CITY OF NORTH BEND

KING COUNTY **WASHINGTON**

MEADOWBROOK SEWER PRELIMINARY ENGINEERING STUDY

G&O #18622
JANUARY 2019

Gray & Osborne, Inc.
CONSULTING ENGINEERS

CITY OF NORTH BEND

KING COUNTY **WASHINGTON**

NORTH BEND

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MEADOWBROOK SEWER
PRELIMINARY ENGINEERING STUDY

ROGER W. KUYKENDALL
STATE OF WASHINGTON
35188
REGISTERED
PROFESSIONAL ENGINEER

1-28-19

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JANUARY 2019

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CONSULTING ENGINEERS

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

APPENDICES

EXECUTIVE SUMMARY

This preliminary engineering study has been completed to assist the City of North Bend with identifying alternatives, constraints, and approximate costs to extend sanitary sewer service into the west area of the City. This area lies west of the South Fork Snoqualmie River and north of the outlet mall (see Figure E-1). Extension of sewer service into this area would allow for development of property to the densities and land uses identified in the City's planning documents and zoning code. This report provides planning-level cost estimates for designing and constructing the sewer extension into the area. Costs do not include the installation or connection of individual services. Funding for the project has not been identified; however, it is thought that the formation of a Utility Local Improvement District (ULID) would be the most likely option.

This report identifies the improvements needed to serve these areas with sanitary sewer, including preliminary alignment plans, project descriptions, and planning-level cost estimates for sewage collection and conveyance to the Wastewater Treatment Facility (WWTF) Influent Pump Station (IPS) constructed under the ULID 6 project. The IPS is located at the intersection of State Route 202 (SR 202, a.k.a. Bendigo Boulevard) and Sydney Avenue North. Estimated costs are identified in Table E-1.

TABLE E-1

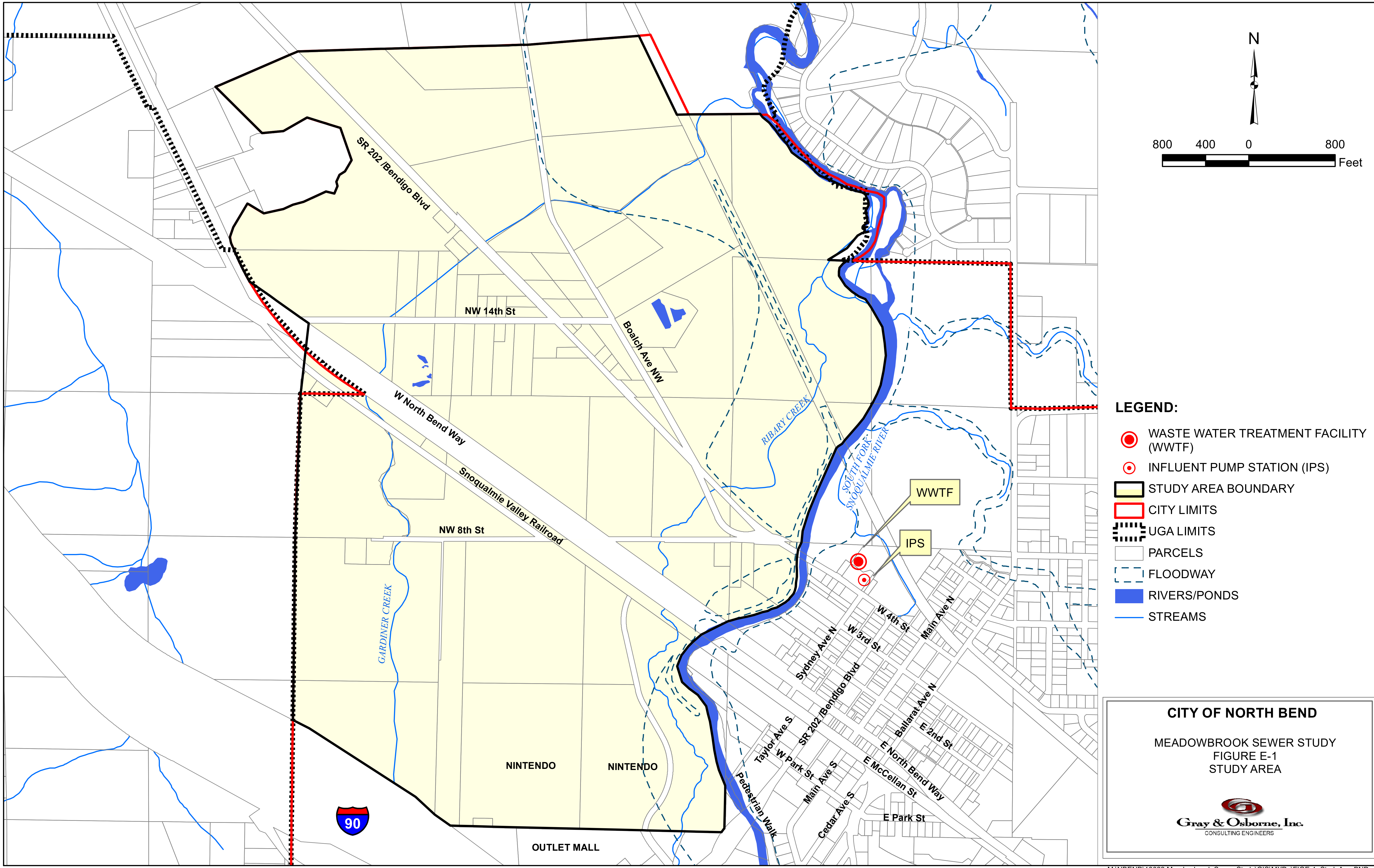
Estimated Project Costs

Collection System	Estimated Project Cost	Annual O&M Costs
Gravity System Only	N/A	N/A
Combination Gravity/Grinder Pump System	$13,360,000	$81,000
Low-Pressure Grinder Pump System	$7,024,000	$8,000
Vacuum System Only	$15,169,000	$75,000

Major design considerations for the project include high groundwater, frequent minor flooding, pumping collected sewage across the river to the wastewater treatment facility, and cost. The collection system will need to pass through a managed floodplain and floodway. Also, much of the study area is subject to seismically induced liquefaction. Three collection systems have been evaluated – a combination of gravity sewers and low-pressure grinder pumps, a system utilizing only low-pressure grinder pumps, and a system utilizing vacuum technologies. A complete gravity collection system is not financially feasible due to the expected sewer depth that would be required generally, but more specifically, to go under Gardiner and Ribary Creeks to extend service to the far reaches of the study area, coupled with known high groundwater conditions.

Regarding cost, in order for a ULID to fund the project, the overall project costs to be assessed to the property owners cannot be greater than the benefit to the properties, as measured by the increase in property values. It is beyond the scope of this study, however, to identify the cost and benefit for each property. It should be noted that the costs identified herein do not include any additional costs or general facility charges that would be required due to buy-in to the existing sewer collection and treatment system, or future sewer infrastructure improvements.

Constructing a low-pressure sewer collection system with grinder pumps appears to be the most cost-effective, and therefore, is recommended. The cost difference can be attributed to several factors, including shallower construction (less trenching, less backfill, less dewatering), fewer and smaller pipe sizes, and the lack of central pump stations.



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CHAPTER 1

INTRODUCTION

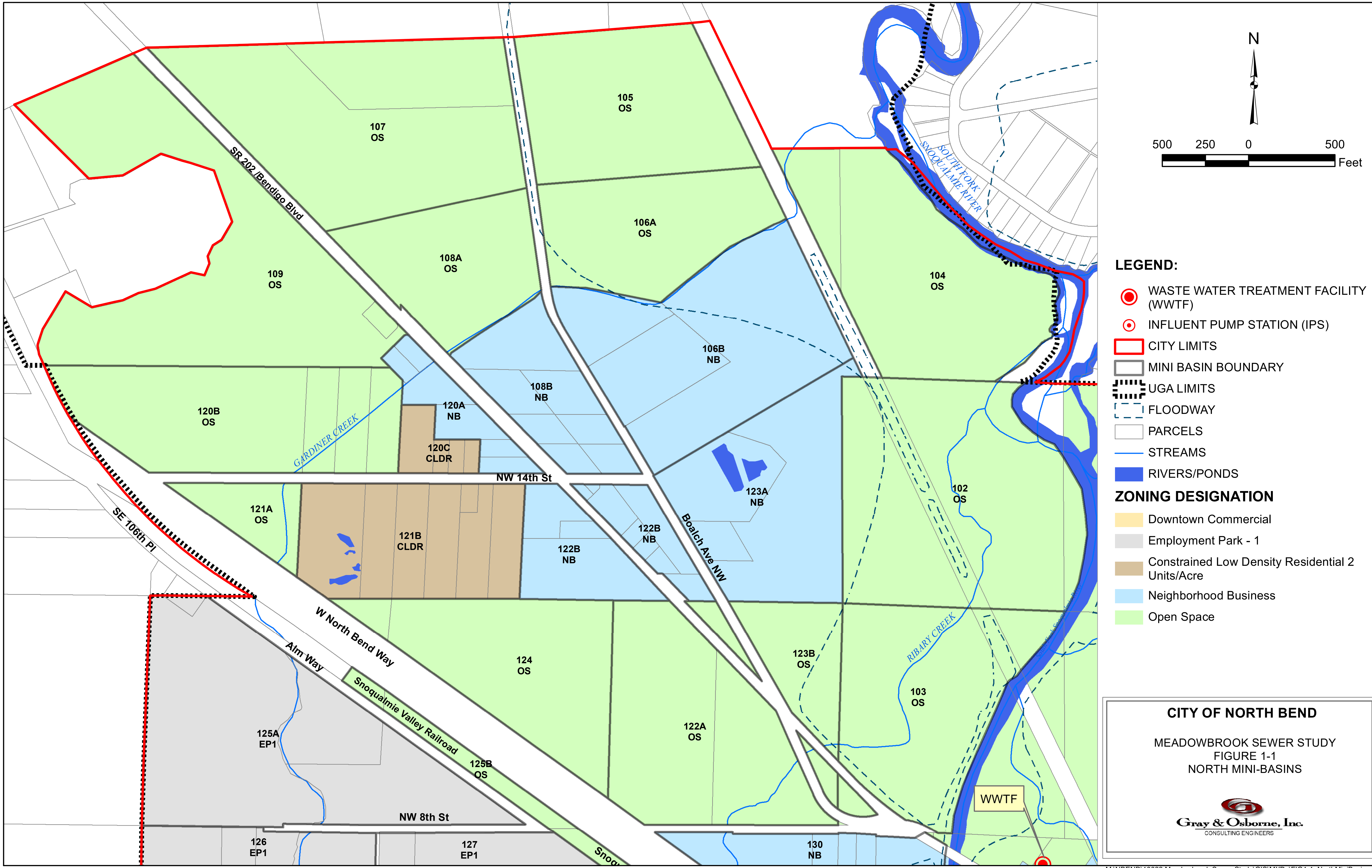
The 2017 Wastewater Facilities Plan (2017 Facilities Plan) identified 20 mini-basins in the study area. For the purposes of this study, these mini-basins have been split into "sub" mini-basins, based upon zoning or expected land use. The study area now totals 30 submini-basins (see Figures 1-1 and 1-2). The 2017 Facilities Plan identifies the study area as being 768 acres in size, with the developed portion of the Nintendo property as the only property currently served by sewer. For the purposes of this study, it is assumed that sewage from Nintendo (Mini-Basins 129 and 131A) is included in the analysis, freeing up some capacity for the South Fork Lift Station.

Most of the area lying north of North Bend Way (see Figure 1-1) is designated as open space (OS – 320.67 acres, excluding the right-of-way), with the NW 14th Street area designated as Constrained Low Density Residential (CLDR – 22.6 acres) and Neighborhood Business (NB – 74.8 acres). Also, Mini-Basin 130, an area near the river bounded by North Bend Way and NW 8th Street, is designated as Neighborhood Business (NB – 17.44 acres). Approximately 150 acres of the area north of North Bend Way lies within the floodway of the river. The area south of North Bend Way (see Figure 1-2) encompasses 216.51 acres of land designated as Employment Park 1 (EP1), including Nintendo. Approximately 19 acres of the area south of North Bend Way lies within the floodway of the river.

The 2017 Facilities Plan identifies the peak hourly sewer flow for buildout conditions of the study area as approximately 1 million gallons per day (1.0 mgd), including Nintendo. Detailed spreadsheets of the mini-basin information, including areas, zoning, sewage flows, etc., can be found in Appendix A.

Existing conditions in the study area include several large residential lots; commercial parcels developed to varying degrees, including a self-storage facility, private school, welding shop, lumber yard, and business park; and some undeveloped parcels. Large parcels of property zoned as open space are owned by the City of North Bend. Roads in the area are generally rural in character, with few urban improvements. The majority of the study area lies within the floodplain of the South Fork Snoqualmie River, Flood Hazard Zones AE, AH, F-AE (Floodway), or AO-1. Topography in the area is very flat, draining generally from the southeast toward the northwest, including Ribary and Gardiner Creeks, both of which ultimately drain into the South Fork Snoqualmie River. Wetlands exist throughout the study area, although most of these have not yet been delineated. Several culverts exist in the study area, and are likely undersized and will need to be updated for fish passage and to support new development. Their ultimate size should be considered during the design of the sewer collection system.

The recommended alignment of the sewer collection system follows closely with that shown in the 2017 Facilities Plan. It is assumed that the vacant open space parcels will not be developed with domestic or commercial uses which generate sewage; however, for those "undevelopable" parcels that already have a dwelling or commercial development, these are assumed to eventually connect to the future sewer system with a nominal flow representative with the land current uses.



CITY OF NORTH BEND

MEADOWBROOK SEWER STUDY
FIGURE 1-1
NORTH MINI-BASINS

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CHAPTER 2

PLANNING CRITERIA AND WASTEWATER FLOWS

Land use in the study area currently varies, with several vacant parcels, single-family homes on large lots, commercial development, and park and open space. Most parcels are located within the South Fork Snoqualmie River floodplain, with some areas located within the floodway. Future development of the area is assumed to be of similar land uses; however, in order to estimate future sewage flows, this study utilizes full buildout of each parcel to its allowed zoning. Table 2-1 identifies the overall zoning and respective allowed land uses in the study area.

TABLE 2-1

Land Use Data

Zoning Designation	Gross Acreage	Allowed Land Uses
Open Space – OS	327.80	Public and Quasi-Public Parks, Open Space, Trail, and Recreation
Constrained Low Density Residential – CLDR	22.80	Residential at 2 Dwelling Units per Acre, Accessory Dwelling Units, Cottage Housing
Neighborhood Business – NB	101.58	General Commercial, Can Accommodate Limited Fabrication and Light Manufacturing
Employment Park 1 – EP1	221.89	Light Industrial and Limited Commercial, including Office, Light Manufacturing, Warehouse and Distribution, and Research and Development
Total (excluding Right-of-Way)	**674.07**	

Based upon the 2017 Facilities Plan, the historical average dry weather daily sewage base flow for single-family residences (average of 2.57 persons per dwelling) is 123.36 gallons per day (gpd), defined as one Equivalent Residential Unit (ERU). Infiltration and inflow (I&I) are significant in some areas of North Bend and is expected to be so in the study area, based upon the high groundwater and frequent flooding. A value of 2,300 gallons per acre per day (gpad) is used for the existing developed and sewered areas in North Bend, with an assumed I&I of 2,000 gpad for new areas. Although for low-pressure system design, it may be appropriate to assume a lower I&I value, 2,000 gpad is assumed for the study area. Due to the small size of the study area mini-basins, a peaking factor of 4 will be used, as identified in the 2017 Facilities Plan.

The 2017 Facilities Plan also identifies average dry weather base sewage flows for each non-residential land use category. For the study area, values of 436 and 44 gpad will be used for the NB and EP1 categories, respectively. For the existing restroom/entertainment facilities on the City's park spaces, a daily average flow of 1,000 gpd is assumed for restroom facilities (existing west Tollgate Park and historic house located in the eastern part of Tollgate Park) and 2,000 gpd for the Meadowbrook Farms facility. Regarding I&I for the parks, the assumed parcel area is only 1 or 2 acres. Table 2-2 provides the current zoning, gross acreage, developable area, and estimated future sewage flows for each of the mini-basins. "Developable Acreage" in Table 2-2 only represents the area lying outside the floodway and does not infer that all areas of the mini-basin are, in fact, developable. In all likelihood, there will be streams and wetlands on many of these parcels, and it is assumed that the allowed buildout density will be met within the non-critical areas of the parcel. The total daily flow is estimated at 684,000 gallons, with peak hourly flow at 596 gallons per minute (gpm) (858,000 gpd).

TABLE 2-2

Mini-Basin Characteristics

Mini-Basin	Zoning Designation	Gross Acreage	Developable Acreage (4)	Sewage Flow (gpd/ac) (5)	I&I Flow (gpd) (9)	Peak Sewage Flow (gpd) (6)
102	OS (1)	35.01	0	0	0	0
103	OS (1)	33.79	0	0	0	0
104	OS (1)	31.33	0	0	0	0
105	OS (1)	23.10	0	0	0	0
106A	OS (1)	17.5	0	0	0	0
106B	NB (1)	30.33	21.23	436	42,460	79,485
107	OS	37.88	0	0	0	0
108A	OS	14.90	0 (2)	871	4,000	12,000
108B	NB	11.94	11.94	436	23,880	44,703
109	OS	39.00	0	0	0	0
120A	NB	5.42	5.42	436	10,840	20,292
120B	OS	25.19	0 (7)	0	0	0
120C	CLDR	3.09	3.09	247 (8)	6,180	9,141
121A	OS	5.26	0	0	0	0
121B	CLDR	19.71	19.71	247 (8)	39,420	58,664
122A	OS	27.82	0 (2)	871	2,000	6,000
122B	NB	12.97	12.97	436	25,940	48,560
123A	NB	23.48	23.48	436	46,960	87,909
123B	OS (1)	7.90	0	0	0	0
124	OS	21.99	0 (2)	871	4,000	12,000
125A	EP1	30.01	30.01	44	60,020	65,302
125B	OS	7.13	0	0	0	0

TABLE 2-2 – (continued)

Mini-Basin Characteristics

Mini-Basin	Zoning Designation	Gross Acreage	Developable Acreage (4)	Sewage Flow (gpd/ac) (5)	I&I Flow (gpd) (9)	Peak Sewage Flow (gpd) (6)
126	EP1	40.75	40.75	44	81,500	88,672
127	EP1	39.16	39.16	44	78,320	85,212
129	EP1	34.33	34.33	44	68,660	74,702
130	NB (1)	17.44	12.94	436	25,882	48,451
131A	EP1 (1)	29.61	26.90	44	53,800	58,534
131B	EP1 (1)(3)	22.83	0	44	0	0
131C	EP1	8.68	8.68	44	1,736	3,264
134	EP1	25.20	25.20	44	50,400	54,835
Totals		**674.07**	**320.81**		**625,998**	**857,726**
Peak Hour Flow						**596 gpm**

(1) Portions of mini-basin are within the designated floodway.
(2) Open space used for parks, with existing facilities.
(3) Future use as Ribary Creek/River floodplain with extension of South Fork Avenue.
(4) Other than park with facilities, all OS zones are considered undevelopable. Right-of-way excluded. Developable does not infer the lack of critical areas, other than floodway.
(5) Based upon values in the 2017 Facilities Plan.
(6) Peak hourly flow represents average flow times peaking factor of 4, plus I&I.
(7) The eastern portion of Mini-Basin 120B may be developable (approximately 7.5 acres).
(8) Residential flow calculated based upon whole dwelling units.
(9) Based upon 2,000 gpad of developed area.

CHAPTER 3

EXISTING FACILITIES AND CONSTRAINTS

EXISTING FACILITIES

The City of North Bend WWTF is located north of downtown on the east banks of the South Fork Snoqualmie River, north of SR 202 and west of Sydney Avenue. Large portions of the City to the south and east of the facility are served by sewer, which is predominantly conveyed to the WWTF by gravity. ULID 6, constructed in 2010, extended a large gravity interceptor into newly annexed areas of North Bend and constructed a new IPS at the corner of SR 202 and Sydney Avenue, immediately adjacent to the WWTF. The interceptor (and an older sewer main) enter the IPS from West 4^{th} Street. A gravity sewer also enters the IPS from Sydney Avenue North.

COLLECTION ROUTE

In accordance with the 2017 Facilities Plan, collection of sewage in the study area would most likely follow the existing roadways, where available, or be constructed across undeveloped property near or along the existing property lines, although the exact future locations of these facilities will be determined by the developer. In order to extend sewer service into the study area, sewage must eventually be pumped across the river to the WWTF. The most likely location for this to occur is along the SR 202 corridor, near the WWTF. Other options, briefly evaluated in Chapter 4, include:

- Snoqualmie Valley Regional Trail
- North Bend Way, then onto Sydney Avenue North
- Across the Nintendo property onto South Fork Avenue, into the South Fork Lift Station

CONSTRAINTS

Physical constraints to constructing a collection system include:

- **Flat Topography –** For gravity piped systems, flat topography does not allow the sewers to follow the natural ground slope, and the sewers become deeper and deeper, resulting in higher costs and greater construction risk.
- **High Groundwater –** High groundwater poses a significant challenge regarding the installation of long gravity systems. Due to the long pipe

runs, a gravity system could require pipe depths of 11 to 12 feet, requiring significant costs to dewater the trenches (even in dry weather periods, when the groundwater levels will be at their lowest), provide shoring for worker safety, and would also introduce the potential for high infiltration rates in the future. Dewatering of excavations is a non-exact science, and depending upon the porosity of the soils, costs for dewatering could increase dramatically and also carries the risk of settlement to adjacent utilities, roadways, and buildings. In addition, manholes would need to be sealed and tested for leakage.

- **Long Distances from the WWTF –** Long gravity pipe runs may become very deep, and in conjunction with flat topography and high groundwater, result is high construction costs. Also, long pressure pipe/force main runs result in high head losses and the need for more powerful pumps. The recommended locations of the north and south lift stations, respectively, are 3,800 and 3,100 feet from the ULID 6 IPS.

- **Frequent Flooding –** Because most of the study area lies within the floodplain of the South Fork Snoqualmie River, sewer facilities with electrical/electronic components, such as vaults, pump stations, and pump controls, will have to be floodproofed to allow their continued operation during a flood event (assuming power is available from the utility or via an auxiliary generator), which increases costs. Also, being located in a flood-prone area introduces the potential for high rates of inflow after sewers are installed.

- **Crossing the River –** Conveying sewage across the South Fork Snoqualmie River poses significant challenges. Several options, all of which are best suited for pressure line/force mains, are possible including microtunneling, boring, directional drilling, hanging pipe(s) from an existing bridge, or constructing a pipe bridge. Each option carries various levels of risk and cost:

    - *Jack-and-Bore or Microtunneling* – Either of these methods require entry and exit pits to send and receive the boring machine, cutting head, or auger, and also the casing pipe. Considering the depth of the river, including future scour depths, these pits may be 20 to 40 feet deep and will have to be dewatered and shored during the boring operation. In addition, it is known that this part of the riverbed is mostly alluvium (loose material washed downriver over time), which creates significant risk for this type of construction. If the boring machine or casing pipe were to hit a buried tree, log, boulder, or other "solid" object, the object would have to be removed via excavation from the surface before proceeding. However, this might not be possible near or under the river.

  - *Directional Drilling* – Directional drilling typically requires a pilot hole to be drilled from the surface on one end to the surface on the other end and then the casing pipe is pulled back through the hole. Sometimes the hole has to "reamed" to a larger diameter before pulling the casing through. Risks associated with this method include pilot hole cave-in, leakage of drilling mud through the alluvium into the river, and buried solid objects (such as boulders, tree trunks, etc., which are likely in alluvium) that might redirect the drill bit.

  - *Hanging Pipe from an Existing Bridge* – This method is straightforward, but is subject to acquiring permission from the bridge owner, conflicts with other utilities already attached, structural condition of the bridge, and available areas to attach hangers. A City of North Bend water main currently hangs from the existing SR 202 bridge. It is not known if the Washington State Department of Transportation (WSDOT) would permit additional pipes to be hung from the existing bridge. Although a specific date has not been determined, the SR 202 Ribary Creek and South Fork Snoqualmie River bridges are scheduled for replacement. If the timing of the bridge replacement and sewer project can be coordinated, hanging the new sewer collection pipe(s) from the new bridges is probably the best option.

  - *Constructing a Separate Pipe Bridge* – This method requires construction of a small bridge that cradles a deck whereupon the pipe is laid. Foundations or abutments are required at each end. Abutments would need to be located outside the floodway, plus a zero-rise and compensatory flood storage analysis would be needed. One advantage to this method is that risk is greatly reduced since everything relating to its construction is on the surface and is known, and the pipe is accessible and can be increased in size at a later date, replaced, or others added. Due to the significant risks for other methods and the uncertainty of the bridge replacement projects, it is recommended that a pipe bridge be constructed to cross the river.

- **Crossing Gardiner and Ribary Creeks –** Gardiner Creek (culverts) will have to be crossed in order to extend sewer to existing buildings at the edges of the study area, and Ribary Creek (bridges) will have to be crossed if the main line crosses the river at SR 202 or North Bend Way. The culverts that pass water beneath roads, trails, and the railroad, are most likely undersized and will have to be replaced at some time. Several options, all of which are best suited for pressure line/force mains, are possible including microtunneling, boring, moling/pushing, hanging pipe(s) from an existing bridge, constructing over the top of a culvert via a shallow open trench, or constructing a pipe bridge. Each option carries various levels of risk and cost. Due to the small pipe sizes, it is recommended that Gardiner Creek be crossed via moling or open trench over the top of any existing or future culverts. A pipe bridge or hanging pipes is recommended for crossing Ribary Creek.

- **Utilities –** Although detailed utility information has not been reviewed as part of this project, it is not anticipated that these utilities will restrict installation of a sewer collection system to any significant extent. In the study area, the following utilities may exist:

  - Puget Sound Energy (PSE) power via overhead utility lines
  - Tanner Electric power via overhead utility lines
  - Comcast Cable television via overhead utility lines
  - CenturyLink telephone via overhead utility lines
  - PSE natural gas
  - North Bend water (Boalch Avenue NW only)

- **Funding –** Extending sewer service into the study area can be funded via different methods:

  - *Developer Extension* – This method would be initiated by a private developer, who would extend sewer service across and to their far property line, bearing the full cost of the project. If a component of the extension must be "oversized" to serve future growth, the City could participate in a cost-sharing agreement, to be reimbursed by future development via local facilities charges. Some reimbursement of the developer's cost is also possible via "latecomer agreements," wherein the City would administer a time-limited agreement that would identify and require other properties served by the extension to reimburse the developer for their fair-share cost. Latecomers agreements carry some risk for the developer, because they typically expire after 15 years.

  - *Utility Local Improvement District (ULID)* – This process is established in state law and requires a group of property owners to petition the City Council to sponsor the sewer project, and assess the cost of the project to all benefited property owners, proportioned based upon parcel area, sewer flow, or other fair and agreed-upon measure. In order to move forward, pre- and post-project property value assessments must be performed, and at least 60 percent of the property owners must approve the ULID. Assessment hearings must be held; and interim financing is required to pay for design and construction, with loan repayments made via the assessments. The extra costs associated with a ULID include legal, hearings and public information/education, election, property assessments, etc., and can range from 15 to 30 percent of the project's construction cost.

- The City could extend sewers into the area, fronting the cost, and charge future connections a local facilities charge, or institute a ULID by Council action (versus the petition method). This method is not recommended due to the unsecured risk to the City.

PERMITTING

The project would require several permits/approvals:

- SEPA review
- City of North Bend Shoreline Substantial Development Permit
- City of North Bend Floodplain Development Permit
- Zero-rise and floodplain compensatory storage analysis
- Railroad crossing review and approval
- City of North Bend Critical Areas Review
- City of North Bend Right-of-Way Permit
- City of North Bend Clearing and Grading Permit

CHAPTER 4

COLLECTION SYSTEM ALTERNATIVES AND COSTS

Advancing the concepts in the 2017 Facilities Plan, four collection system alternatives are considered. All of these alternatives require that sewage be collected and then pumped across the river:

1. **Gravity System Only –** A gravity-only system would provide gravity sewer mains, which would eventually discharge into a lift station wet well, prior to being pumped across the river:

    a. It is feasible to install gravity sewer mains fronting all of the developable property (NB, CLDR, EP1) in the north area, draining into a single lift station. However, gravity service cannot practically be provided to the animal clinic and open space/park areas (Meadowbrook Farms, Tollgate Park restrooms, and Tollgate historic house), so these would have to be served by owner-constructed individual grinder pumps with long, low-pressure service lines discharging into the gravity mains. To extend gravity mains to these existing buildings would be prohibitively expensive due to the fact that the sewer main would have to go beneath Gardiner Creek (making the entire gravity system 5 to 6 feet deeper), and/or be several hundred feet in length, only to serve a handful of ERUs. Therefore, gravity-only service for the north area is not recommended.

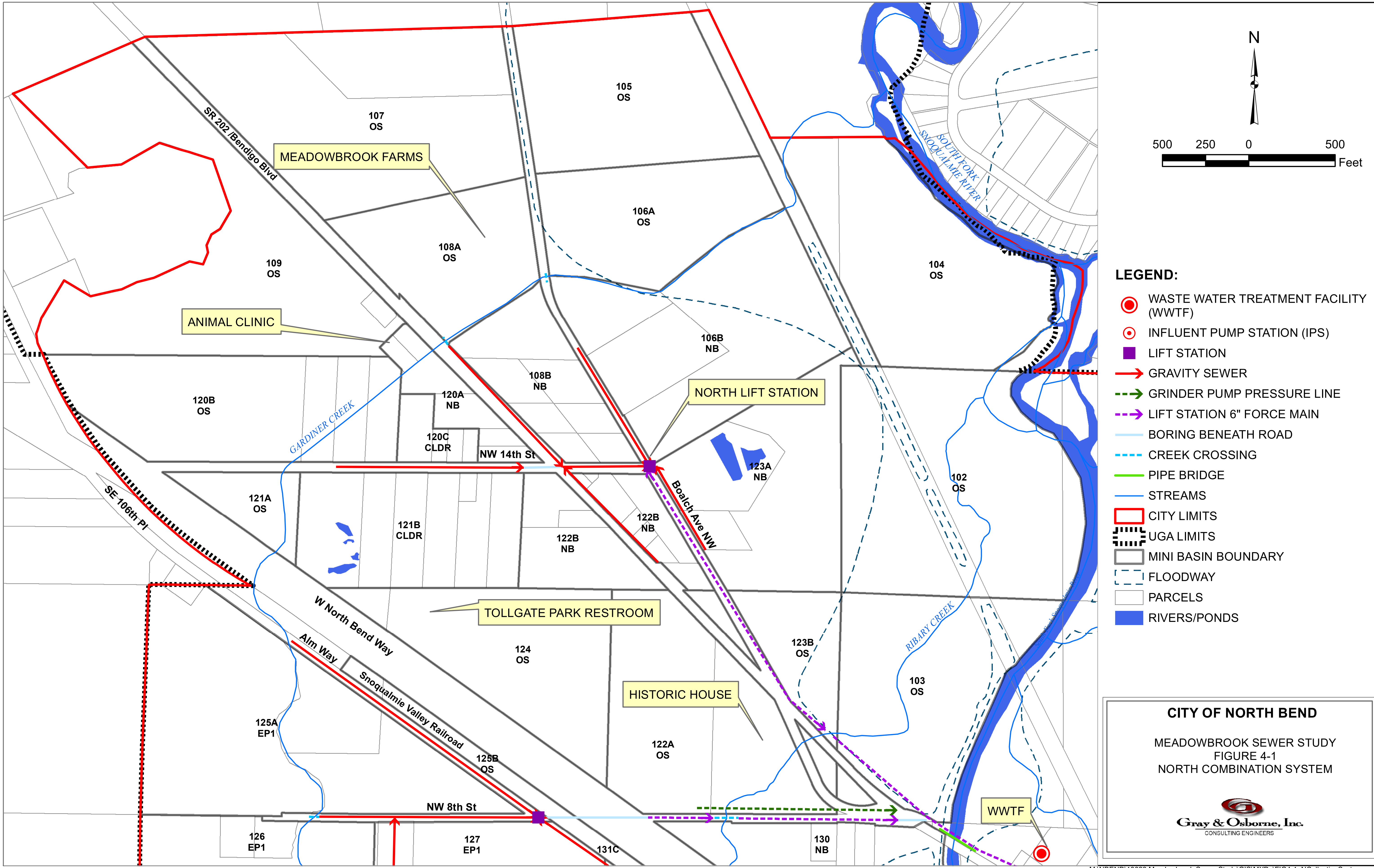
    b. For the south area, because all of the property, except for Nintendo, is currently vacant, installing a complete gravity system draining to a single lift station is feasible if the property owners know the approximate locations of future streets and buildings. Without such information, gravity mains could be installed along existing streets and property lines at depths that can serve the entire property. However, large portions of Mini-Basins 125A, 126, and 134 are located on the west side of Gardiner Creek, so these would need to be served by an owner-constructed low-pressure grinder pump system for similar reasons as the north area. Therefore, a gravity-only system is not recommended for the south area.

    c. To serve Mini-Basin 130 (zoned NB) by gravity would be feasible, although the gravity main would be short and a separate lift station to get over the river would be designed for only 34 gpm, so there would be no advantage to installing a deep gravity system instead of a low-pressure grinder pump system. Disadvantages to a gravity system include increased costs due to the depth of constructing the sewer main and also maintaining a very low-capacity lift station. Therefore, a low-pressure grinder pump system is recommended to serve Mini-Basin 130, regardless of the methods used to serve the other areas.

2. **Combination Gravity/Low-Pressure System –** As described in Alternative 1, utilizing a gravity main system in combination with individual grinder pumps to serve more remote areas is feasible (see Figures 4-1 and 4-2). A cost breakdown for this alternative is provided in Appendix B. It should be noted that a property owner or developer will be required to design and construct their own system to drain or pump to the main. Disadvantages of this type of system for this project include the depth of construction and the associated dewatering costs. However, constructing gravity sewers is very typical and does not require specialty materials, contractors, or equipment.

3. **Low-Pressure System Only –** To serve the entire north and south areas with low-pressure grinder pumps is feasible (see Figures 4-3 and 4-4). The greatest advantage for such a system is much shallower installation, with carries significant cost savings. Disadvantages include greater power consumption; having the City own, maintain, and operate several hundred grinder pumps; and system failure due to extended power outages (assuming that most individual properties would not all have auxiliary power available). Each grinder pump has enough storage for several days of sewage, should power be lost. There is one special advantage to low-pressure systems. Since the study area is located within a seismic liquefaction area, the flexibility of the HDPE low-pressure mains reduces the potential for pipe separation during an earthquake. A cost breakdown is provided for this alternative in Appendix B. It should be noted that a property owner or developer will be required to design and construct their own system to pump to the main.

   In accordance with Ecology regulations for residential or commercial/industrial complexes serving multiple owners or tenants, sewer facilities must be owned, operated, and maintained by the City. Therefore, the design of the low-pressure system must include specifics regarding power supply, alarms, and telemetry, so that the City can be confident of continuous, reliable operation and adequate notification for emergency response. This may include emergency storage. Due to the short life expectancy of grinder pump facilities when compared to gravity systems, each property would be charged a monthly rate that incudes grinder pump repair and replacement costs.



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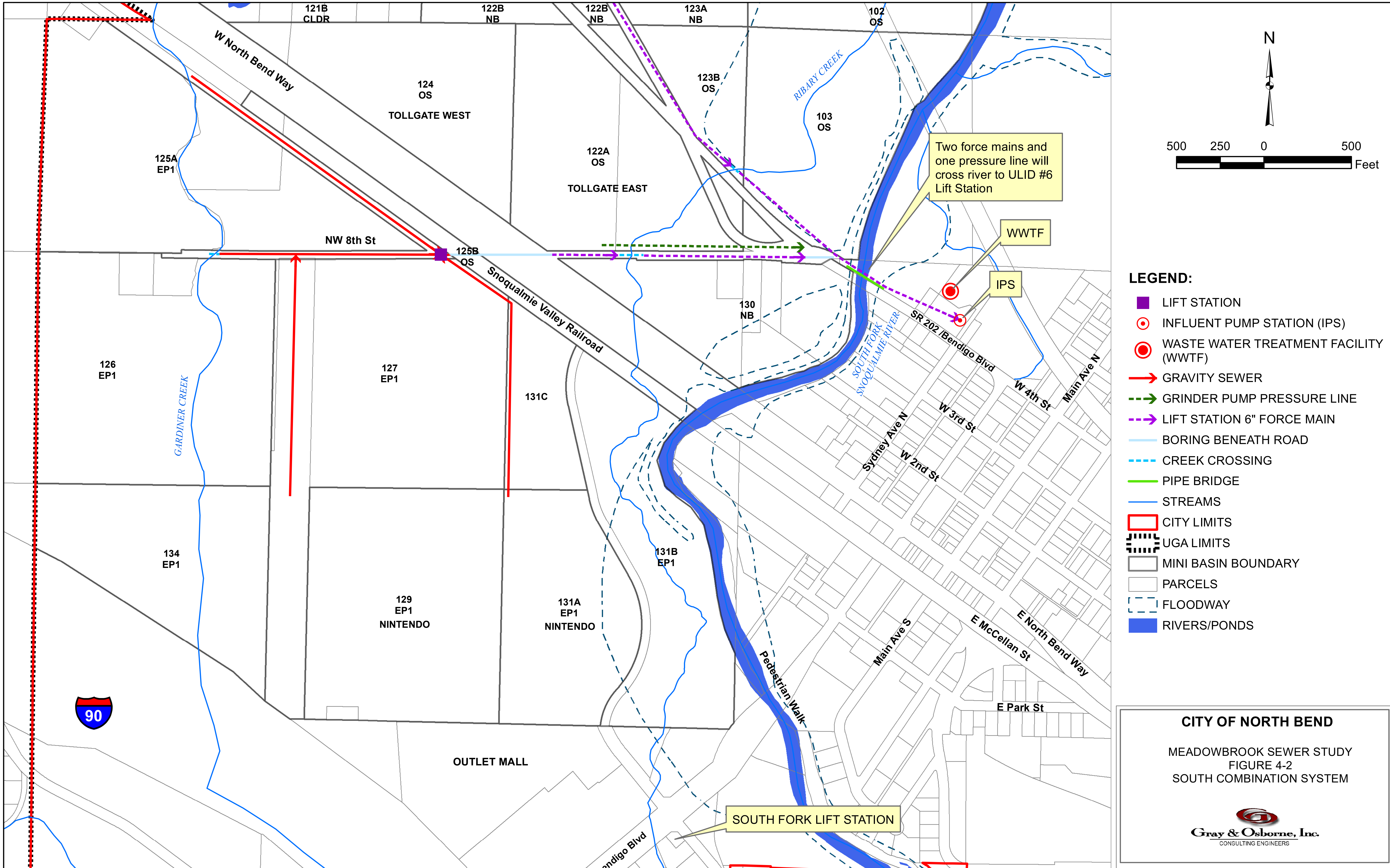

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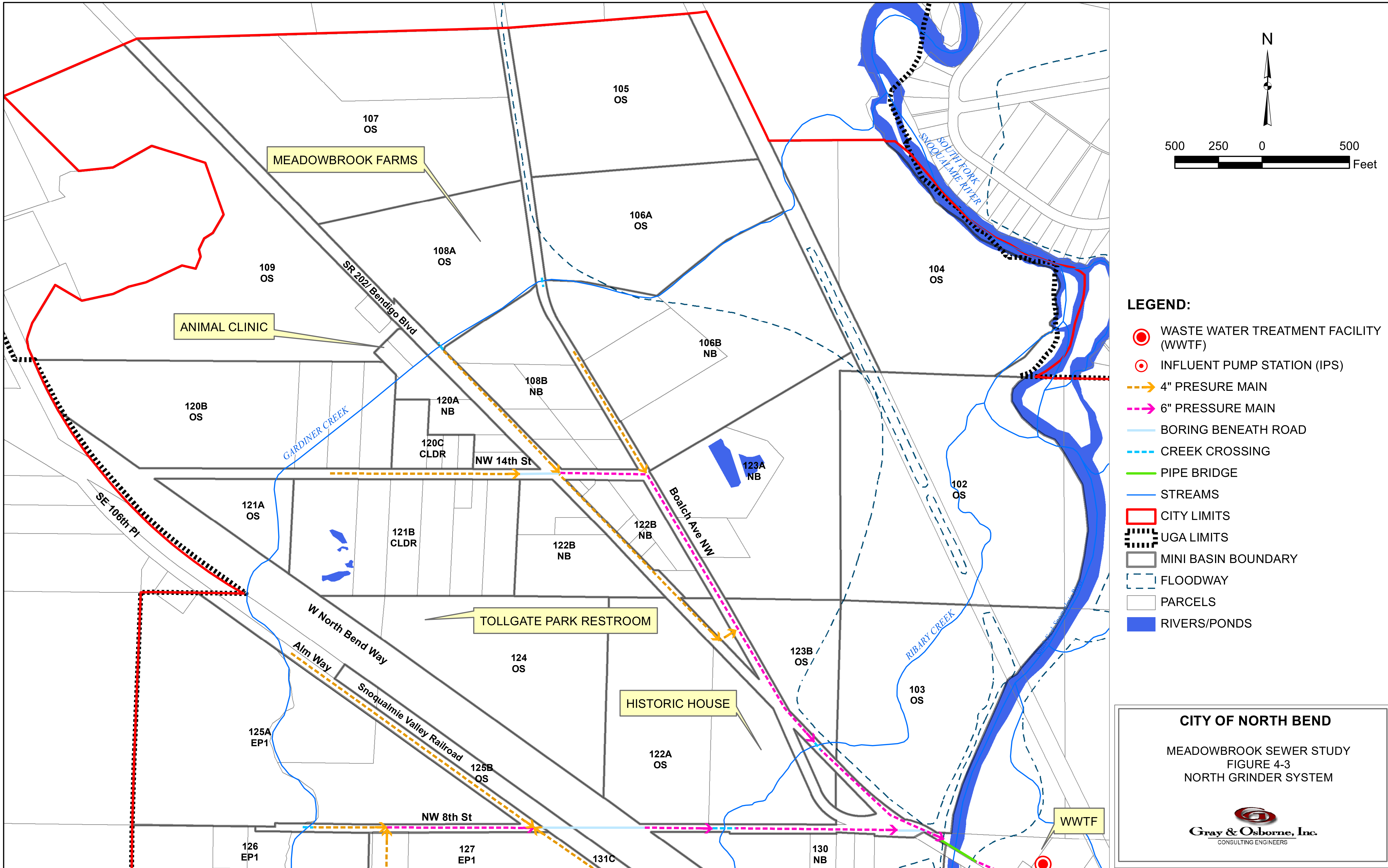

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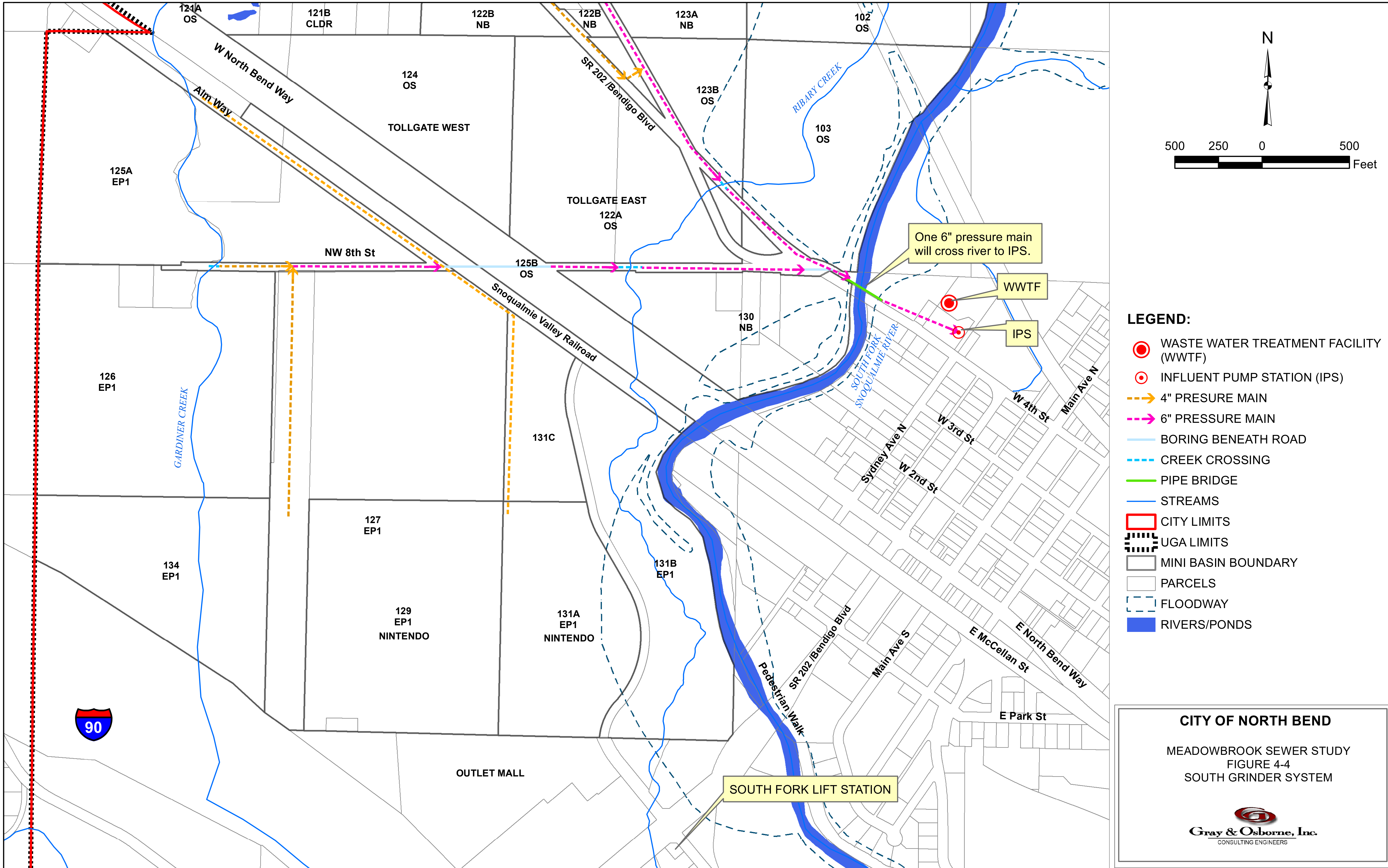

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4. **Vacuum System Only –** Vacuum sewer systems operate by having a central vacuum system that creates a negative pressure in the vacuum mains. Sewage from the building drains into an individual valve pit unit via gravity side sewer. When the tank fills to a certain level, a valve opens, allowing air from the atmosphere to enter, propelling the sewage into the main. The proper functioning of this valve is critical to each individual service's operation, and subject to periodic failure and replacement. Sewage is collected into a central tank at the vacuum station, where it is then pumped to a designated discharge point (e.g., the ULID 6 IPS).

   It is feasible to serve the entire north and south areas with a vacuum sewer collection system (see Figure 4-5). The greatest advantage for such a system is much shallower installation, with carries a significant cost savings. Disadvantages include greater power consumption since the central vacuum system runs 24 hours per day; odor issues at the vacuum station; increased I&I due to the negative pressure in the side sewers and mains; special training required for operating a non-typical system; and having the City own, maintain, and operate many vacuum valve pits. A cost breakdown is provided for this alternative in Appendix B. It should be noted that a property owner or developer will be required to design and construct their own system to connect to the main.

   Similar to a low-pressure system, the design of the vacuum system must include specifics regarding power supply, alarms, and telemetry so that the City can be confident of continuous, reliable operation and adequate notification for emergency response. This may include emergency storage.

Regarding crossing the river, four alternative locations are considered. At each of these locations, the crossing method could be microtunneling, boring, hanging pipe(s) from an existing bridge, or constructing a pipe bridge:

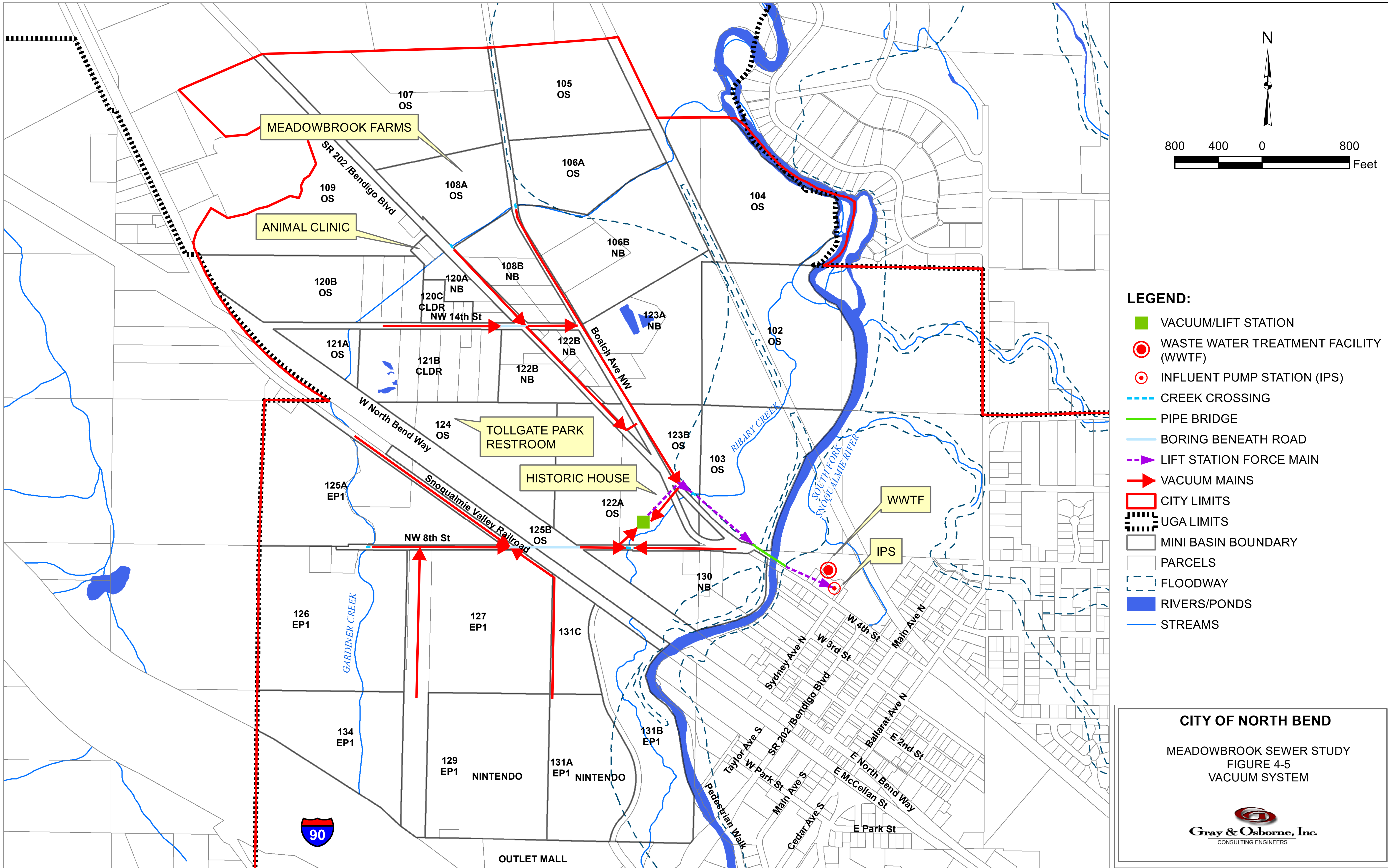
1. **SR 202 –** This route may be the most logical, due to its proximity to the WWTF and the fact that it is located at the approximate mid-point between the north and south portions of the study area. For Mini-Basin 130 (an area to be served by individual grinder pumps), the most logical place for the low-pressure line is to cross the SR 202 bridge, since this basin is just across the river from the WWTF.

   This route also requires the pipe(s) to cross the bridge over Ribary Creek, which is about 900 feet to the west. Both the north and south lift station force mains (or low-pressure mains) would pump directly to the ULID 6 IPS. Installing utilities in a state-owned highway right-of-way and hanging pipe(s) from the bridge must be permitted by WSDOT.

2. **Snoqualmie Valley Regional Trail –** This route, about 1,100 feet north of the SR 202 crossing, would require all the sewage to be pumped to the north (the south area would pump into the north system), through heavily forested areas in the floodway, across Ribary Creek and the river, and within the trail right-of-way to the WWTF. Installing utilities within the trail right-of-way may require permits from King County and from Burlington Northern Santa Fe Railway (BNSF) since they still own the right-of-way. During the ULID 6 project, a pipeline route in the trail right-of-way (east of the WWTF) was considered, but was abandoned due to the legal complexities and costs to have the pipeline meet BNSF standards and federal regulations. However, the route could still be available if the pipeline was constructed adjacent to the right-of-way through easements acquired by the City from the property owners.

3. **North Bend Way –** This route includes crossing at North Bend Way and then turning up Sydney Avenue to the WWTF, and is about 1,000 feet south of the SR 202 crossing. One advantage is that permits would not be needed from WSDOT. This route also requires the pipe(s) to cross the bridge over Ribary Creek, which is about 600 feet to the west.

4. **South Fork Lift Station –** This route includes crossing the Nintendo property (or the future extension of South Fork Avenue) into the existing portion of South Fork Avenue adjacent to the outlet mall, across SR 202, and into the South Fork Lift Station. This route would require that all the sewage be pumped to the south (the north area would pump into the south area). Easements would be required to cross the Nintendo property, and upgrades would be required to the South Fork Lift Station, force main, and downstream gravity sewer systems.



CITY OF NORTH BEND

MEADOWBROOK SEWER STUDY
FIGURE 4-5
VACUUM SYSTEM

Gray & Osborne, Inc.
CONSULTING ENGINEERS

M:\NBEND\18622 Meadowbrook Sewer Study\GIS\MXDs\FIG4-5_VacuumSystem.mxd

CHAPTER 5

RECOMMENDATIONS

Based upon capital and O&M costs, it is recommended that sewer service to the Meadowbrook area be provided with a low-pressure grinder pump system.

RECOMMENDED PROJECT DESCRIPTION

The recommended sewer collection system to serve the Meadowbrook area includes:

- Installing 4- and 6-inch low-pressure mains along the developable properties' frontage in existing roadways, or along property lines, if no roadway exists.
- Air-vacuum release valves and several pressure main cleanouts.
- Constructing a 240-foot-long pipe bridge cross the South Fork Snoqualmie River, located north of SR 202 that will carry one 6-inch low-pressure main to the ULID 6 IPS.
- Ancillary work such as traffic control, erosion control, environmental studies and mitigation, site restoration, dewatering, engineering design, administration, permitting, and construction management.

For cost estimating, the installation of the pressure mains includes placement within the existing paved roadways, except for SR 202 where it is assumed that the mains will be installed in the shoulder or on private property. Therefore, the work includes patching the trenches with crushed rock and hot mix asphalt prior to overlaying the entire roadway.

COST ESTIMATE ASSUMPTIONS

The planning-level cost estimates include all costs to design, permit, and construct the project, under the assumptions listed herein. Specific details of quantity calculations are included in the attached cost estimate spreadsheets for the three alternatives. Assumptions regarding the cost estimates include:

1. A 20 percent construction contingency has been added to cover unforeseen construction costs, such as extensive dewatering, environmental permitting and mitigation, unforeseen underground conditions, or other items that might be discovered during engineering design.

2. Line item costs have been added, as a percentage of the total estimated construction cost, for engineering design (15 percent), construction management (15 percent), administration (6 percent), permitting (4 percent), environmental studies and mitigation (3 percent), and archeological studies (2 percent). Costs for forming a ULID are assumed to be 30 percent.

3. All cost figures have been rounded up to the nearest thousand dollars.

4. Sales tax (8.9 percent) on the total construction cost is included.

PREDESIGN ASSUMPTIONS

The following assumptions are made regarding the project alignment/layout, design details, service limits, etc.:

1. Service will not be extended to the following open-space mini-basins, except as otherwise specified: 102, 103, 104, 105, 106A, 107, 108A (see below), 109, 120B (see below), 121A, 122A (see below), 123B, 124 (see below), and 125B. Although not part of this project, the following describes the most likely manner in which service could be extended to mini-basins 108A, 120B, 122A, and 124, which already contain an existing structure served by an on-site septic system:

    a. Mini-Basin 108A to serve the Meadowbrook Farms banquet facility. Service will include an individual grinder pump and 1.25-inch low-pressure line from the facility to the main collection system for the North Lift Station. The service line will be moled/pushed under Boalch Avenue NW to the east side of the road and over Gardiner Creek.

    b. Mini-Basin 120B to serve three undeveloped, open space parcels (parcels 5418700120, 5418700125, and 5418700130). The main collection system will already be extended on NW 14th Street to serve Mini-Basin 121B and will front these open space parcels.

    c. Mini-Basin 122A to serve the historic house at 901 Bendigo Boulevard North, near the intersection of Boalch Avenue and SR 202. Service will include an individual grinder pump and 1.25-inch low-pressure line from the facility to the main collection system for the North Lift Station. The service line will be moled/pushed under SR 202 to the east side of the road.

    d. Mini-Basin 124 to serve the Tollgate Park restrooms. Service will include an individual grinder pump and 1.25-inch low-pressure line from the facility to the main collection system for the North Lift Station. The service line will be moled/pushed under SR 202 to the east side of the road.

2. There are other locations within the study area served by on-site septic systems that could also be connected to the main collection system via a low-pressure grinder pump system:

   a. Mini-Basin 120A to serve the North Bend Animal Clinic. Service will include an individual grinder pump and 1.25-inch low-pressure line from the facility to the main collection system for the North Lift Station. The service line will be moled/pushed under SR 202 to the east side of the road and over Gardiner Creek.

   b. Mini-Basin 125A will require a grinder pump(s) to serve future development in this mini-basin, with a low-pressure service line crossing over Gardiner Creek to the main collection system in Alm Way to the South Lift Station. However, since the area is undeveloped, the grinder pumps and service lines will NOT be installed with the project. Future development in the mini-basin will be required to design and construct these facilities and make the connection to the main collection system.

   c. Mini-Basin 126 to serve one existing structure, located west of the creek. Service will include an individual grinder pump and 1.25-inch low-pressure line from the structure to the main collection system in NW 8th Street for the South Lift Station. The service line from the west side of the creek will be moled/pushed over Gardiner Creek.

   d. Mini-Basin 130 to serve the existing five houses lying south of SR 202. Service will include individual grinder pumps, with service lines moled/pushed beneath NW 8th Street to a 2-inch low-pressure main located within a shared trench with the force main from the South Lift Station (Alternative 2). The pressure main will pass beneath SR 202 in a shared casing to the east side of the road, thence across the pipe bridge directly to ULID 6 IPS. For Alternative 3, each structure will connect directly into the 6-inch pressure main within NW 8th Street.

   e. Mini-Basin 134 will require a grinder pump(s) to serve future development in this mini-basin, with a low-pressure service line crossing over Gardiner Creek to the main collection system south of NW 8th Street to the South Lift Station. However, since the area is undeveloped, the grinder pumps and service lines will NOT be installed with the project. Future development in the mini-basin will be required to design and construct these facilities and make the connection to the main collection system.

3. For Alternative 2, Gravity/Grinder Combination System:

    a. Sewer manholes will be provided outside the lift stations every 400 feet, and at the upstream end of each pipe run. The average depth of manholes is assumed to be 10 feet.

    b. All gravity sewer mains will be 8 inches in diameter, at a minimum slope of 0.5 percent, and average depth of 8.5 feet. Trench width and asphalt patch are assumed to be 4 feet. Patches will require 6 inches of crushed surfacing base course and 3 inches of hot mix asphalt (HMA), and the road will be overlaid, full-width, with 2 inches of HMA. Sewer mains are anticipated to be constructed within the paved section of all roads, except SR 202, where the main will be constructed in the shoulder or on private property within easements.

    c. The North Lift Station will be located at the northwest corner of the intersection of Boalch Avenue NW and NW 14th Street. Approximate peak hour flow (station design flow) is 260 gpm. The force main will be PVC/HDPE, 6 inches in diameter, to maintain a scouring velocity of 3.0 feet per second (fps).

    d. The South Lift Station will be located at the northwest corner of the intersection of Alm Way and NW 8th Street. Approximate peak hour flow (station design flow) is 330 gpm. The force main will be PVC/HDPE, 6 inches in diameter, to maintain a scouring velocity of 3.7 fps.

4. For Alternative 3, Low-Pressure Grinder System:

    a. All low-pressure main lines 4 to 6 inches in diameter will be installed at an average depth of 5 feet. Trench width and asphalt patch are assumed to be 4 feet. Patches will require 6 inches of crushed surfacing base course and 3 inches of HMA, and the road will be overlaid, full-width, with 2 inches of HMA. Sewer mains are anticipated to be constructed within the paved section of all roads, except SR 202, where the main will be constructed in the shoulder or on private property within easements.

5. For Alternative 4, Vacuum System:

   a. All vacuum main lines will be installed at an average depth of 5 feet. Trench width and asphalt patch are assumed to be 4 feet. Patches will require 6 inches of crushed surfacing base course and 3 inches of HMA, and the road will be overlaid, full-width, with 2 inches of HMA. Vacuum mains are anticipated to be constructed within the paved section of all roads, except SR 202, where the main will be constructed in the shoulder or on private property within easements.

6. Land areas and distances have been acquired via King County iMap. Right-of-way areas are excluded from the service area.

7. The single-track railroad running adjacent to and south of North Bend Way is an active track used for the Santa Train, Thomas the Train, and other events to run passengers from downtown North Bend to downtown Snoqualmie. It is assumed that all crossings will be completed by boring a casing beneath the railroad.

8. Crossing the South Fork Snoqualmie River will be accomplished via a suspension pipe bridge. Costs for other methods, such as microtunneling, boring, and hanging pipes from bridges, have not been estimated.

9. All pipe crossings beneath roads or railroad tracks will be made with a bored casing pipe, rather than via open-cut methods.

10. Pipe crossings at Ribary Creek will be made by crossing over the top or hanging pipes.

APPENDIX A

SEWER FLOW SPREADSHEETS

CITY OF NORTH BEND
MEADOWBROOK SEWER STUDY
MINI-BASIN INFORMATION FOR ENTIRE STUDY AREA

MiniBasin	Zoning	FAR (gpd/acre)	Flood Zone	Ownership	Notes	Loading Node	Total Area (acre)	Non-Floodway Area (acre)	Developable Area (acre)*	Residential Base Flow (gpd)	Residential PF	Residential Peak Flow (gpd)	Commercial Base Flow (gpd)	Commercial PF	Commerical Peak Flow (gpd)	Peak Sewage Flow (gpd)	I/I Area (acre)	I/I Rate (gpd/acre)	I/I Flow (gpd)	Total Peak Flow (gpd)
102	OS		AE 85% Floodway	City	Not developable	653	35.01	5.25		0	4	0	0	4	0	0	0.00	2000	0	0
103	OS		AE 69% Floodway	City	Not developable	653	33.79	10.47		0	4	0	0	4	0	0	0.00	2000	0	0
104	OS		AE 100% Floodway	City	Not developable	653	31.33	0.00		0	4	0	0	4	0	0	0.00	2000	0	0
105	OS		AE 100% Floodway	City	Not developable	653	23.10	0.00		0	4	0	0	4	0	0	0.00	2000	0	0
106A	OS		AE 97% Floodway	City	Not developable	653	17.50	0.53		0	4	0	0	4	0	0	0.00	2000	0	0
106B	NB	436	AE, AO-1; 30% Floodway	Private	Youth Act	653	30.33	21.23	21.23	0	4	0	9256	4	37025	37025	21.23	2000	42460	79485
107	OS		AE, SH-X	City	Not developable	653	37.88	37.88		0	4	0	0	4	0	0	0.00	2000	0	0
108A	OS	871	AE, SH-X	City	Meadowbrook Farm - Kitchen	653	14.90	14.90	2.00	0	4	0	2000	4	8000	8000	2.00	2000	4000	12000
108B	NB	436	AE, SH-X	Private		653	11.94	11.94	11.94	0	4	0	5206	4	20823	20823	11.94	2000	23880	44703
109	OS		AE, SH-X, AH	City	Not developable	653	39.00	39.00		0	4	0	0	4	0	0	0.00	2000	0	0
120A	NB	436	AE	Private		653	5.42	5.42	5.42	0	4	0	2363	4	9452	9452	5.42	2000	10840	20292
120B	OS		AE, AH	City	Not developable	653	25.19	25.19		0	4	0	0	4	0	0	0.00	2000	0	0
120C	CLDR		AE	Private		653	3.09	3.09	3.09	740	4	2961	0	4	0	2961	3.09	2000	6180	9141
121A	OS		AE, AH	City	Not developable	653	5.26	5.26		0	4	0	0	4	0	0	0.00	2000	0	0
121B	CLDR		AE, AH	Private		653	19.71	19.71	19.71	4811	4	19244	0	4	0	19244	19.71	2000	39420	58664
122A	OS	871	AE, AH	City	Tollgate Farms Park - SFR	653	27.82	27.82	1.00	0	4	0	1000	4	4000	4000	1.00	2000	2000	6000
122B	NB	436	AH, AO-1	Private		653	12.97	12.97	12.97	0	4	0	5655	4	22620	22620	12.97	2000	25940	48560
123A	NB	436	AH, AO-2	Private		653	23.48	23.48	23.48	0	4	0	10237	4	40949	40949	23.48	2000	46960	87909
123B	OS		AE 29% Floodway	City	Not developable	653	7.90	5.61		0	4	0	0	4	0	0	0.00	2000	0	0
124	OS	871	AH	City	Tollgate Farms Park - Public Restroom	653	21.99	21.99	2.00	0	4	0	2000	4	8000	8000	2.00	2000	4000	12000
125A	EP1	44	AE, SH-X	Private		South	30.01	30.01	30.01	0	4	0	1320	4	5282	5282	30.01	2000	60020	65302
125B	OS			City	RR - Not developable	South	7.13	7.13		0	4	0	0	4	0	0	0.00	2000	0	0
126	EP1	44	AE, AH	Private		South	40.75	40.75	40.75	0	4	0	1793	4	7172	7172	40.75	2000	81500	88672
127	EP1	44	AE, AH	Private		South	39.16	39.16	39.16	0	4	0	1723	4	6892	6892	39.16	2000	78320	85212
129	EP1	44	AE, AH	Private	Nintendo Facility	S. Fork LS	34.33	34.33	34.33	0	4	0	1511	4	6042	6042	34.33	2000	68660	74702
130	NB	436	AE 26% Floodway	Private		South	17.44	12.91	12.94	0	4	0	5642	4	22569	22569	12.94	2000	25882	48451
131A	EP1	44	AE 13% Floodway	Private	Nintendo Facility	S. Fork LS	20.93	18.22	26.90	0	4	0	1184	4	4734	4734	26.90	2000	53800	58534
131B	EP1		AE 63% Floodway	City		South	22.83	8.45		0	4	0	0	4	0	0	0.00	2000	0	0
131C	EP1	44		Private		South	8.68	8.68	8.68	0	4	0	382	4	1528	1528	8.68	200	1736	3264
134	EP1	44	SH-X	Private		South	25.20	25.20	25.20	0	4	0	1109	4	4435	4435	25.20	2000	50400	54835
TOTAL							**674.06**	**516.58**	**320.81**	**5551**		**22204.8**	**52381**		**209524**	**231729**	**320.81**		**625998**	**857727**

Peak Hour: 596 GPM

* Open Space zones are assumed to be non-developable unless used for parkland with services

Yellow represents OS that could be used for ballfields, tourism, etc. Sewer flow estimated.
Tributary to North L.S.
Tributary to South L.S.

Commercial Flow (FAR*gpd/sf) =	0.1
Residential Flow (gpd/du) =	123.36
Residential Population (people/du) =	2.57
Per capita Flow (gpd) =	48

MM PF =	1.2
MD PF =	1.6
PH Collection PF =	4.0
PH I/I New System =	2000 gpad

Zone	FAR (gpd/acre)
POSPF	871
CLDR	N/A
NB	436
EP1	44

12/10/2018

CITY OF NORTH BEND
MEADOWBROOK SEWER STUDY
MIN-BASIN INFORMATION FOR NORTH AREA

MiniBasin	Zoning	FAR (gpd/acre)	Flood Zone	Ownership	Notes	Loading Node	Total Area (acre)	Non-Floodway Area (acre)	Developable Area (acre)*	Residential Base Flow (gpd)	Residential PF	Residential Peak Flow (gpd)	Commercial Base Flow (gpd)	Commercial PF	Commerical Peak Flow (gpd)	Peak Sewage Flow (gpd)	I/I Area (acre)	I/I Rate (gpd/acre)	I/I Flow (gpd)	Total Peak Flow (gpd)
106B	NB	436	AE, AO-1; 30% Floodway	Private	Youth Act	653	30.33	21.23	21.23	0	4	0	9256	4	37025	37025	21.23	2000	42460	79485
108A	OS	871	AE, SH-X	City	Meadowbrook Farm - Kitchen	653	14.90	14.90	2.00	0	4	0	2000	4	8000	8000	2.00	2000	4000	12000
108B	NB	436	AE, SH-X	Private		653	11.94	11.94	11.94	0	4	0	5206	4	20823	20823	11.94	2000	23880	44703
120A	NB	436	AE	Private		653	5.42	5.42	5.42	0	4	0	2363	4	9452	9452	5.42	2000	10840	20292
120C	CLDR		AE	Private		653	3.09	3.09	3.09	740	4	2961	0	4	0	2961	3.09	2000	6180	9141
121B	CLDR		AE, AH	Private		653	19.71	19.71	19.71	4811	4	19244	0	4	0	19244	19.71	2000	39420	58664
122A	OS	871	AE, AH	City	Tollgate Farms Park - SFR	653	27.82	27.82	1.00	0	4	0	1000	4	4000	4000	1.00	2000	2000	6000
122B	NB	436	AH, AO-1	Private		653	12.97	12.97	12.97	0	4	0	5655	4	22620	22620	12.97	2000	25940	48560
123A	NB	436	AH, AO-2	Private		653	23.48	23.48	23.48	0	4	0	10237	4	40949	40949	23.48	2000	46960	87909
124	OS	871	AH	City	Tollgate Farms Park - Public Restroom	653	21.99	21.99	2.00	0	4	0	2000	4	8000	8000	2.00	2000	4000	12000
TOTAL							**171.65**	**162.55**	**102.84**	**5551**		**22204.8**	**37717**		**150870**	**173075**	**102.84**		**205680**	**378755**
																		Peak Hour:	263	gpm

* Open Space zones are assumed to be non-developable unless used for parkland with services

Yellow represents OS that could be used for ballfields, tourism, etc. Sewer flow estimated.

Tributary to North L.S.

Commercial Flow (FAR*gpd/sf) =	0.1
Residential Flow (gpd/du) =	123.36
Residential Population (people/du) =	2.57
Per capita Flow (gpd) =	48

MM PF =	1.2
MD PF =	1.6
PH Collection PF =	4.0
PH I/I New System =	2000 gpad

Zone	FAR (gpd/acre)
POSPF	871
CLDR	N/A
NB	436
EP1	44

12/10/2018

CITY OF NORTH BEND
MEADOWBROOK SEWER STUDY
MINI-BASIN INFORMATION FOR SOUTH AREA

MiniBasin	Zoning	FAR (gpd/acre)	Flood Zone	Ownership	Notes	Loading Node	Total Area (acre)	Non-Floodway Area (acre)	Developable Area (acre)*	Residential Base Flow (gpd)	Residential PF	Residential Peak Flow (gpd)	Commercial Base Flow (gpd)	Commercial PF	Commerical Peak Flow (gpd)	Peak Sewage Flow (gpd)	I/I Area (acre)	I/I Rate (gpd/acre)	I/I Flow (gpd)	Total Peak Flow (gpd)
125A	EP1	44	AE, SH-X	Private		653	30.01	30.01	30.01	0	4	0	1320	4	5282	5282	30.01	2000	60020	65302
126	EP1	44	AE, AH	Private		653	40.75	40.75	40.75	0	4	0	1793	4	7172	7172	40.75	2000	81500	88672
127	EP1	44	AE, AH	Private		653	39.16	39.16	39.16	0	4	0	1723	4	6892	6892	39.16	2000	78320	85212
129	EP1	44	AE, AH	Private	Nintendo Facility	594	34.33	34.33	34.33	0	4	0	1511	4	6042	6042	34.33	2000	68660	74702
130	NB	436	AE 26% Floodway	Private		653	17.44	12.91	12.94	0	4	0	5642	4	22569	22569	12.94	2000	25882	48451
131A	EP1	44	AE 9% Floodway	Private		653	29.61	26.90	26.90	0	4	0	1184	4	4734	4734	26.90	2000	53800	58534
134	EP1	44	SH-X	Private		653	25.20	25.20	25.20	0	4	0	1109	4	4435	4435	25.20	2000	50400	54835
TOTAL							**216.51**	**209.26**	**209.29**	**0**		**0**	**14282**		**57127**	**57127**	**209.29**		**418582**	**475709**
																		Peak Hour:	330	gpm

* Open Space zones are assumed to be non-developable unless used for parkland with services

Yellow represents OS that could be used for ballfields, tourism, etc. Sewer flow estimated.

Tributary to South L.S.

Commercial Flow (FAR*gpd/sf) =	0.1
Residential Flow (gpd/du) =	123.36
Residential Population (people/du) =	2.57
Per capita Flow (gpd) =	48

MM PF =	1.2
MD PF =	1.6
PH Collection PF =	4.0
PH I/I New System =	2000 gpad

Zone	FAR (gpd/acre)
POSPF	871
CLDR	N/A
NB	436
EP1	44

12/10/2018

APPENDIX B

COST ESTIMATES

CITY OF NORTH BEND
MEADOWBROOK SEWER STUDY
ENGINEER'S PLANNING LEVEL COST ESTIMATE
20-Jan-19
G &O #18622.00
NO CONNECTIONS - NORTH LIFT STATION - COMBINATION

ITEM NO.	BASE BID: DESCRIPTION	ESTIMATED QUANTITY		UNIT PRICE	AMOUNT
1	Unexpected Site Changes	1	CALC	$20,000	$20,000
2	Survey	1	LS	$9,500	$9,500
3	SPCC Plan	1	LS	$2,000	$2,000
4	Mobilization, Cleanup, and Demobilization	1	LS	$201,000	$201,000
5	Project Temporary Traffic Control	1	LS	$60,000	$60,000
6	Clearing and Grubbing	1	LS	$10,000	$10,000
7	Removal of Structures and Obstructions	1	LS	$28,275	$28,275
8	Sawcutting	6,180	LF	$3	$18,540
9	Locate Existing Utilities	1	LS	$20,000	$20,000
10	Controlled Density Fill	5	CY	$250	$1,250
11	Crushed Surfacing Base Course	1,441	TN	$25	$36,025
12	Temporary HMA	50	TN	$250	$12,500
13	HMA Cl. 1/2" PG 64-22 Patching	334	TN	$200	$66,800
14	HMA Cl. 1/2" PG 64-22 Overlay	1,166	TN	$110	$128,260
15	PVC Sewer Pipe, 8 In. Diam. (Incl. Bedding)	5,085	LF	$50	$254,250
16	Bore with Steel Casing 30 In.	80	LF	$400	$32,000
17	HDPE Sewer Grinder Pump Low Pressure Main, 1.25 In. Diam. (Incl. Bedding)	0	LF	$40	$0
18	Manhole Type 2 48 In. Dia.	15	EA	$5,000	$75,000
19	Removal of Unsuitable Material (Trench)	200	CY	$40	$8,000
20	Trench Excavation Safety Systems	1	LS	$80,000	$80,000
21	Bank Run Gravel for Trench Backfill	10,812	TN	$25	$270,300
22	Dewatering	1	LS	$61,200	$61,200
23	Connect Ex. Structure via Side Sewer	0	EA	$1,500	$0
24	Side Sewer Pipe, 4-inch Diam.	0	LF	$50	$0
25	Connect Ex. Structure via Duplex Grinder Pump (tank, pump, piping, and valves)	0	EA	$16,000	$0
26	Locate, Uncover & Abandon Existing Septic System	0	EA	$1,500	$0
27	Erosion / Water Pollution Control	1	LS	$10,000	$10,000
28	Restoration	1	LS	$45,000	$45,000
29	Project Documentation	1	LS	$3,000	$3,000
30	Package Lift Station	1	EA	$750,000	$750,000
31	HDPE Sewer Force Main, 6 In. Diam. (Incl. Bedding)	3,245	LF	$50	$162,250
32	Pipe Suspension Bridge with 240 LF of 6" DI FM	240	LF	$2,000	$480,000
33	FM Access Vaults	2	EA	$10,000	$20,000
	Estimated Construction Cost				$2,865,150
	Construction Contingency	20.0%			$573,030
	Sales Tax	8.9%			$305,998
	Total Estimated Construction Cost				**$3,745,000**
	ULID Costs	30%			$1,123,500
	Engineering Design	15%			$561,750
	Construction Management	15%			$561,750
	Administration	6%			$224,700
	Permitting	4%			$149,800
	Environmental Studies & Mitigation	3%			$112,350
	Archeological Studies	2%			$74,900
	Total Estimated Project Cost				**$6,554,000**

Assumptions include:

For SR202, all small diameter pipe crossings shall be moled, all large diameter crossings shall be bored, and pipes & manholes shall be installed in the shoulder
100% trench backfill import material
Quantities increased by 10%, rounded up
Average gravity trench depth ~ 8.5 feet to invert
Full-width overlay required on 14th Street and Boalch Ave
Conversion of 1.7 tons per cubic yard for gravel
All trenches are 4 feet wide, including joint trenches

CITY OF NORTH BEND
MEADOWBROOK SEWER STUDY
ENGINEER'S PLANNING LEVEL COST ESTIMATE
20-Jan-19
G &O #18622.00
NO CONNECTIONS - SOUTH LIFT STATION - COMBINATION

ITEM NO.	BASE BID: DESCRIPTION	ESTIMATED QUANTITY		UNIT PRICE	AMOUNT
1	Unexpected Site Changes	1	CALC	$25,000	$25,000
2	Survey	1	LS	$9,500	$9,500
3	SPCC Plan	1	LS	$1,500	$1,500
4	Mobilization, Cleanup, and Demobilization	1	LS	$254,000	$254,000
5	Project Temporary Traffic Control	1	LS	$80,000	$80,000
6	Clearing and Grubbing	1	LS	$20,000	$20,000
7	Removal of Structures and Obstructions	1	LS	$42,450	$42,450
8	Sawcutting	9,160	LF	$3	$27,480
9	Locate Existing Utilities	1	LS	$10,000	$10,000
10	Controlled Density Fill	5	CY	$250	$1,250
11	Crushed Surfacing Base Course	1,724	TN	$25	$43,100
12	Temporary HMA	60	TN	$250	$15,000
13	HMA Cl. 1/2" PG 64-22 Patching	531	TN	$200	$106,200
14	HMA Cl. 1/2" PG 64-22 Overlay	1,303	TN	$110	$143,330
15	PVC Sewer Pipe, 8 In. Diam. (Incl. Bedding)	6,080	LF	$50	$304,000
16	Bore with Steel Casing 30 In.	710	LF	$400	$284,000
17	HDPE Sewer Grinder Pump Low Pressure Main, 1.25 In. Diam. (Incl. Bedding)	0	LF	$40	$0
17A	HDPE Low Pressure Main, 2 In. Diam. (Incl. Bedding)	1,250	LF	$40	$50,000
18	Manhole Type 2 48 In. Dia.	17	EA	$5,000	$85,000
19	Removal of Unsuitable Material (Trench)	225	CY	$40	$9,000
20	Trench Excavation Safety Systems	1	LS	$90,000	$90,000
21	Bank Run Gravel for Trench Backfill	11,810	TN	$25	$295,250
22	Dewatering	1	LS	$81,600	$81,600
23	Connect Ex. Structure via Side Sewer	0	EA	$1,500	$0
24	Side Sewer Pipe, 4-inch Diam.	0	LF	$50	$0
25	Connect Ex. Structure via Duplex Grinder Pump (tank, pump, piping, and valves)	0	EA	$16,000	$0
26	Locate, Uncover & Abandon Existing Septic System	0	EA	$1,500	$0
27	Erosion / Water Pollution Control	1	LS	$10,000	$10,000
28	Restoration	1	LS	$50,000	$50,000
29	Project Documentation	1	LS	$3,000	$3,000
30	Package Lift Station	1	EA	$750,000	$750,000
31	HDPE Sewer Force Main, 6 In. Diam. (Incl. Bedding)	2,910	LF	$50	$145,500
32	240 LF of 6" DI FM over pipe bridge	240	LF	$50	$12,000
33	240 LF of 1.25" HDPE low pressure line over pipe bridge	240	LF	$30	$7,200
34	FM Access Vaults	2	EA	$10,000	$20,000
	Estimated Construction Cost				$2,975,360
	Construction Contingency		20.0%		$595,072
	Sales Tax		8.9%		$317,768
	Total Estimated Construction Cost				**$3,889,000**
	ULID Costs		30%		$1,166,700
	Engineering Design		15%		$583,350
	Construction Management		15%		$583,350
	Administration		6%		$233,340
	Permitting		4%		$155,560
	Environmental Studies & Mitigation		3%		$116,670
	Archeological Studies		2%		$77,780
	Total Estimated Project Cost				**$6,806,000**

Assumptions include:

For North Bend Way, RR, and SR202, all small diameter pipe crossings shall be moled, all large diameter crossings shall be bored, and pipes & manholes shall be installed in the shoulder
100% trench backfill import material
Quantities increased by 10%, rounded up
Average gravity trench depth ~ 8.5 feet to invert
Full-width overlay required on 8th Street and Alm Way
Conversion of 1.7 tons per cubic yard for gravel
All trenches are 4 feet wide, including joint trenches

CITY OF NORTH BEND
MEADOWBROOK SEWER STUDY
ENGINEER'S PLANNING LEVEL COST ESTIMATE
20-Jan-19
G &O #18622.00
NO CONNECTIONS - NORTH GRINDER PUMP SYSTEM

ITEM NO.	BASE BID: DESCRIPTION	ESTIMATED QUANTITY		UNIT PRICE	AMOUNT
1	Unexpected Site Changes	1	CALC	$20,000	$20,000
2	Survey	1	LS	$9,500	$9,500
3	SPCC Plan	1	LS	$2,000	$2,000
4	Mobilization, Cleanup, and Demobilization	1	LS	$110,000	$110,000
5	Project Temporary Traffic Control	1	LS	$60,000	$60,000
6	Clearing and Grubbing	1	LS	$10,000	$10,000
7	Removal of Structures and Obstructions	1	LS	$14,670	$14,670
8	Sawcutting	6,660	LF	$3	$19,980
9	Locate Existing Utilities	1	LS	$20,000	$20,000
10	Controlled Density Fill	5	CY	$250	$1,250
11	Crushed Surfacing Base Course	1,358	TN	$25	$33,950
12	Temporary HMA	50	TN	$250	$12,500
13	HMA Cl. 1/2" PG 64-22 Patching	271	TN	$200	$54,200
14	HMA Cl. 1/2" PG 64-22 Overlay	1,166	TN	$110	$128,260
15	4" Pressure Main, Incl. bedding & backfill	4,400	LF	$50	$220,000
16	6" Pressure Main, Incl. bedding & backfill	3,620	LF	$55	$199,100
17	4" Pressure Main, Bore w/ Casing under SR202 @ 14th Street	80	LF	$250	$20,000
18	Air and Vacuum Release Valve	2	EA	$4,000	$8,000
19	Pressure Main Cleanout	8	EA	$3,000	$24,000
20	HDPE Sewer grinder Pump Low Pressure Main, 1.25 In. Diam., Incl. bedding & backfill	0	LF	$40	$0
21	Removal of Unsuitable Material (Trench)	120	CY	$40	$4,800
22	Trench Excavation Safety Systems	1	LS	$20,000	$20,000
23	Bank Run Gravel for Trench Backfill	5,412	TN	$25	$135,300
24	Dewatering	1	LS	$17,000	$17,000
25	Connect Ex. Structure via Duplex Grinder Pump (tank, pump, piping, and valves)	0	EA	$16,000	$0
26	Locate, uncover & Abandon Existing Septic System	0	EA	$1,500	$0
27	Erosion / Water Pollution Control	1	LS	$10,000	$10,000
28	Restoration	1	LS	$45,000	$45,000
29	Project Documentation	1	LS	$3,000	$3,000
30	Pipe Suspension Bridge with 240 LF of 6" DI FM	240	LF	$2,000	$480,000
	Estimated Construction Cost				$1,682,510
	Construction Contingency	20.0%			$336,502
	Sales Tax	8.9%			$179,692
	Total Estimated Construction Cost				**$2,199,000**
	ULID Costs	30%			$659,700
	Engineering Design	15%			$329,850
	Construction Management	15%			$329,850
	Administration	6%			$131,940
	Permitting	4%			$87,960
	Environmental Studies & Mitigation	3%			$65,970
	Archeological Studies	2%			$43,980
	Total Estimated Project Cost				**$3,849,000**

Assumptions include:
All small diameter pipe crossings shall be moled, all large diameter crossings shall be bored
100% trench backfill import material
Quantities increased by 10%, rounded up
Full-width overlay required on 14th Street and Boalch
All trenches are 4 feet wide, including joint trenches

CITY OF NORTH BEND
MEADOWBROOK SEWER STUDY
ENGINEER'S PLANNING LEVEL COST ESTIMATE
20-Jan-19
G &O #18622.00
NO CONNECTIONS - SOUTH GRINDER PUMP SYSTEM

ITEM NO.	BASE BID: DESCRIPTION	ESTIMATED QUANTITY		UNIT PRICE	AMOUNT
1	Unexpected Site Changes	1	CALC	$25,000	$25,000
2	Survey	1	LS	$9,500	$9,500
3	SPCC Plan	1	LS	$1,500	$1,500
4	Mobilization, Cleanup, and Demobilization	1	LS	$127,000	$127,000
5	Project Temporary Traffic Control	1	LS	$60,000	$60,000
6	Clearing and Grubbing	1	LS	$20,000	$20,000
7	Removal of Structures and Obstructions	1	LS	$15,450	$15,450
8	Sawcutting	9,460	LF	$3	$28,380
9	Locate Existing Utilities	1	LS	$10,000	$10,000
10	Controlled Density Fill	5	CY	$250	$1,250
11	Crushed Surfacing Base Course	1,244	TN	$25	$31,100
12	Temporary HMA	40	TN	$250	$10,000
13	HMA Cl. 1/2" PG 64-22 Patching	396	TN	$200	$79,200
14	HMA Cl. 1/2" PG 64-22 Overlay	1,263	TN	$110	$138,930
15	4" Pressure Main, Incl. bedding & backfill	5,155	LF	$50	$257,750
16	6" Pressure Main, Incl. bedding & backfill	2,300	LF	$55	$126,500
17	6" Pressure Main, Bore w/Casing under RR/NBW/SR202 on 8th Street	710	LF	$250	$177,500
18	Air and Vacuum Release Valve	2	EA	$4,000	$8,000
19	Pressure Main Cleanout	8	EA	$3,000	$24,000
20	HDPE Sewer grinder Pump Low Pressure Main, 1.25 In. Diam., Incl. bedding & backfill	0	LF	$40	$0
21	Removal of Unsuitable Material (Trench)	110	CY	$40	$4,400
22	Trench Excavation Safety Systems	1	LS	$20,000	$20,000
23	Bank Run Gravel for Trench Backfill	5,297	TN	$25	$132,425
24	Dewatering	1	LS	$17,000	$17,000
25	Connect Ex. Structure via Duplex Grinder Pump (tank, pump, piping, and valves)	0	EA	$16,000	$0
26	Locate, uncover & Abandon Existing Septic System	0	EA	$1,500	$0
27	Erosion / Water Pollution Control	1	LS	$10,000	$10,000
28	Restoration	1	LS	$50,000	$50,000
29	Project Documentation	1	LS	$3,000	$3,000
30	Pipe Suspension Bridge with 240 LF of 6" DI FM	0	LF	$60	$0

Estimated Construction Cost		$1,387,885
Construction Contingency	20.0%	$277,577
Sales Tax	8.9%	$148,226
Total Estimated Construction Cost		**$1,814,000**
ULID Costs	30%	$544,200
Engineering Design	15%	$272,100
Construction Management	15%	$272,100
Administration	6%	$108,840
Permitting	4%	$72,560
Environmental Studies & Mitigation	3%	$54,420
Archeological Studies	2%	$36,280
Total Estimated Project Cost		**$3,175,000**

Does not include costs associated with funding via and LID or ULID

Assumptions include:

All small diameter pipe crossings shall be moled, all large diameter crossings shall be bored
100% trench backfill import material
Quantities increased by 10%, rounded up
Full-width overlay required on Alm Way, 8th Street
All trenches are 4 feet wide, including joint trenches

CITY OF NORTH BEND
MEADOWBROOK SEWER STUDY
ENGINEER'S PLANNING LEVEL COST ESTIMATE
20-Jan-19
G &O #18622.00
NO CONNECTIONS - VACUUM - COMBINATION

ITEM NO.	BASE BID: DESCRIPTION	ESTIMATED QUANTITY		UNIT PRICE	AMOUNT
1	Unexpected Site Changes	1	CALC	$20,000	$20,000
2	Survey	1	LS	$19,000	$19,000
3	SPCC Plan	1	LS	$4,000	$4,000
4	Mobilization, Cleanup, and Demobilization	1	LS	$548,000	$548,000
5	Project Temporary Traffic Control	1	LS	$120,000	$120,000
6	Clearing and Grubbing	1	LS	$20,000	$20,000
7	Removal of Structures and Obstructions	1	LS	$30,510	$30,510
8	Sawcutting	16,070	LF	$3	$48,210
9	Locate Existing Utilities	1	LS	$40,000	$40,000
10	Controlled Density Fill	10	CY	$250	$2,500
11	Crushed Surfacing Base Course	2,160	TN	$25	$54,000
12	Temporary HMA	100	TN	$250	$25,000
13	HMA Cl. 1/2" PG 64-22 Patching	652	TN	$200	$130,400
14	HMA Cl. 1/2" PG 64-22 Overlay	2,299	TN	$110	$252,890
15	PVC Vacuum Pipe, 8 In. Diam. (Incl. Bedding)	15,400	LF	$70	$1,078,000
16	Bore with Steel Casing 30 In.	160	LF	$400	$64,000
17	PVC Valve Pit Line, 3 In. Diam. (Incl. Bedding)	0	LF	$40	$0
18	Manhole Type 2 48 In. Dia.	0	EA	$5,000	$0
19	Removal of Unsuitable Material (Trench)	200	CY	$40	$8,000
20	Trench Excavation Safety Systems	1	LS	$45,000	$45,000
21	Bank Run Gravel for Trench Backfill	14,820	TN	$25	$370,500
22	Dewatering	1	LS	$34,000	$34,000
23	Connect Ex. Structure via Side Sewer	0	EA	$1,500	$0
24	Side Sewer Pipe, 4-inch Diam.	0	LF	$50	$0
25	Valve Pit (tank, piping, and valves)	0	EA	$9,000	$0
26	Locate, Uncover & Abandon Existing Septic System	0	EA	$1,500	$0
27	Erosion / Water Pollution Control	1	LS	$20,000	$20,000
28	Restoration	1	LS	$95,000	$95,000
29	Project Documentation	1	LS	$6,000	$6,000
30	Vacuum/Lift Station w/ Building	1	EA	$3,000,000	$3,000,000
31	HDPE Sewer Force Main, 6 In. Diam. (Incl. Bedding)	1,950	LF	$50	$97,500
32	Pipe Suspension Bridge with 240 LF of 6" DI FM	240	LF	$2,000	$480,000
33	FM Access Vaults	2	EA	$10,000	$20,000
	Estimated Construction Cost				$6,632,510
	Construction Contingency		20.0%		$1,326,502
	Sales Tax		8.9%		$708,352
	Total Estimated Construction Cost				**$8,668,000**
	ULID Costs		30%		$2,600,400
	Engineering Design		15%		$1,300,200
	Construction Management		15%		$1,300,200
	Administration		6%		$520,080
	Permitting		4%		$346,720
	Environmental Studies & Mitigation		3%		$260,040
	Archeological Studies		2%		$173,360
	Total Estimated Project Cost				**$15,169,000**

Assumptions include:

For SR202, all small diameter pipe crossings shall be moled, all large diameter crossings shall be bored, and pipes shall be installed in the shoulder
100% trench backfill import material
Quantities increased by 10%, rounded up
Average FM/Vacuum trench depth ~ 5 feet to invert
Full-width overlay required on 14th Street, Boalch, 8th Street, and Alm Way
Conversion of 1.7 tons per cubic yard for gravel
All trenches for 8" or larger are 4 feet wide, 3 feet for all others

City of North Bend
Meadowbrook Sewer Study
NO CONNECTIONS - Preliminary O&M Costs

Design Life Summary:			
Gravity Sewer	50	Yrs	
Pumps and Controls	20	Yrs	
Lift Station Structure	50	Yrs	
Motors	10	Yrs	
Impellers	7	Yrs	
Valves	25	Yrs	
Force Main	50	Yrs	
General Cost Summary:			
P/A (i=4.0%, n=50 yrs)	21.4822	Present : Annual Cost, based on 4% discount rate & 50 year life	
Electrical Power Cost	0.095	$/kWh	
Gravity System Costs:			
Gravity Lift Station Run Time	2000	hrs/yr	
Gravity Lift Station O&M Cost	31,600	$/yr/lift station	plus one hour per day staff time
Gravity Sewer O&M Cost	1.00	$/LF/yr	vactor MHs annually
Force Main O&M Cost	0.50	$/LF/yr - includes flushing and valve replacement	
Grinder Pump O&M Costs:			
Pump Energy Use	200	kWh/grinder pump/yr	
Pressure Main O&M	0.50	$/LF/yr - includes flushing and valve replacement	
Pump O&M Cost	440	$/yr/grinder pump	
Vacuum Station O&M Costs:			
Vacuum Station Run Time	8,760	hs/yr	
Vacuum Station O&M Cost	47,400	$/yr/lift station	plus 1.5 hours per day staff time, includes pump station
Vacuum Main O&M Cost	0.50	$/LF/yr	
Valve Pit O&M Cost	100	$/yr/grinder pump	

Alternatives Design Summary	**Alternative 2 - Combination System** North	South	**Alternative 3 - Grinder Only System** North	South	**Alternative 4 - Vacuum System**
Gravity or Vacuum LS HP	10	10	0	0	20
No. of Gravity or Vacuum LS	1	1	0	0	0
Gravity Sewer Length (LF)	5085	6080	0	0	0
Force Main Total Length (LF)	3485	3150	0	0	2190
Pressure Main Total Length (LF)	0	0	8260	7695	0
Total No. Grinder PS's	0	0	0	0	0
Vacuum Pump HP	0	0	0	0	25
No. of Vacuum Stations	0	0	0	0	1
Vacuum Main Total Length (LF)	0	0	0	0	15400
Total No. Valve Pits	0	0	0	0	0
Yearly O&M Cost Summary:					
Gravity LS Pump Electrical ($/yr)	$1,400	$1,400	$0	$0	$2,834
Gravity LS O&M ($/yr)	$31,600	$31,600	$0	$0	$0
Gravity Sewer O&M ($/yr)	$5,100	$6,100	$0	$0	$0
Force Main O&M Cost ($/yr)	$1,700	$1,600	$0	$0	$1,100
Grinder PS Electrical ($/yr)	$0	$0	$0	$0	$0
Pressure Main O&M ($/yr)	$0	$0	$4,100	$3,800	$0
Grinder PS O&M ($/yr)	$0	$0	$0	$0	$0
Vacuum Station Electrical ($/yr)	$0	$0	$0	$0	$15,500
Vacuum Station O&M ($/yr)	$0	$0	$0	$0	$47,400
Vacuum Main O&M ($/yr)	$0	$0	$0	$0	$7,700
Valve Pit O&M ($/yr)	$0	$0	$0	$0	$0
Yearly O&M ($/yr)	$39,800	$40,700	$4,100	$3,800	$74,534
Total Yearly O&M ($/yr)	$81,000		$8,000		$75,000
Present Worth of Annual O&M	$1,740,000		$172,000		$1,611,000
Total Capital Project Cost	$13,360,000		$7,024,000		$15,169,000
Total 50 Year Life Cycle Cost	**$15,100,000**		**$7,196,000**		**$16,780,000**