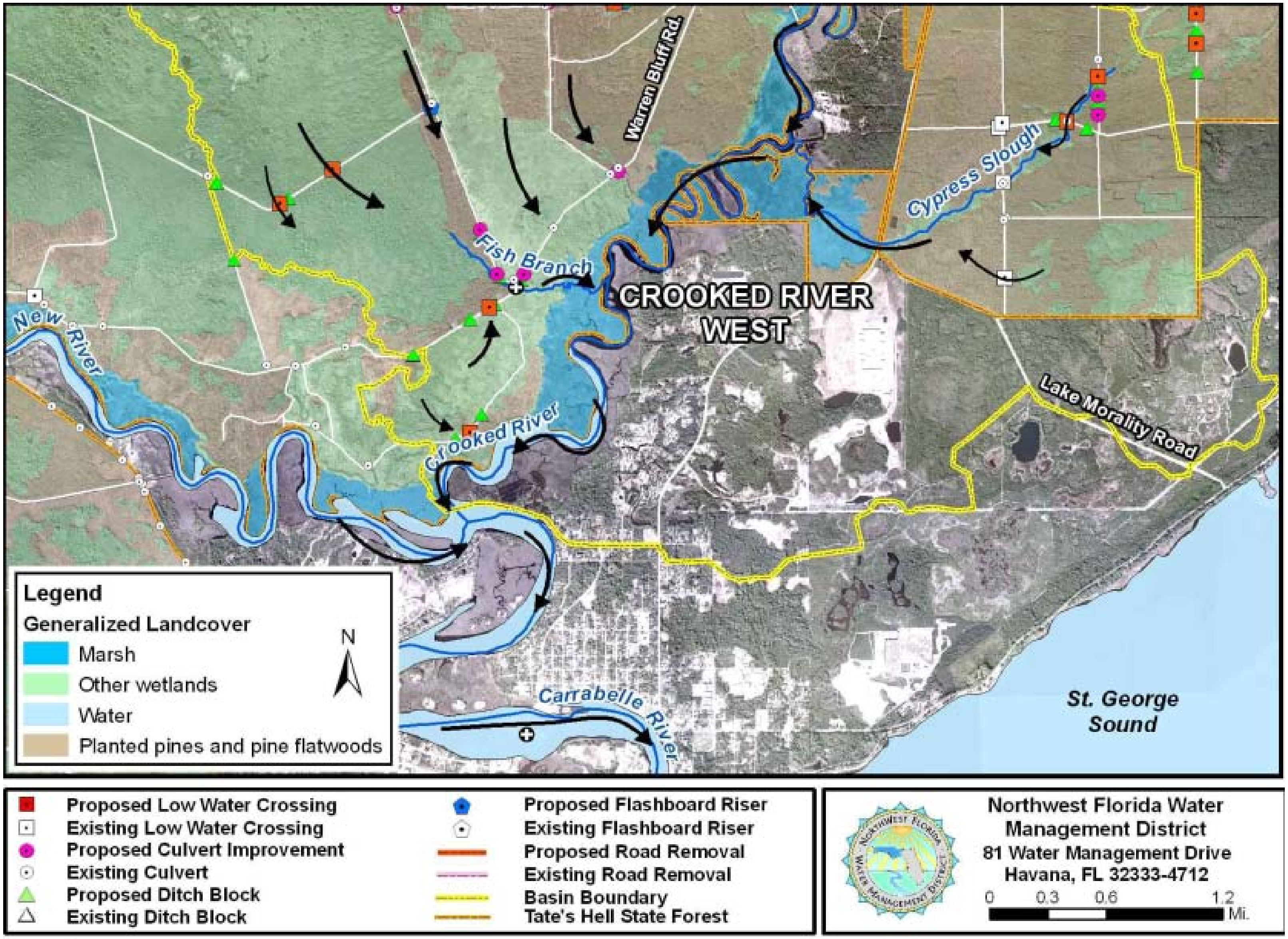

Figure 85. Proposed hydrologic improvements and post-restoration drainage patterns in the southern portion of the western Crooked River basin.

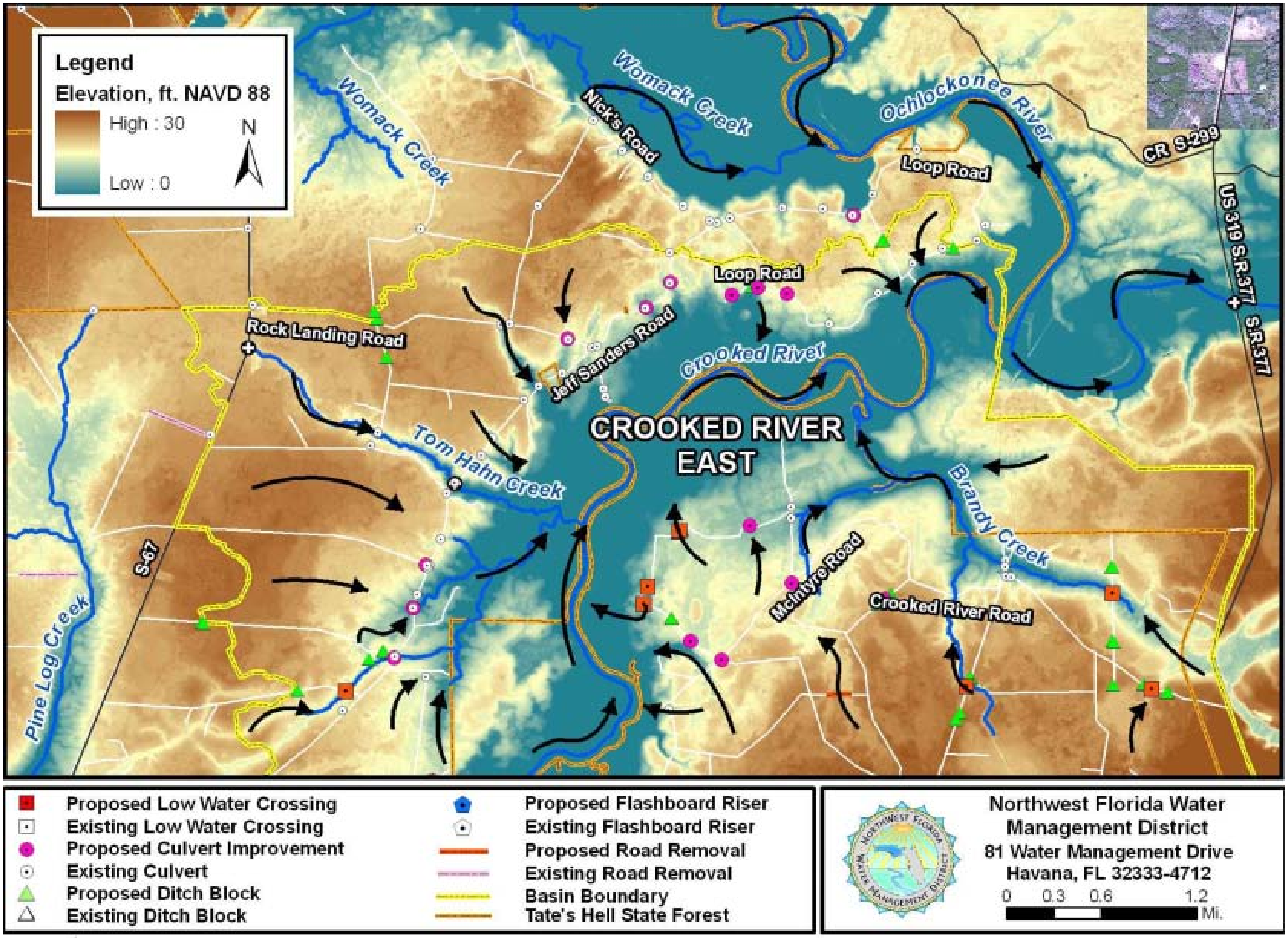

Figure 86. LiDAR elevation data, proposed hydrologic improvements and post-restoration drainage patterns in the northern portion of the eastern Crooked River basin.

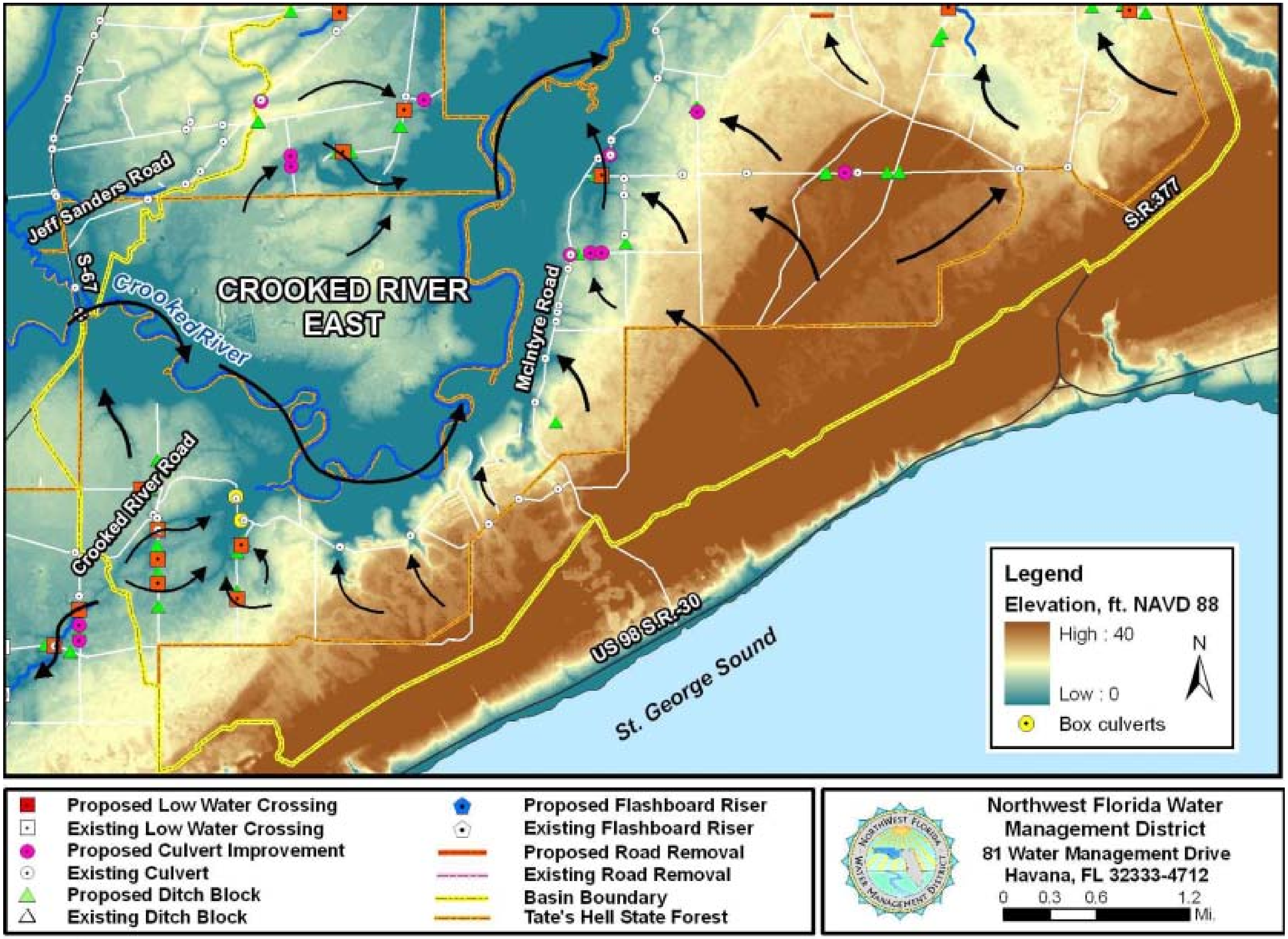

Figure 87. LiDAR elevation data, proposed hydrologic improvements and post-restoration drainage patterns in the southern portion of the eastern Crooked River basin.

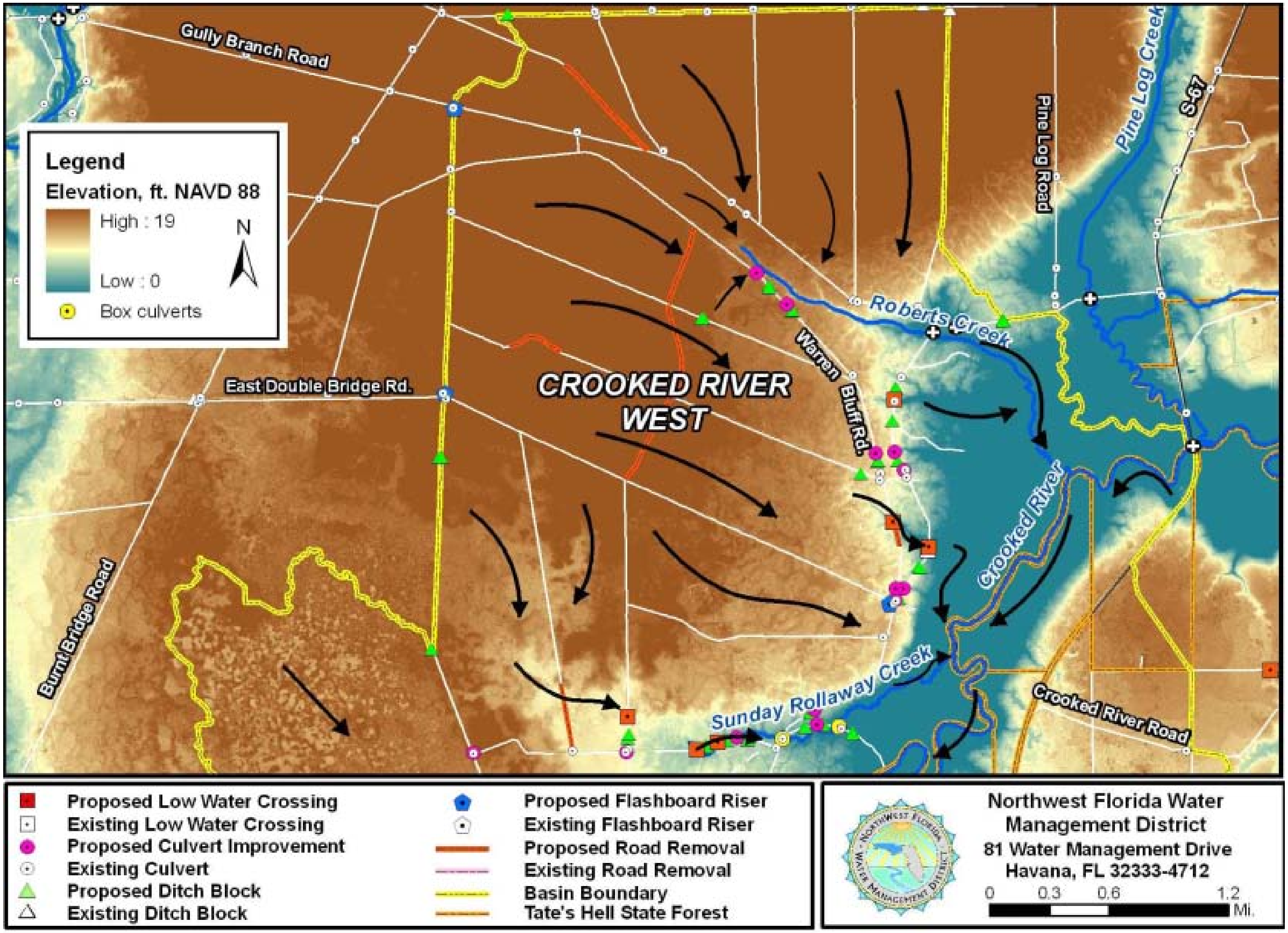

Figure 88. LiDAR elevation data, proposed hydrologic improvements and post-restoration drainage patterns in the northern portion of the western Crooked River basin.

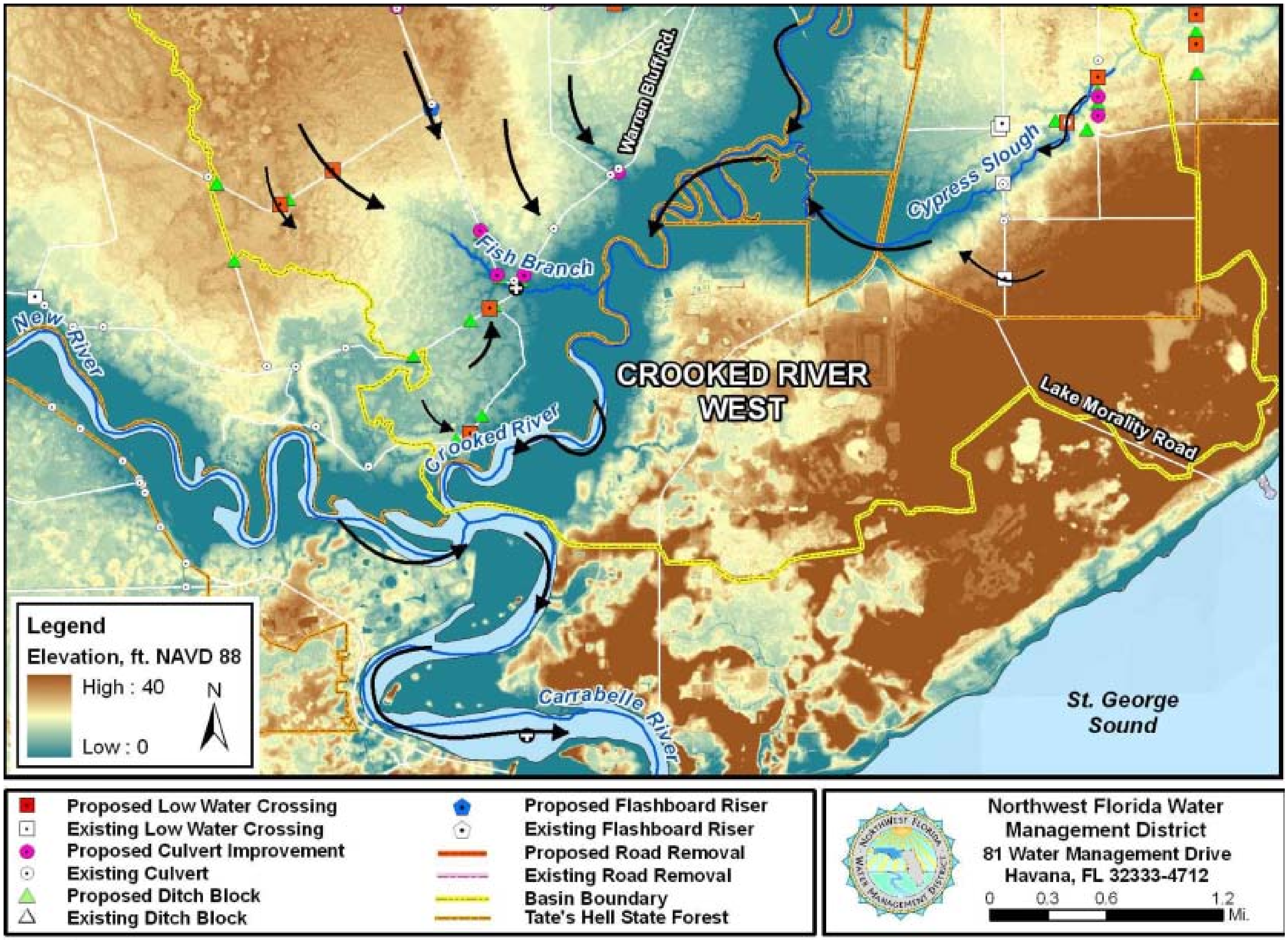

Figure 89. LiDAR elevation data, proposed hydrologic improvements and post-restoration drainage patterns in the southern portion of the western Crooked River basin.

Pine Log Creek Basin

Restoration Priority: Medium

Basin Area: 15,300 acres

Description: The Pine Log Creek drainage basin comprises 15,300 acres on the east side of Tate's Hell State Forest. Pine Log Creek flows south and discharges to the Crooked River. Although most of the basin is located west of Highway 67, a portion of the basin is located east of Highway 67 and west of Jeff Sanders Road.

The 1953 black and white aerial photography shows that the central portion of the basin, located between Rock Landing and Gully Branch roads, was once a vast, low-lying basin swamp (Figures 90 and 93). The construction of dirt logging roads and conversion of the basin swamp to pine plantation has significantly altered the landscape and surface water drainage patterns. Today, surface water runoff flows into large ditches on County Line Road, Road 152 (immediately south of County Line Rd), and Pine Log Road before flowing through bridges and culverts and eventually discharging to Pine Log Creek.

The only previous hydrologic restoration effort was the Pine Log Lakes project, which was implemented by a private entity to fulfill wetland mitigation requirements associated with offsite activities. The project involved removing a short section of Fish Kill Road, installing a flashboard riser and several ditch blocks and culverts (see existing structures Figure 92). Unfortunately, the flashboard riser is not effective because the large volume of flow in the ditch has created a new channel that bypasses the riser and flows into the ditch on the eastern side. The road removal, which was intended to enable water to surface water runoff to flow south towards Pine Log Creek, is of limited effectiveness because the ditch on the northern side of the road segment was left intact and therefore water continues to flow east in the ditch. Additionally, the planted pines south of the road removal area appear to have been bedded and the topography modified. Rather than flowing south across the road removal area as intended, surface water runoff flows continues to flow east in the ditch and then flows south through a culvert near the intersection with Pine Log Road.

2010 – 2020 Hydrologic Restoration Plan: The objectives of the hydrologic restoration activities are to restore portions of the former basin swamp, reduce surface water flow in roadside ditches, and increase the flow through natural wetland systems towards Pine Log Creek.

Two segments of road totaling 1.1 miles are proposed to be removed to reconnect former wetland habitats and facilitate sheet flow north of County Line Road (Figures 90, 91, and 92). Further south, three north-south oriented road segments totaling 1.9 miles are proposed for removal as part of the restoration of the former large basin swamp. The timing of the road removals will depend on when the Division of Forestry is able to harvest the remaining timber in the adjacent areas. Additional short segments of Fish Kill Road are proposed for removal on either side of the existing section of road removed as part of the Pine Log Lakes mitigation project. The proposed ditch blocks at the eastern end of the Fish Kill Road removal segment will prevent the easterly flow of water in the roadside ditches and facilitate natural drainage to the south towards Pine Log Creek. The low water crossings proposed north of Fish Kill Road are wetland crossings rather than stream crossings and may only contain water intermittently. Culverts are proposed to reconnect contributing drainage areas along Rock Landing Road, Pine Log Road, and several smaller roads.

A new bridge is proposed to replace two existing large culverts where Pine Log Creek crosses Pine Log Load (Figures 90, 91, and 92). The road is eroding at this location and the new bridge will increase the conveyance capacity and allow a more natural stream channel to become reestablished. West of the bridge along the creek, a long low water crossing is proposed to replace a series of three small culverts. These culverts were installed as part of the Pine Log Lakes mitigation project; however a low water crossing would facilitate a more natural flow regime at this location. The remnant Pine Log Creek stream channel is shallow wide, and braided in the vicinity of these three culverts.

In the southeastern portion of the Pine Log Creek basin, three low water crossings and associated ditch blocks are proposed in lieu of the existing culverts to increase conveyance capacity and facilitate the restoration of natural channel morphometry in these interconnected basin swamps (Figures 94, 95, and 96). An additional culvert is proposed in the southern portion of the basin on the western side of Pine Log Creek. A flashboard riser and a culvert removal are proposed to reduce ditch flow across the basin boundary.

In all, the proposed hydrologic improvements encompass the removal of three miles of dirt logging roads and adjacent ditches and the installation of nine low water crossings, one flashboard riser, 19 culverts, and 23 ditch blocks.

Estimated Construction Cost for Hydrologic Improvements: $ 425,000

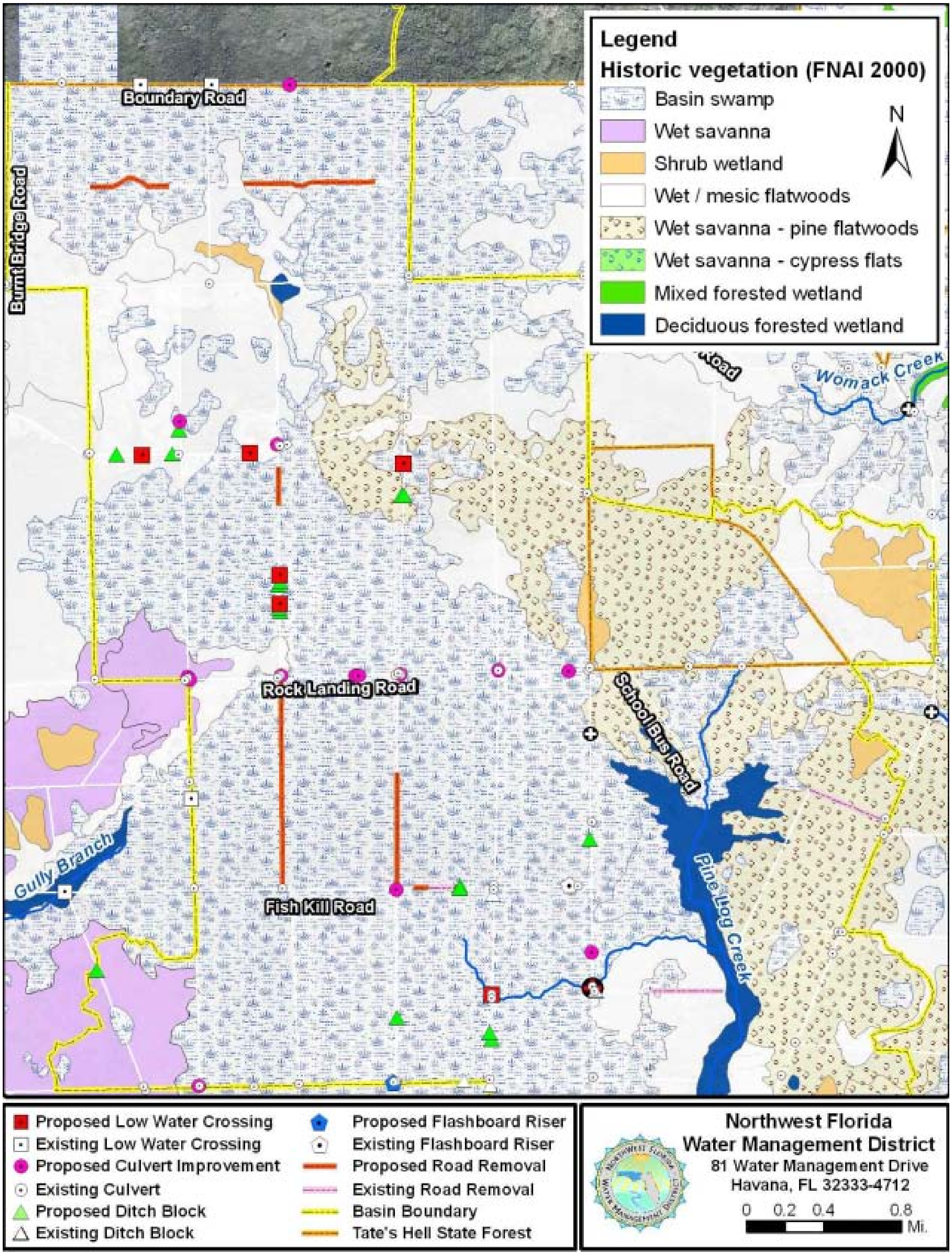

Figure 90. Historical ecological communities and proposed hydrologic improvements in the northern portion of the Pine Log Creek basin.

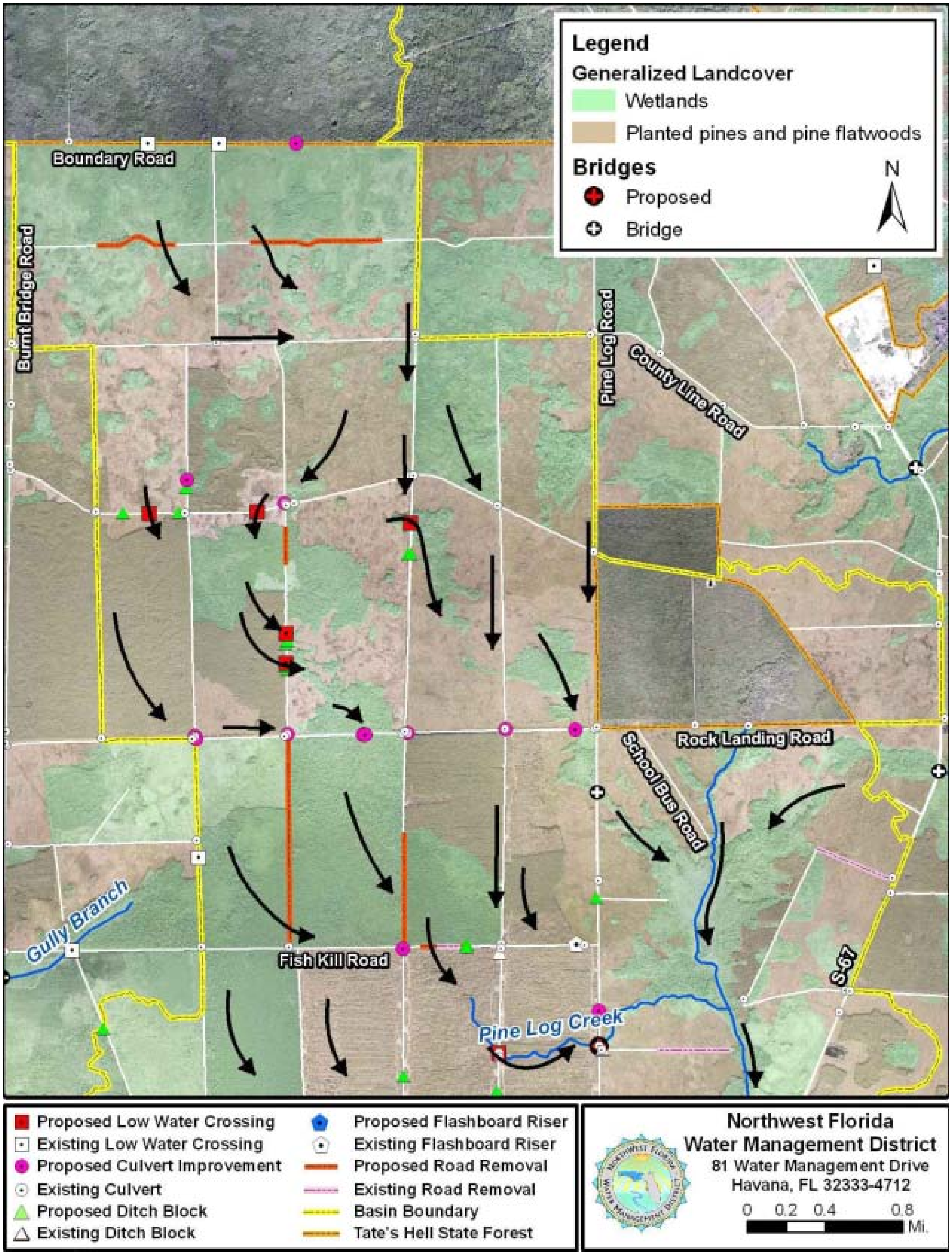

Figure 91. Proposed hydrologic improvements and post-restoration drainage patterns in the northern portion of the Pine Log Creek basin.

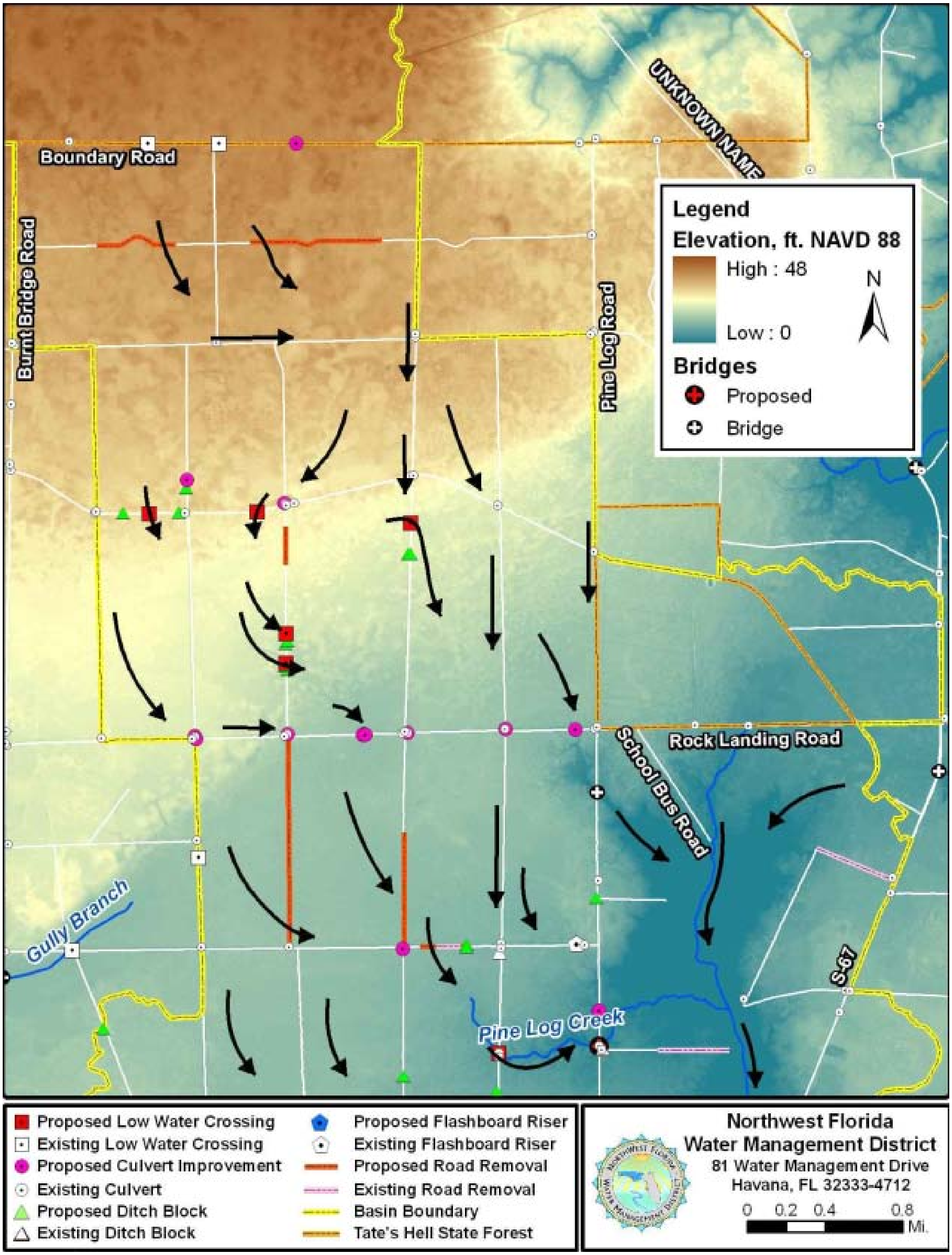

Figure 92. LiDAR elevation data, proposed hydrologic improvements and post-restoration drainage patterns in the northern portion of the Pine Log Creek basin.

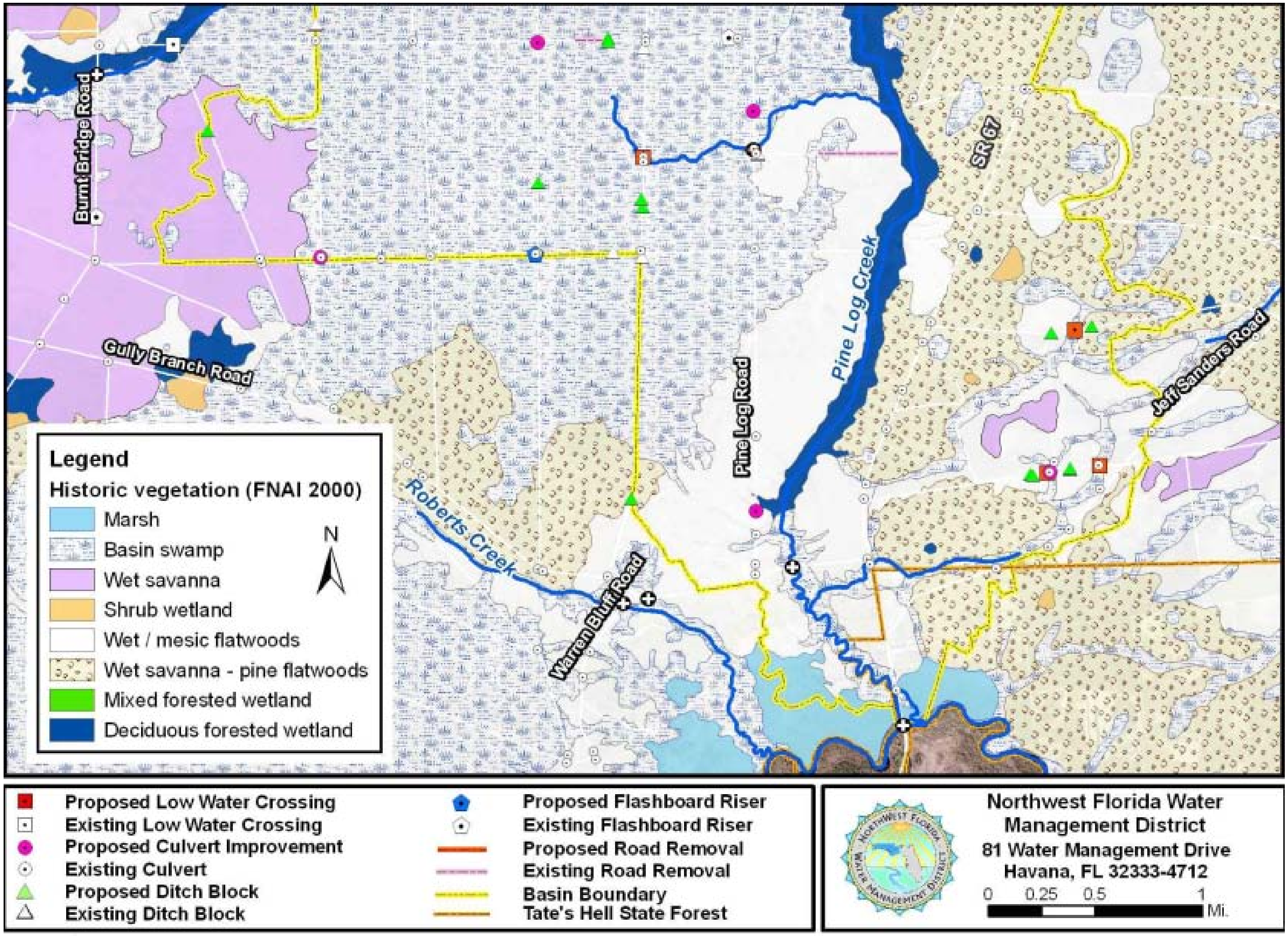

Figure 93. Historical ecological communities and proposed hydrologic improvements in the southern portion of the Pine Log Creek basin.

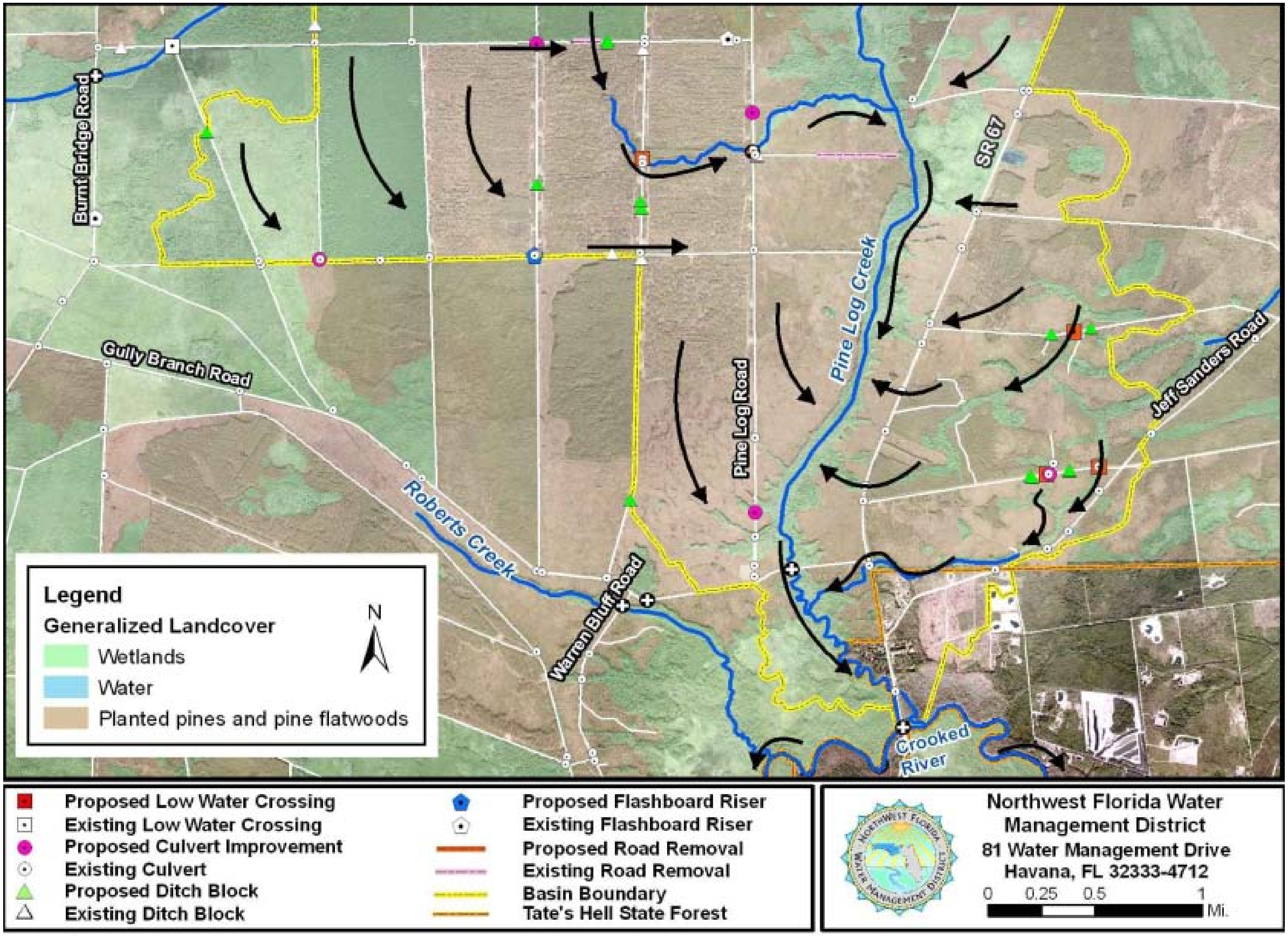

Figure 94. Proposed hydrologic improvements and post-restoration drainage patterns in the southern portion of the Pine Log Creek basin.

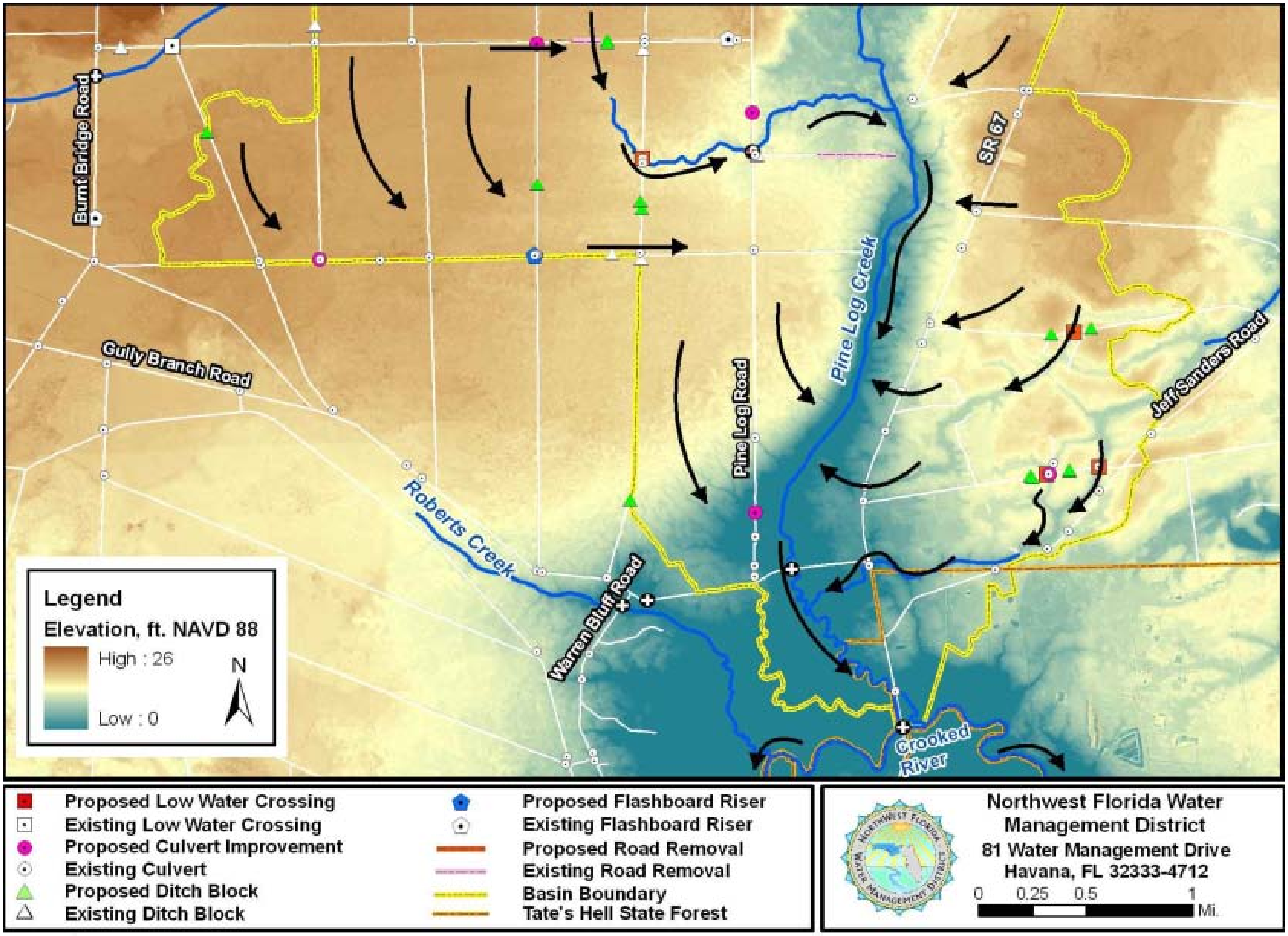

Figure 95. LiDAR elevation data, proposed hydrologic improvements and post-restoration drainage patterns in the southern portion of the Pine Log Creek basin.

Womack Creek, Haw Creek, and the Ochlockonee River Basins

Restoration Priority: Low

Basin Area: Womack Creek: 6,700 acres; Haw Creek: 3,200 acres; and portion of the Ochlockonee River basin within the Tate's Hell State Forest: 2,200 acres

Description: The Womack Creek area comprises the northeast corner of Tate's Hell State Forest and includes portions of the Haw Creek and Ochlockonee River basins. Womack Creek and Haw Creek are both tributaries to the Ochlockonee River. The Ochlockonee River flows east and discharges to Ochlockonee Bay, which is located between Apalachee Bay and St. George Sound.

Historically, this area was comprised largely of basin swamps and mixed forested wetlands with scattered areas of shrub wetlands and mesic flatwoods (Figures 96 and 97). Today, mixed forested wetlands continue to comprise the floodplains of Womack Creek and the Ochlockonee River. Many basin swamps remain although they are heavily dominated by titi, particularly to the east of SR 67. The former mesic flatwoods and some drier basin swamp areas have been converted to pine plantation. Beginning in about 1997, the Division of Forestry began restoring longleaf pine in many of these areas.

In 2005, the NWFWMD initiated the Womack Creek Mitigation Project. The project restored approximately 20 acres of mixed hardwood forest and 50 acres of hydric pine flatwoods. Restoration activities included mechanical removing and roller-chopping of invasive shrubs, prescribed burning, and planting of wiregrass plugs. Additional planting of mixed hardwoods is scheduled for the winter of 2010 / 2011. Post construction monitoring suggests that the site is trending towards desired vegetation conditions.

2010 – 2020 Hydrologic Restoration Plan: Future restoration activities will restore historical surface water drainage patterns by reconnecting basin swamps and other wetlands, and restoring surface water drainage towards the creeks. West of SR 67, a culvert and two ditch blocks are proposed within the Haw Creek basin to restore flows in a basin swamp that once conveyed water north towards the creek (Figures 96, 98, and 100). The basin swamp has been bisected by Pine Log Road. Once the culvert is installed, surface water flows from this basin swamp system will be able to flow north towards Haw Creek through an existing culvert located on Boundary Road.

Within the Womack Creek basin, several new culverts and ditch blocks are proposed west of SR 67 to enhance surface water drainage towards the creek (Figures 98 and 100). Three flashboard risers are proposed along County Line Road to reduce ditch flow to the south (at Pine Log Road) and slow the flow of water in the large drainage ditch on the north side of the road.

East of SR 67, a culvert replacement and three ditch blocks are proposed north of Log Cabin Road to enhance surface water flows in the Ochlockonee River basin (Figures 98, and 100). Between Log Cabin Road and Womack Creek, four low water crossings and associated ditch blocks are proposed to restore drainage patterns within a basin swamp and mixed forested wetland system.

Southeast of Womack Creek, three additional low water crossings, two culverts, and associated ditch blocks are proposed to restore northerly flow through wetlands that drain towards Womack Creek's smaller tributary streams (Figures 99, and 101). A number of additional ditch blocks are proposed in the southeast portion of the Womack Creek basin to separate flow between culverts and to restore natural topographic features and local surface water drainage divides.

In all, the proposed hydrologic improvements in the Haw Creek and Womack Creek basins include seven low water crossings, three flashboard risers, 18 culvert improvements and 53 ditch blocks.

Estimated Construction Cost for Hydrologic Improvements: $ 350,000

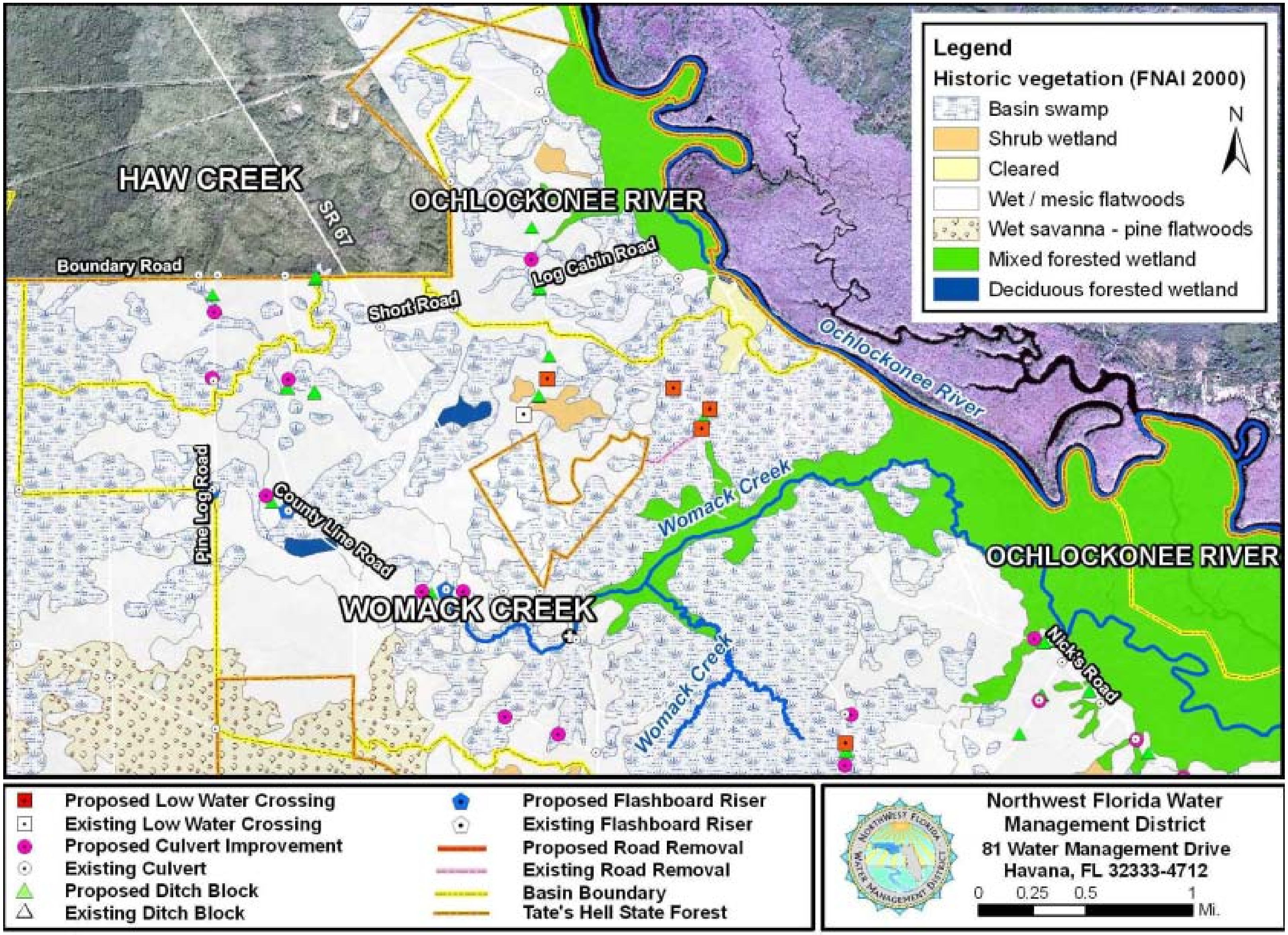

Figure 96. Historical ecological communities and proposed hydrologic improvements in the western portion of the Womack Creek, Haw Creek, and Ochlockonee River basin.

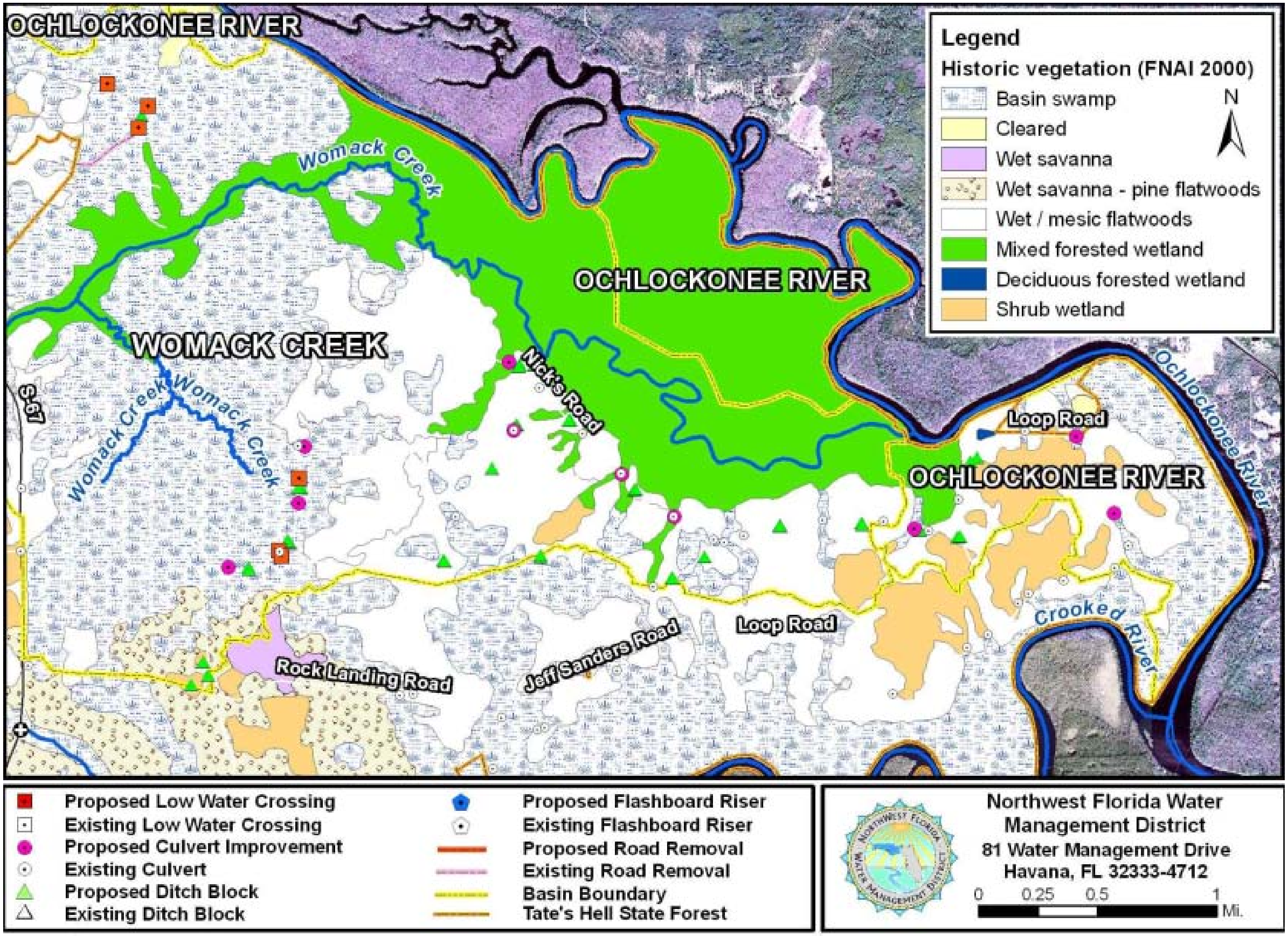

Figure 97. Historical ecological communities and proposed hydrologic improvements in the eastern portion of the Womack Creek, Haw Creek, and Ochlockonee River basin

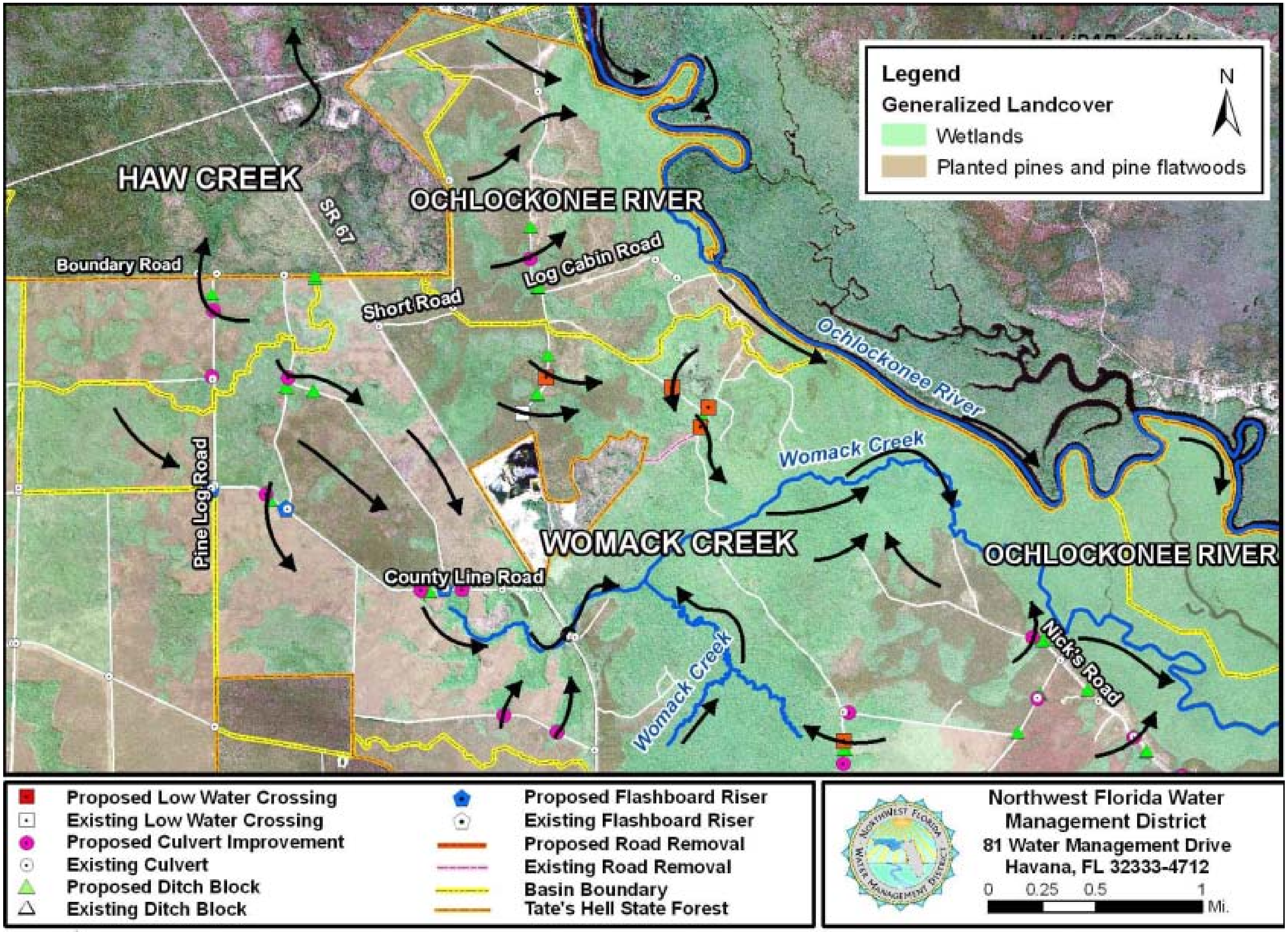

Figure 98. Proposed hydrologic improvements and post-restoration drainage patterns in the western portion of the Womack Creek, Haw Creek, and Ochlockonee River basins.

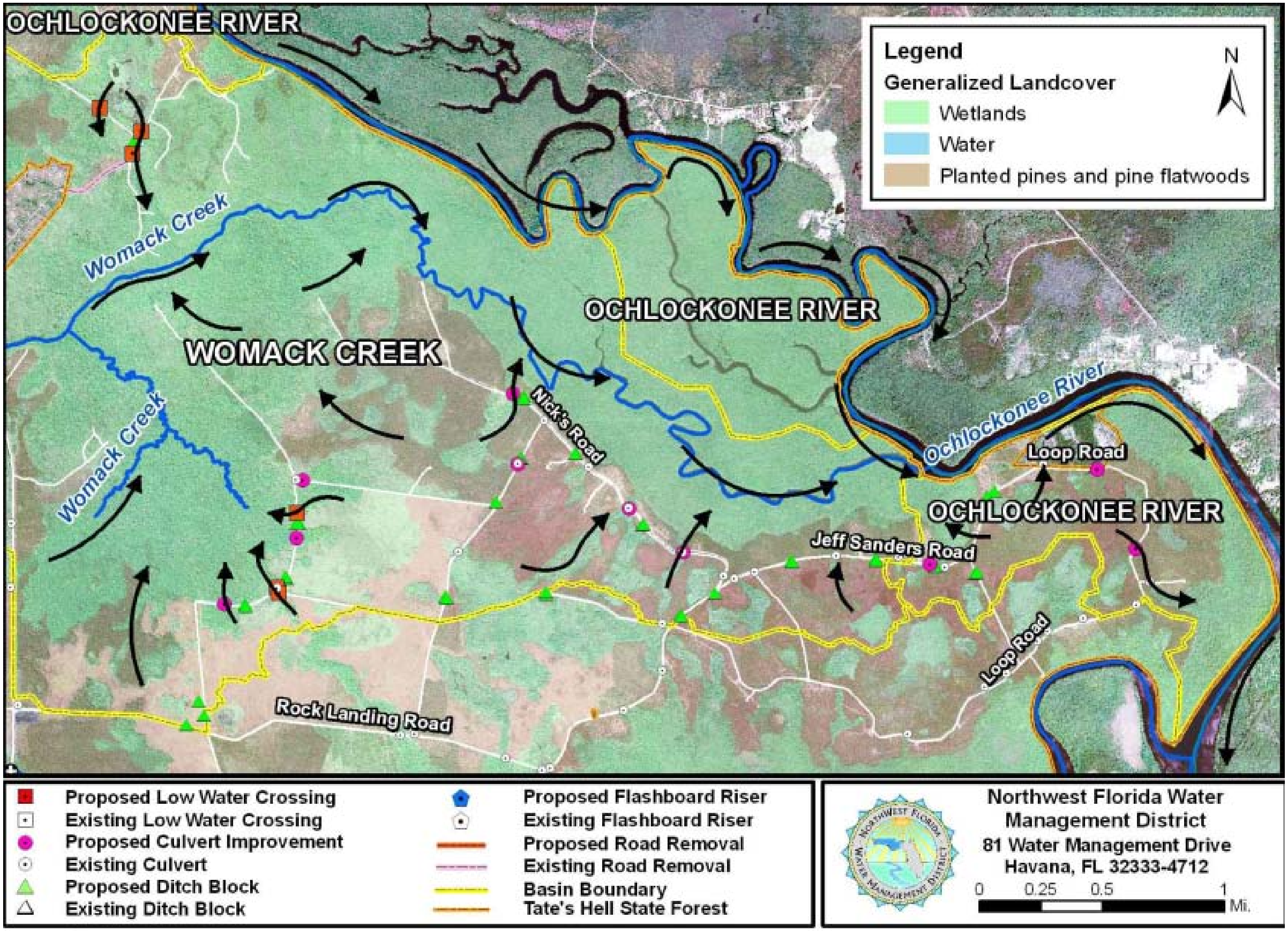

Figure 99. Proposed hydrologic improvements and post-restoration drainage patterns in the eastern portion of the Womack Creek, Haw Creek, and Ochlockonee River basins.

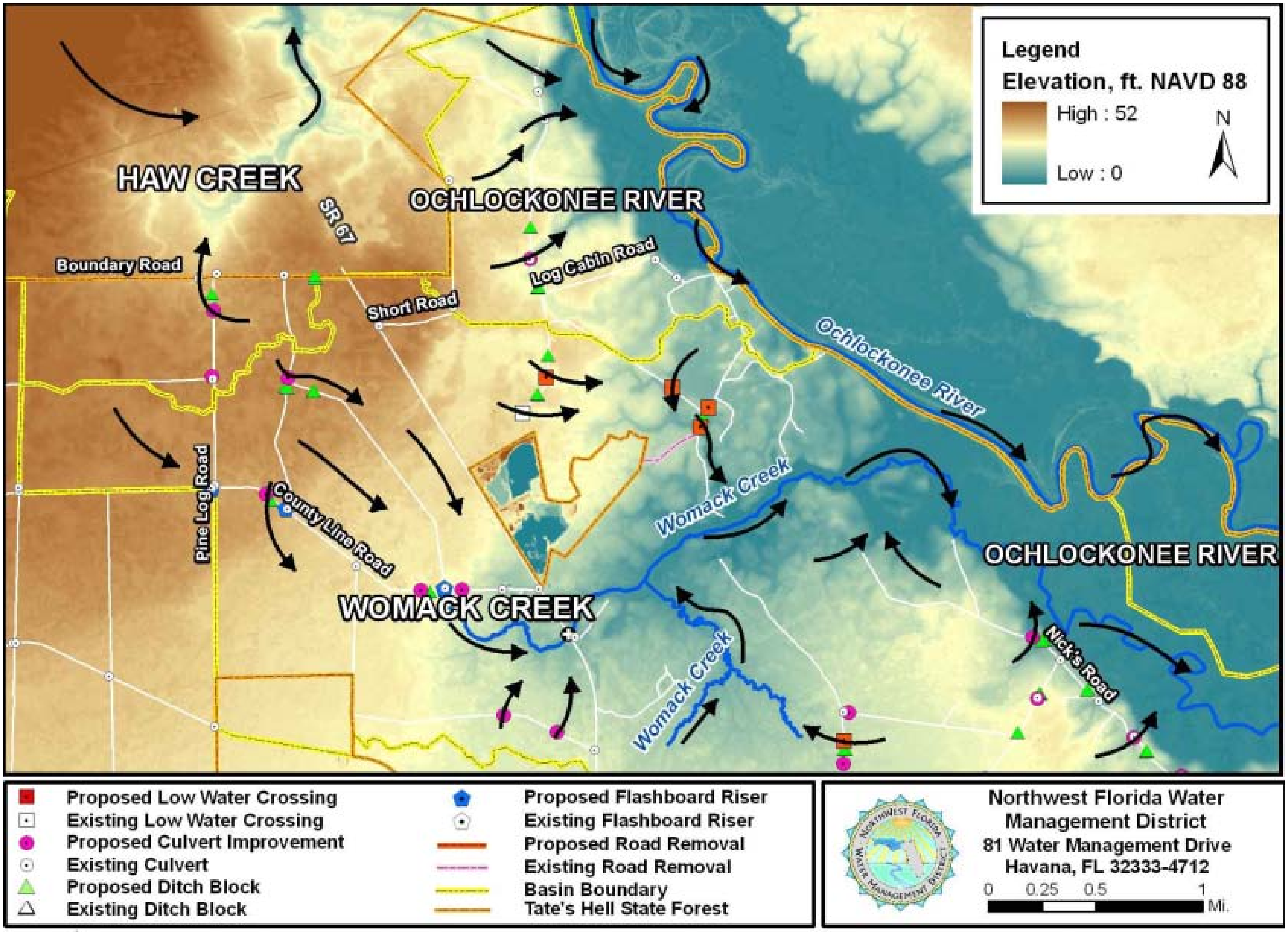

Figure 100. LiDAR elevation data, proposed hydrologic improvements and post-restoration drainage patterns in the western portion of the Womack Creek, Haw Creek, and Ochlockonee River basins.

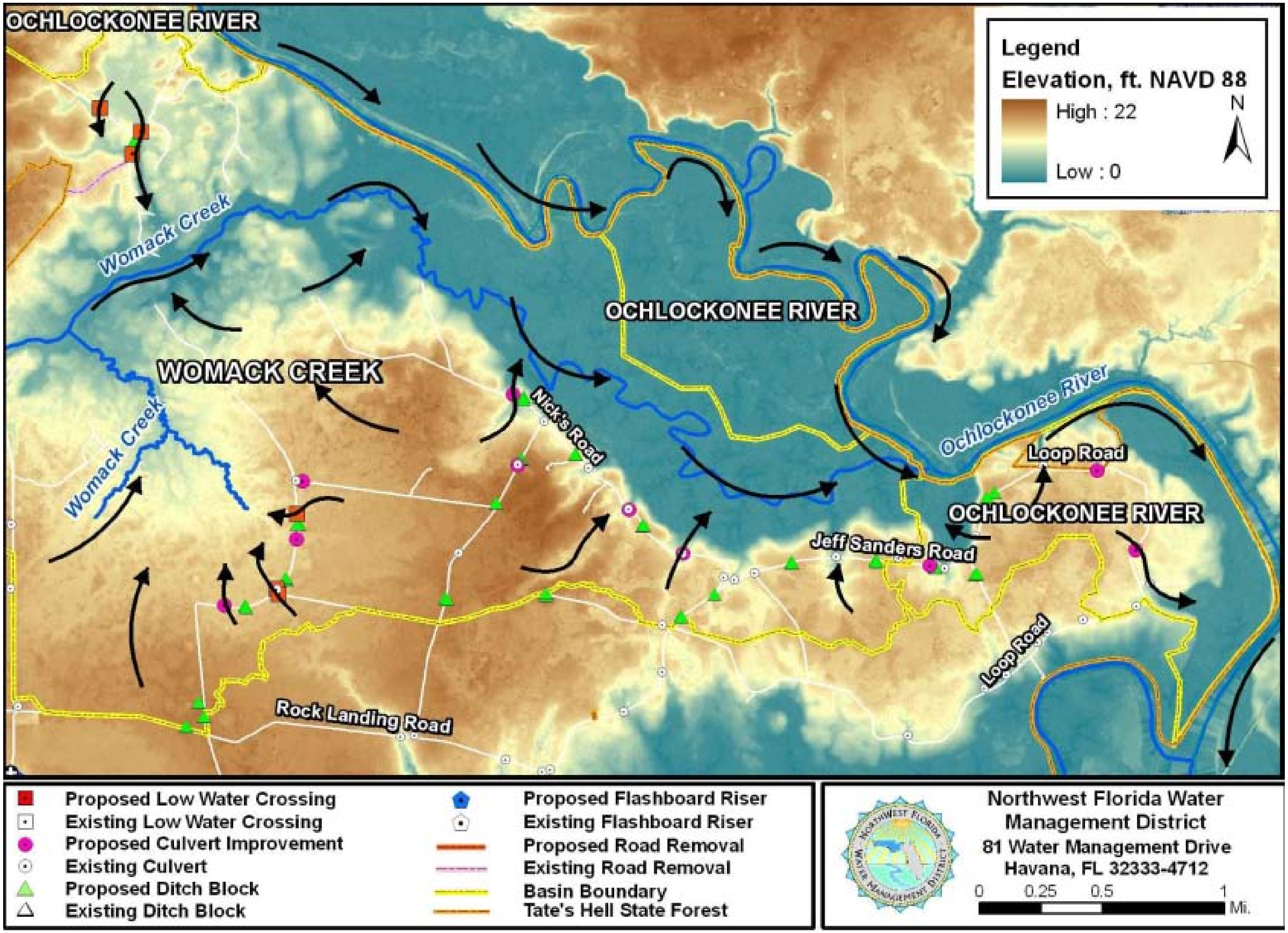

Figure 101. LiDAR elevation data, proposed hydrologic improvements and post-restoration drainage patterns in the eastern portion of the Womack Creek, Haw Creek, and Ochlockonee River basins.

Implementation of Hydrologic Restoration Plans

This Hydrologic Restoration Plan is intended to provide a blueprint for future restoration activities at Tate's Hell State Forest during the 2010 – 2020 timeframe. Hydrologic restoration plans and preliminary estimates of construction costs are provided for the 29 watersheds within Tate's Hell State Forest.

To accompany this Hydrologic Restoration Plan document, a set of GIS shapefiles have been prepared for use by the Division of Forestry and the NWFWMD. These GIS shapefiles show the locations and attributes of the proposed low water crossings, culvert modifications, flashboard risers, ditch blocks and road removals. Because the GIS environment allows the user to zoom in and overlay various data layers and forest management plans, these shapefiles are anticipated to be used as the basis for the planning and implementation of restoration projects within Tate's Hell State Forest. It is recommended that these shapefiles be updated periodically as new field data become available or as site conditions or timber management plans change. It is envisioned that the GIS files that comprise the Hydrologic Restoration Plan will be updated annually by the NWFWMD and the Division of Forestry similar to the annual updates of the harvesting plan, prescribed burn plan, and other forest management plans.

Project Implementation

The implementation of specific restoration projects will typically involve additional field reviews, final design and permitting, construction, habitat modifications, and post-restoration monitoring. Prior to finalizing the design for a particular project, a comprehensive field review should be performed to assess current site conditions and confirm the suitability and design details of the proposed hydrologic improvements. Prior to applying for state and federal permits, the project details should be reviewed with Division of Forestry staff to confirm that the proposed hydrologic restoration activities do not pose a conflict with other current land management activities.

Due to the large number of listed species present within Tate's Hell State Forest, maps of species occurrences, including locations of Red-cockaded Woodpecker (RCW) clusters, should be reviewed prior to project construction. If RCW clusters occur within the project vicinity, the Division of Forestry biologist or FWC personnel should be consulted. Hydrologic improvements should be reviewed to confirm that they do not adversely affect RCW nesting or foraging habitat. Construction activities are prohibited within 200 feet of any RCW cavity tree during the April through July nesting season.

Construction activities, particularly road removals and low water crossings, should be scheduled to occur during the dry season whenever possible. Under wet weather and high water table conditions, it can be difficult for heavy equipment to excavate soils in many areas of Tate's Hell State Forest, particularly in the vicinity of current or historical wetlands. Appropriate erosion and sedimentation control procedures should be followed to minimize construction impacts to ditches, adjacent wetlands, and downstream waters. Seeding and mulching bare soils, such as the top and sides of ditch blocks, is recommended. However, seed and mulch materials should not contain any invasive species. For example, Bahia grass should not be used for any seeding or mulching activities.

It is recommended that road removal areas be replanted with wiregrass or appropriate tree species. In most cases, native groundcover vegetation will also recolonize the former road footprint. Appropriate signage, guardrails and water depth indicators should be installed in conjunction with low water crossings to facilitate appropriate vehicle access.

It is recommended that the Division of Forestry continue to manage restored habitats using prescribed burning, tree thinning and exotic and invasive species control in a manner that is consistent with the Vegetation Management Guidelines document (Division of Forestry and FNAI 2001). Where reforestation is needed, it is recommended that trees be planted at naturally occurring tree densities or only slightly higher. Slash pines appear to be very resilient even in wet areas and replanting restoration project areas, such as historical wet savannas, at high pine densities (> 200 trees per acre) can lead to an unnaturally dense tree canopy over time.

Post-construction monitoring of environmental conditions should be performed to ensure that restoration projects are achieving the desired results. Volume I of this Hydrologic Restoration Plan provides guidelines for environmental monitoring of restoration areas.

Operation and Maintenance

Water control structures such as culverts, ditch blocks, flashboard risers and weirs should be inspected annually and after significant storm events, pine harvesting operations, and prescribed burns. Following each inspection, any maintenance or repair needs should be documented and reported to the Division of Forestry, the NWFWMD, or other responsible entity. Large-scale disturbances to the restoration project areas should be documented. Example disturbances include natural wildfires, excessive flooding, damage by wild hogs, the spread of invasive or exotic species and human activities such as trash dumping and unauthorized vehicle access.

Flashboard risers are the only type of operable structure associated with the hydrologic restoration projects outlined in this plan. There are currently only about 10 flashboard risers in Tate's Hell State Forest. It is unknown how frequently these structures have been operated. Approximately 80 additional flashboard risers have been proposed. Although not all of the flashboard risers will be installed immediately, the total number of flashboard risers may exceed 20 to 30 within the next five years. To optimize the hydrologic benefits that can be achieved with flashboard risers, it is recommended an operations plan be developed. The operations plan for the flashboard risers should provide criteria, guidelines, and schedules for installing and removing boards to retain and release water. Monitoring of ditch water levels at a subset of locations is recommended to provide information that can be used to improve the design and operation of flashboard risers over time.

Adaptive Management

Post-construction monitoring of environmental conditions and hydrologic structures should be performed at Tate's Hell State Forest to ensure that desired ecosystem conditions are achieved and restoration goals are met. There are many uncertainties inherent in the restoration process and many reasons why actual ecosystem conditions may differ from those set forth as restoration goals. An adaptive management approach recognizes that uncertainties exist and provides the flexibility to take corrective actions to address them (Figure 102). An adaptive management approach to wetland restoration is advocated by many agencies and organizations (ACOE 2008, NOAA 2008, Ramsar Convention 2008, Clewell et al. 2005, Diefenderfer and Thom 2003).

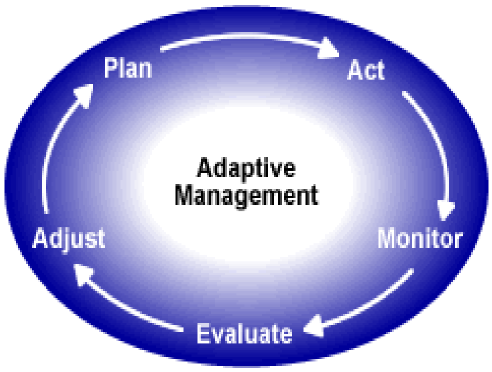

Figure 102. Adaptive management (NOAA 2008)

Under adaptive management, if ecosystem conditions are not exhibiting a trend towards desired conditions, restoration goals and activities are re-evaluated and restoration plans are revised as needed. Revisions might include changes in habitat management practices (e.g. prescribed burning, replanting, thinning of pines) or modifications to hydrologic improvements. It is recommended that hydrologic restoration sites be re-evaluated at least annually for the first five years following initial construction activities and at least every five years thereafter.

It is anticipated that the Hydrologic Restoration Plan will be periodically updated or revised and presented to the District Government Board for approval. The plan may be revised in response to ongoing environmental monitoring activities, changes in Division of Forestry land management practices, issues related to environmental permitting, or for other reasons.

Funding

The hydrologic restoration plans for the 29 surface water drainage basins include nearly 20 miles of road removals, and more than 300 culvert improvements, 200 low water crossings, 690 ditch blocks, and 80 flashboard risers (Table 2). The estimated construction costs for these proposed hydrologic improvements total nearly $8 million. It is anticipated that

Table 2. Summary of proposed hydrologic improvements and estimated construction costs for Tate's Hell State Forest.

Structure	Unit cost	Total Number	Total Cost
Culvert modifications	$5,000	320	$1,313,350
Box culverts / weirs	$40,000	6	$240,000
Bridges	$100,000	8	$800,000
Ditch block	$2,550	691	$1,762,050
Flashboard riser	$6,000	80	$480,000
Low water crossing	$15,000	200	$3,000,000
Road removal	$17,000	19.84	$337,195
			$7,932,595

restoration activities will be implemented by the NWFWMD, the Division of Forestry, the FWC, and other public and private entities. Potential sources of funding include agency budgets, FDOT mitigation funds, private funds, and state and federal grants.

Summary and Recommendations

A long history of silviculture and the large-scale conversion of native habitats to slash pine plantation have significantly altered the former landscape of Tate's Hell State Forest. Prior to the mid 1950s, this area was a wetland-dominated landscape referred to as Tate's Hell Swamp. More than 12 unique ecological community types were present ranging from wet savannas to coastal marshes (FNAI 1997 and 200). During the 1960s and 1970s, native wet and mesic flatwoods and the drier portions of many wetland ecosystems were converted to intensively managed slash pine plantation. More than 800 miles of roads were constructed and drainage ditches were constructed along most roads to provide road fill and drain nearby wetlands. Pines were planted in dense stands, bedded, fertilized, and fire was typically suppressed. These widespread habitat alterations impacted ecological communities and wetland functions, and altered the magnitude and timing of surface water runoff discharged from the area to Apalachicola Bay, East Bay, and surrounding waters.

In 1994, the State of Florida began acquiring land for Tate's Hell State Forest with the goal of restoring historical surface water drainage patterns and ecological communities to improve the timing, magnitude and quality of surface waters discharged from the area to the Apalachicola Bay system. Today the forest encompasses more than 202,000 acres and is managed as a multi-use area by the Florida Division of Forestry with cooperation from the Florida Fish and Wildlife Conservation Commission. Although habitat and hydrologic restoration are the primary land management goals, the forest is also used for recreational activities such as hunting and kayaking, and historical pine flatwoods continue to be managed for timber production.

During the past ten years, a number of hydrologic restoration projects have been implemented at Tate's Hell State Forest by the NWFWMD, the Florida Division of Forestry, the Florida Fish and Wildlife Conservation Commission, and other public and private entities. Recognizing the need for a long-term plan to guide future restoration efforts, the NWFWMD and the Division of Forestry began discussing hydrologic restoration goals, sharing data, and working on the plan development. These two volumes represent the culmination of that effort.

Hydrologic restoration goals shared by the NWFWMD and Division of Forestry include:

(1) Improving the water quality of surface water flows and runoff discharged to East Bay, Apalachicola Bay, and surrounding waters
(2) Restoring historical surface water drainage patterns
(3) Enhancing wetland hydrology and function
(4) Restoring a mix of native ecological communities

Volume I of the Hydrologic Restoration Plan describes the site conditions at Tate's Hell State Forest, prioritizes areas for restoration and provides guidelines for environmental monitoring and habitat management at hydrologic restoration sites. Volume II presents hydrologic restoration plans for the 29 surface water drainage basins in Tate's Hell State Forest, provides estimated construction costs for the proposed improvements, and discusses aspects of project implementation. The accompanying set of GIS shapefiles prepared for the Division of Forestry shows the locations and attributes of the proposed low water crossings, culvert modifications, flashboard risers, ditch blocks and road removals. It is recommended that these shapefiles be updated annually by the NWFWMD and the Division of Forestry as new data become available or as site conditions change.

Areas within Tate's Hell State Forest were prioritized for restoration based on potential water quality benefits, the feasibility of restoration, and the distribution of habitats of species of conservation concern. Approximately 25 listed plant and animal species occur within Tate's Hell State Forest including the Red-cockaded Woodpecker and Eastern indigo snake, and plants such as Curtis' loosestrife and white-birds-in-a-nest. The highest priority areas for restoration are generally located on the western side of the forest. High priority areas include the Fort Gadsden Creek basin, the Sumatra area, and the Doyle Creek, Juniper Creek, Whiskey George Creek, and Cash Creek basins.

The development of a hydrologic restoration plan for each surface water drainage basin was based on an extensive review of site data including forest stand attributes, historical and present-day aerial photography, LiDAR elevation data, road and culvert attributes, recreational facilities, and maps of historical ecological communities. Based on the initial data review, strategies were developed to restore historical drainage patterns to the greatest extent feasible given current site conditions and constraints. To restore historical surface water drainage patterns, hydrologic improvements such as low water crossings, ditch blocks, flashboard risers, and culvert modifications have been proposed along with habitat modifications such as shrub removal and prescribed burning.

In total, the 29 basin plans include nearly 20 miles of road removal, and more than 300 culvert improvements, 200 low water crossings, 690 ditch blocks, and 80 flashboard risers. The estimated construction costs for these proposed hydrologic improvements total nearly $8 million. Costs reflect the sum of labor and materials associated with construction activities and are based on bids received for restoration projects in 2009. Costs for site preparation (e.g. roller-chopping or burning) and habitat improvements (e.g. replanting, pine thinning and shrub reduction) have not been included as many of these activities may be conducted by the Division of Forestry.

Due to the large size of Tate's Hell and the extensive degree of hydrologic impacts, restoration is anticipated to be a gradual process with cumulative benefits accruing as hydrologic restoration and habitat management activities are implemented during the next several decades. Restoration projects are anticipated to be implemented by Division of Forestry, NWFWMD, and other public and private entities. Potential funding sources include agency budgets, FDOT mitigation funds, and state and federal grants. For projects that are implemented using FDOT funds, the Division of Forestry would be required to refrain from using wetland mitigation areas solely for long-term timber production and would closely adhere to prescribed wetland mitigation requirements.

An adaptive management approach will be followed for hydrologic restoration whereby post construction monitoring will be performed to confirm that ecosystem conditions and hydrologic goals are being achieved. If ecosystem conditions are not exhibiting a trend towards desired conditions, restoration actions and goals will be re-evaluated and restoration plans or activities will be revised as needed. It is anticipated that the Hydrologic Restoration Plan will be periodically updated and presented to the District Government Board for approval. The plan may be revised in response to ongoing environmental monitoring activities, changes in Division of Forestry land management practices, issues related to environmental permitting, or for other reasons.

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