EXECUTIVE SUMMARY

ENVIRONMENTAL STUDY REVIEW
SECONDARY TREATMENT UPGRADING OPTIONS
OWEN SOUND WASTEWATER TREATMENT PLANT
OWEN SOUND, ONTARIO

Prepared For:
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CRA also acknowledges the interest of the City's Environment, Planning, Operations and Advisory Committees, and several Members of Council.

The project was funded by the City of Owen Sound with contributions from the Ontario Ministry of the Environment.

LIST OF ABBREVIATIONS AND ACRONYMS

Term	*Description*
Al^{+3}	Aluminum Ion
AVG	Average
BAF	Biological Aerated Filter
BNR	Biological Nutrient Removal
BPR	Biological Phosphorus Removal
BW	Back Wash
Bio-P	Biological Phosphorus
BOD_5	Biochemical Oxygen Demand (five-day)
CAS	Conventional Activated Sludge
$CBOD_5$	Inhibited or Carbonaceous five-day BOD
CEPA	Canadian Environmental Protection Act
COMRIF	Canada-Ontario Municipal Rural Infrastructure Fund
CONC	Concentration
CRA	Conestoga-Rovers & Associates Ltd.
D	Depth
Dia	Diameter
DO	Dissolved Oxygen
DWF	Dry Weather Flow
EA	Environmental Assessment
EFF	Effluent
ESIS	East Side Interceptor Sewer
F/M	Food-to-Microorganisms Ratio
HRT	Hydraulic Retention Time
$kg/m^3 \cdot d$	Kilograms per cubic metre per day
kWH	Kilowatt Hours
L	Litre
L/min	Litres per minute
m	Metre
m^2	Square metre
m^3/d	Cubic metres per day
$m^3/m^2 \cdot d$	Cubic metres per square metres per day
mg	Milligrams
mg/L	Milligrams per litre
MBR	Membrane Bioreactor
MIGD	Million imperial gallons per day
MIN	Minimum
ML	Millilitres
MLD	Million litres per day
MLSS	Mixed Liquor Suspended Solids
MBBR	Moving Bed Biofilm Reactor
MBR	Membrane Bioreactor
MOE	Ontario Ministry of the Environment

LIST OF ABBREVIATIONS AND ACRONYMS

Term	*Description*
MWWTP	Municipal Wastewater Treatment Plant
NH_4+	Ammonium Ion
NH_3	Un-ionized Ammonia
NA	Not Available
NH_3-N	Total Ammonia Nitrogen
NO_2-N	Nitrite Nitrogen
NO_3-N	Nitrate Nitrogen
O&M	Operations and Maintenance
PF	Peak Factor
PLC	Programmable Logic Controller
RAS	Return Activated Sludge
RAW	Raw Sludge or Sewage
SBR	Sequencing Batch Reactor
SLR	Solids Loading Rate
SOR	Surface Overflow Rate
SP	Soluble Phosphorus
SRT	Solids Retention Time
SS	Suspended Solids
SVI	Sludge Volume Index
SWD	Side Wall Depth
$TBOD_5$	Total five-day Biochemical Oxygen Demand
TF	Trickling Filter
TKN	Total Kjeldahl Nitrogen
TP	Total Phosphorus
TS	Total Solids
TSS	Total Suspended Solids
UV	Ultraviolet
V	Volume
VS	Volatile Solids
VSS	Volatile Suspended Solids
WAS	Waste Activated Sludge
wrt	With respect to
WSPS	West Side Pump Station
WWF	Wet Weather Flow
WWTP	Wastewater Treatment Plant

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1.0 INTRODUCTION

1.1 INTRODUCTION AND OBJECTIVES

The City of Owen Sound (the City) retained Conestoga-Rovers & Associates Ltd. (CRA) to complete an environmental study review of secondary treatment upgrading options for the Owen Sound Wastewater Treatment Plant (WWTP).

The principal objective of this project was to complete an assessment of secondary treatment upgrading alternatives to meet the Provincial Guideline F-5 requirements with no expansion of the current rated plant capacity of 24,500 cubic metres per day (m^3/d) (24.5 MLD). Under Guideline F-5, the Ontario Ministry of the Environment requires municipal treatment works, such as the Owen Sound WWTP, to provide secondary treatment or equivalent as the normal level of treatment.

Specific objectives for the project were addressed and documented through six separate Technical Memoranda as listed below:

- Condition Assessment - Technical Memorandum No. 1 (TM1);
- Design Hydraulic and Organic Loading - Technical Memorandum No. 2 (TM2);
- Effluent Quality - Technical Memorandum No. 3 (TM3);
- Secondary Treatment Upgrading Conventional Activated Sludge: Waterfront Versus Remote Location - Technical Memorandum No. 4 (TM4);
- Existing WWTP: Secondary Treatment Upgrading Alternatives Evaluation - Technical Memorandum No. 5 (TM5); and
- Existing WWTP Secondary Treatment Upgrade: Conceptual Design for BAF Process - Technical Memorandum No. 6 (TM6).

Each of the Technical Memoranda was prepared to present the details addressing each project objective and is included for further reference in the accompanying report.

1.2 EXISTING WWTP DESCRIPTION

The Owen Sound WWTP is currently operating under a rated plant capacity of 24, 500 m^3/d (24.5 MLD) as specified in the Certificate of Approval (C of A) Number 3-0913-76-006, dated 1976. The Owen Sound WWTP was originally constructed in 1962 with a significant expansion in 1978. Minor upgrades include the addition of sludge storage facilities in 1996 and the conversion from gas chlorination to sodium hypochlorite for disinfection in 1999.

Current treatment processes at the Owen Sound WWTP include a raw sewage pump station, screening, aerated grit removal, pre-aeration, primary treatment with chemical (ferric chloride) addition for phosphorus removal, disinfection using sodium hypochlorite, anaerobic sludge digestion, biosolids holding/storage facilities, and the application of stabilized biosolids to agricultural lands. Treated effluent is discharged to Owen Sound Bay. Existing buildings on the plant site include an administration/control building (complete with basic laboratory facilities) and a garage/workshop.

Historically, there have been bypasses from the sanitary sewer collection system in Owen Sound under wet weather conditions. Since 1998, the City has undertaken various capital works to identify, quantify, and reduce bypass overflow quantities and separate combined sewers in the City. Works to increase the capacity of the system to accommodate more flow are being conducted simultaneously. Progress and monitoring reports are now prepared annually that document bypass quantities and assist in the investigation of the impact of capital works remedial measures.

In 2005, the City commenced the Core Upgrading Project to upgrade the capacity of the West Side Pumping Station (WSPS) and alleviate identified hydraulic restrictions at the Owen Sound WWTP including a twinned influent sewer and firm capacity pumping provisions. This project does not include the need for new preliminary treatment including fine screening/grit removal, although this project has been conceptualized and remains in the capital budget.

1.3 CONDITION ASSESSMENT

Based on a preliminary site inspection, discussion with plant operating staff, and review of background documents, the overall condition of existing facilities at the Owen Sound WWTP is acceptable, with major equipment replacement generally completed as needed to ensure the continued operation of the facility. Overall, the existing treatment facilities (i.e. primary clarification, biosolids handling) are in good condition and could be incorporated in the upgrade to secondary treatment.

2.0 DESIGN HYDRAULIC AND ORGANIC LOADING

2.1 FLOW CHARACTERIZATION

The current annual average daily plant flow represents approximately 50 percent to 60 percent of the rated plant capacity of 24,500 m^3/d. Annual average flows have not increased significantly since at least the early 1990s.

In general, elevated flow conditions are sustained through the late winter and spring months. Maximum month (March) flows represent approximately 1.5 times the annual average daily flow and maximum day flows were in the range of approximately 4 times the annual average daily flow.

2.2 DESIGN FLOWS

The design average day flow for the upgrade to secondary treatment is to maintain the existing rated capacity of the plant (24,500 m^3/d). This approach is based on maintaining the current mix of residential, industrial, commercial, and institutional uses within the City. The peak flow to the Owen Sound WWTP has been established for the current upgrading assessment at the current rating of 3.4 times the average day flow, or 83,300 m^3/d. Based on the observed current flow characteristics, it is anticipated that this peak flow could occur over several sustained days during wet weather conditions.

Current projects are in progress to improve the firm raw sewage pump capacity to 86,400 m^3/d and this value is recommended as the basis for peak hourly and peak instantaneous flow in the upgrade to secondary treatment. The design flow basis for the plant upgrade to secondary treatment is presented in Table 2.1.

TABLE 2.1

DESIGN FLOWS FOR UPGRADE TO SECONDARY TREATMENT

Flow Condition	Flow rate (m^3/d)
Average Day Flow	24,500
Peak Day Flow	83,300
Peak Instantaneous Flow	86,400

It is recognized that current efforts to reduce extraneous inflow/infiltration and capture sewage bypasses in the sanitary collection system may reduce future peak flow conditions at the Owen Sound WWTP and these impacts should be reviewed prior to the initiation of any detailed design for secondary treatment upgrading.

2.3 DESIGN ORGANIC LOADING

The concentrations of all the key constituents (BOD_5, TSS, TKN, and TP) in the raw wastewater were lower than typical domestic wastewater characteristics. The raw sewage concentrations at the Owen Sound WWTP are characteristic of dilute wastewater strength, typical to collection systems with significant inflow/infiltration and/or combined sewers. The historical average per capita loadings, including industrial, commercial and institutional contributions, for BOD_5, TP, and TKN are also at the lower end of the range typical of municipal wastewater.

The City provides full municipal services to the majority of its residents and industrial, commercial and institutional contributors. Based on available data, it is anticipated that potential future leachate or septage handling requirements at the Owen Sound WWTP will have a minimal impact on the overall plant load.

The review of background documents and recent historical influent data provides sufficient justification to select dilute wastewater characteristics as the design basis for secondary treatment upgrading. The recommended concentrations for BOD_5, TSS, TKN, and TP were selected from these annual averages over the 3-year review period (2002-2004), with an increase of 130 percent to reflect impacts occurring during dry weather flow.

The raw wastewater concentrations and loadings at the rated plant capacity of 24,500 m^3/d are presented in Table 2.2 as the design basis for the conceptual upgrading of the Owen Sound WWTP to secondary treatment.

TABLE 2.2

DESIGN INFLUENT CONCENTRATIONS AND LOADINGS AT RATED PLANT CAPACITY (24,500 m^3/d)

Parameter	Design Concentration (mg/L)	Design Loading (kg/d)
BOD_5	130	3,185
TSS	180	4,410
TKN	21	515
TP	4	98

3.0 EFFLUENT QUALITY

3.1 CURRENT EFFLUENT QUALITY REQUIREMENTS

Compliance requirements for the Owen Sound WWTP are not specified in the current C of A. Therefore, the effluent quality is currently subject to the criteria for primary sewage treatment plants specified in Ontario Ministry of the Environment (MOE) Procedure F-5-1 as follows:

- 50 percent removal for BOD_5;
- 70 percent removal for TSS; and
- Total phosphorus less than 1 mg/L.

A review of the recent (2002-2004) plant historical effluent quality indicates that the plant is meeting the effluent guidelines on a yearly average basis. Yearly average removals for both BOD_5 and TSS have met the MOE Guideline, with BOD_5 and TSS removals averaging approximately 66 percent and 82 percent, respectively, for the period reviewed (i.e. 2002-2004). Yearly average concentrations of TP were less than 1.0 mg/L for the period reviewed.

The effluent quality typically associated with secondary treatment is 25 mg/L for BOD_5 and TSS and 1 mg/L for TP. It is noted that the current annual average effluent concentrations are close to or meeting the effluent quality typically associated with secondary treatment. Annual BOD_5, TSS, and TP effluent concentrations averaged 33 mg/L, 26 mg/L, and 0.43 mg/L, respectively, for the period reviewed (i.e. 2002-2004).

3.2 EFFLUENT QUALITY REQUIREMENTS FOR SECONDARY TREATMENT UPGRADE

The MOE was contacted to establish their position with respect to pertinent water quality issues and future effluent criteria for upgrading the Owen Sound WWTP to secondary treatment. This contact concluded that an assimilative capacity assessment for the wastewater treatment plant discharge to Owen Sound Bay would be required to finalize effluent quality requirements. Assimilative capacity assessments use flow and water quality data of the receiving water body to provide an analysis of impacts on the receiver from the WWTP effluent. The results of an assimilative capacity assessment would therefore dictate the exact effluent quality requirements for the upgrade to secondary treatment.

For the purposes of this assessment, secondary effluent criteria were specified as shown in Table 3.1 as a basis for the process design of secondary treatment upgrading alternatives. The secondary treatment effluent concentrations are slightly more restrictive than the "normal" level of treatment as required in the provincial Guidelines (25 mg/L for BOD and TSS concentrations and 1 mg/L TP concentration), and are similar to the BOD and TSS concentration effluent criteria that have been applied recently in a local area (i.e. Meaford WWTP).

Since firm effluent objectives cannot be identified until completion of a detailed assimilative capacity study for the Owen Sound Bay, there is limited potential that more restrictive effluent criteria may be imposed. Therefore, potentially more restrictive effluent criteria were also identified (Table 3.1) as a basis to define the facility planning impacts and assist in the decision-making process.

TABLE 3.1

FINAL EFFLUENT COMPLIANCE CRITERIA SPECIFIED FOR EVALUATION OF ALTERNATIVES

Parameter	**Secondary Treatment Effluent Concentration (mg/L)**	**Potentially More Restrictive Effluent Concentration (mg/L)**
BOD_5	20	15
TSS	20	15
NH_3-N	10	5
TP	0.8	0.5

4.0 CONVENTIONAL ACTIVATED SLUDGE (CAS): WATERFRONT VERSUS REMOTE LOCATION

4.1 CAS COMPARISON RATIONALE

Process design and costing was completed for the upgrade to Conventional Activated Sludge (CAS) as secondary treatment at the existing waterfront location. CAS is the most common process used for high rate secondary treatment in Canada serving approximately 80 percent of the Canadian population.

The existing WWTP site is located on the shoreline of Owen Sound Bay and it is adjacent to a public boat launch. Owen Sound Bay and the waterfront is a key area of the City as the Bay supports diverse water uses including water-related recreational activities, sports fishery habitat and the intake for the City's potable water supply system. Recognizing this sensitivity of the waterfront area from a development perspective, process design and costing was also completed for the re-location of the entire wastewater treatment plant, including secondary treatment, to a remote site (not on the waterfront). The evaluation was based on a generic property located within a 2 to 3 kilometre (km) radius of the existing wastewater treatment plant property.

The upgrade to CAS at the waterfront requires additional land area (footprint) for aeration and secondary clarifier treatment processes. Compact, but less common, technologies were subsequently evaluated as alternatives to CAS for the waterfront upgrade.

4.2 CAS COMPARISON RESULTS

Preliminary site plan layouts for CAS at the waterfront and a remote site were developed and are presented for reference on Figure 4.1 and Figure 4.2, respectively. The proposed plant layout at a new remote site allows for optimum process layout, control, and operation. The site space constraints at the waterfront location present significant challenges for the upgrade to secondary treatment using the CAS process as follows:

- Compromise of the treatment process control and operation; and
- Requirement for off-site biosolids storage (as a result of space constraints).

A comparison of the life cycle cost estimates for CAS on the waterfront and a remote site are presented in Table 4.1. The significantly lower capital cost at the waterfront reflects the value of the existing treatment processes and equipment (i.e. primary sedimentation, anaerobic digestion) that are incorporated in the upgrade to secondary treatment. The primary difference in O&M costs is attributed to the additional pumping (power) and odour control measures associated with the high lift station remaining on the waterfront to transfer wastewater to the remote plant site.

TABLE 4.1

20-YEAR PRESENT WORTH COST SUMMARY

CAS Alternative	Direct Capital Costs ($ millions)	Annual O&M Costs ($ millions)	20-Year Present Worth ($ millions)
Waterfront (existing)	41.30	2.1	71.80
Remote (new)	70.00	2.5	106.40

There are several other issues to be considered in the comparison between CAS at the waterfront and at a remote plant site. These non-economic issues cannot be reflected in the cost comparison but may impact the decision-making process. These issues include the following:

- The requirements of the Class EA process;
- Ability to expand beyond the current rated plant capacity;
- Adaptability to future regulatory changes (i.e. effluent criteria, biosolids management); and
- Impact on waterfront land uses (i.e. buffer zones, traffic, odour).

A summary comparison of the CAS process at the waterfront and at a remote plant site, including non-economic issues, is presented in Table 4.2.

TABLE 4.2

SUMMARY COMPARISION OF CONVENTIONAL ACTIVATED SLUDGE (CAS) AT THE WATERFRONT VERSUS A REMOTE PLANT SITE

Criteria	CAS on Waterfront	CAS at Remote Site
Process/Layout	• Non-ideal layout required (gravity flow, hydraulic flow split) • Off-site biosolids storage required	• No process limitations • Operation of pumping station at waterfront required
Capital Cost	• $41.3 million dollars • Incorporate existing treatment processes in upgrade • More costly shoreline construction (piling, dewatering) for addition of secondary treatment	• $70.0 million dollars • Decommission existing treatment processes at waterfront and reconstruct at remote site • Significant land acquisition
O&M Cost	• $2.1 million dollars per year	• $2.5 million dollars per year • Additional pumping (power)
Class EA Process	• Schedule A or Schedule B • No site, forcemain or outfall selection required (use existing)	• Schedule C • Search/selection of site, forcemain route and outfall required • Impacts of each potential site/route on natural, social and financial environments to be addressed
Future Expansion	• Compromised	• Acquisition of adequate land
Future Regulatory Changes	• Compromised	• Acquisition of adequate land
Waterfront Land Use Impacts	• Will not meet separation distance • Advanced mitigation may be required for noise/vibration, traffic, odour, visual aesthetics	• Pumping station remains on waterfront

Upgrading at the waterfront to CAS offers a lower capital expenditure and life cycle cost than construction of a new remote CAS plant. However, the site constraints create substantial challenges to the use of CAS at the waterfront, including compromise of the process layout and the requirement for off-site sludge storage. Compact, but less common, secondary treatment technologies were therefore considered as an alternative for upgrading at the waterfront.

5.0 EXISTING WWTP - SECONDARY TREATMENT UPGRADING ALTERNATIVES EVALUTION

Each of the wastewater technologies reported in use in Canada for secondary treatment of municipal wastewater was considered part of a long list of potential treatment technologies for upgrading at the Owen Sound WWTP. This long list of potential secondary treatment technologies was subjected to screening criteria as follows to establish a preferred short list of alternatives for more detailed comparison:

- Must consistently meet effluent quality objectives;
- Must demonstrate performance and reliability at full scale for similar sized facilities;
- Must demonstrate compatibility with the existing plant processes (primary treatment, biosolids stabilization, and disposal practices); and
- Must minimize land area requirements.

The screening process resulted in the identification of the processes shown in Table 5.1. Each of the short-listed biological systems would be implemented with simultaneous nitrification in a single sludge system to meet the anticipated effluent quality requirements, including partial nitrification, at the Owen Sound WWTP. With the exception of the Moving Bed Biofilm Reactor (MBBR) alternative, all secondary treatment alternatives were added downstream of the existing primary treatment process. As proposed by the MBBR proprietors (Anox-Kaldnes), the MBBR process would be implemented without primary sedimentation (i.e. MBBR would be constructed within the existing primary clarifiers). Furthermore, it is anticipated that the quantity of sludge generated by each biological process will be similar to less than the sludge quantity generated by CAS.

TABLE 5.1

ALTERNATIVES SHORT LIST

Alternative No.	Alternative Name	Abbreviation	Unit Process Description
1.	Conventional Activated Sludge	CAS	Primary treatment followed by CAS and UV disinfection
2.	Biological Aerated Filter	BAF	Primary treatment followed by BAF and UV disinfection
3.	Sequencing Batch Reactor	SBR	Primary treatment followed by SBR and UV disinfection
4.	Moving Bed Biofilm Reactor	MBBR	MBBR followed by UV disinfection (i.e. no primary treatment)
5.	Membrane Bioreactor	MBR	Primary treatment followed by MBR and UV disinfection

For each short-listed alternative, a preliminary process design was prepared as the basis for subsequent site plan layout and evaluation. In addition, preliminary capital, annual operating, and 20-year present worth life cycle costs were developed for each alternative. The process designs were based on applicable parameters for each technology with preliminary input provided by the suppliers of proprietary equipment as required. A site layout plan for each alterative was prepared and is presented on Figures 5.1 to 5.5 consecutively for the CAS, BAF, SBR, MBBR, and MBR alternatives.

Evaluation criteria were applied to each alternative in the four primary categories:

- Technical performance;
- Operating and maintenance;
- Land use; and
- Financial.

A discussion of each evaluation criteria as applied to each secondary treatment alternative on the short list was developed, accompanied by a simple ranking system (excellent, good, fair and poor). The ranking system was developed as a means to compare processes and to distinguish one treatment process from another for each criterion. A summary of the relative comparison for each alternative is presented in Table 5.2.

Based on consideration of all evaluation criteria, the preferred secondary treatment alternative for upgrading the Owen Sound WWTP at the waterfront site is the biological aerated filter (BAF). The key advantage of the BAF technology is the minimum footprint requirement that makes this option well suited for application where there are significant siting constraints. The compact footprint allows for the potential of on-site sludge storage and the addition of tertiary treatment, if more restrictive effluent criteria were applied. Capital cost and the 20-year present worth of the BAF and CAS alternatives at the waterfront was similar.

The 20-year life cycle cost of the MBR system is substantially higher than other alternatives considered. However, the MBR would achieve a tertiary effluent quality without any additional footprint or equipment requirements. The MBR system warrants further consideration in comparison to the BAF with tertiary treatment in the event that more restrictive effluent criteria becomes applicable.

TABLE 5.2

ALTERNATIVE EVALUATION SUMMARY
UPGRADE TO SECONDARY TREATMENT

EVALUATION CRITERIA	ALTERNATIVE 1 (CAS) Conventional Activated Sludge	2 (BAF) Biological Aerated Filter	3 (SBR) Sequencing Batch Reactor	4 (MBBR) Moving Bed Biological Reactor	5 (MBR) Membrane Biological Reactor
TECHNICAL PERFORMANCE					
• Ability to consistently meet effluent objectives	good	good	good	good	excellent
• Prior track record	excellent	good	good	fair	good
• Adaptability to accommodate extraneous flows and extended wet periods	good	excellent	good	excellent	excellent
• Impact on solids generation and biosolids management	good	good	good	fair	excellent
• Need for remote biosolids storage facilities	poor	excellent	fair	fair	excellent
OPERATING AND MAINTENANCE					
• Degree of operational skill required	good	good	good	good	fair
LAND USE					
• WWTP physical footprint required	poor	excellent	poor	poor	excellent
FINANCIAL (Biological Processes only)					
• Capital costs ($million)	16.9	19.9	16.5	19.9	34.8
• Yearly O&M Costs ($million/year)	0.705	0.699	0.714	0.765	1.083
• 20-year present worth costs ($million)	27.3	30.2	26.9	31.1	53.0

6.0 EXISTING WWTP SECONDARY TREATMENT UPGRADE CONCEPTUAL DESIGN FOR BAF PROCESS

Conceptual design information for the upgrade and refurbishment of the existing primary treatment plant in Owen Sound to a BAF secondary treatment facility was provided. A conceptual layout for the BAF upgrade to the existing WWTP is presented on Figure 6.1. Key aspects of the facility design were identified as follows:

- Facility aesthetics;
- Facility odour control;
- Site geotechnical conditions; and
- Site layout conditions.

Appropriate negotiations for a 150 metre buffer zone along the north side of the plant are recommended to meet separation distance requirements if the WWTP upgrading proceeds at the existing waterfront location.

For the BAF process, critical concepts for further consideration were identified as follows:

- Fine screening requirements;
- Backwash system considerations;
- Media replacement;
- Automation potential; and
- Primary effluent concentrations (chemically-enhanced removal).

Estimated capital costs for the BAF facility upgrade at the waterfront for the rated 24.5 MLD capacity is $41.8 million, with O&M costs to treat the full 24.5 MLD flow are estimated to be $2.1 million annually. The BAF components of the full plant upgrade were estimated to cost approximately $19.9 million.

These cost estimates are Class 4 Study or Feasibility level estimates as defined by the recommended practices of the Association for the Advancement of Cost Engineering (AACE) and are to be used for Study and Feasibility programs. The methodology used to develop the cost estimates was based on conceptual process design, preliminary major equipment costs and installation factors, and appropriate unit material and labour prices for quantifiable work. This level of estimate is considered to have a minus 30 percent to plus 50 percent accuracy range.

A tertiary filtration process may be required if advanced effluent total phosphorus concentrations (i.e. less than 0.5 mg/L) result from the proposed receiving water assimilative capacity study. The estimated additional capital cost for tertiary filtration, if warranted, is in the range of $3.0 to $3.5 million.

7.0 CONCLUSIONS AND RECOMMENDATIONS

7.1 CONCLUSIONS

The following conclusions are made:

1. The BAF technology is the preferred secondary treatment alternative for upgrading the Owen Sound WWTP at the waterfront. The key advantage of BAF technology is its minimum footprint, thereby allowing the potential for on-Site sludge storage, expansion beyond the current rated plant capacity, and the addition of tertiary treatment.

2. The 20-year Present Worth Cost for upgrading at the waterfront with BAF is lower than CAS at a remote plant site. The difference of approximately $34.3 million in present worth cost is attributed primarily to the existing treatment processes that are incorporated in the waterfront upgrade and the additional pumping to a remote site. Other non-economic issues that were considered in the comparison of upgrading at the waterfront versus a remote site included the requirements of the Class EA process, ability to expand beyond the current rated plant capacity, adaptability to future regulatory changes and the impact on waterfront land uses.

3. Upgrading to secondary treatment at the waterfront with BAF technology must proceed under the Municipal Class EA process as a Schedule A (provided no land acquisition is required) or a Schedule B (with acquisition of adjacent bike park land located to the south) activity. The relocation of the WWTP to a remote site would proceed as a Schedule C activity and a broader and more complex EA would be required.

7.2 RECOMMENDATIONS

The following recommendations are made:

1. An assimilative capacity assessment is recommended as a next step in finalizing the future effluent requirements for the secondary treatment upgrade.

2. Prior to commencing a WWTP Class EA, it would be advantageous for the City to determine if a new remote WWTP location should be studied or not. A broader and more complex EA would be required to study new WWTP locations.

3. The City is recommended to begin a Class EA study to finalize the alternative evaluation and selection process. The Class EA study is required to obtain MOE approval of the preferred alternative.

4. The development of a biosolids management plan is recommended to evaluate identified alternatives and to determine the preferred strategy with respect to the requirements of the Nutrient Management Act. Issues to be addressed in a biosolids management plan include alternative management practices, location of biosolids storage facilities and type of storage tank containment. A phased approach for the provision of biosolids management facilities (i.e. anaerobic digestion, biosolids storage) based on current flow conditions would defer some of the facility upgrade capital costs to a later date. The biosolids plan could also form part of the WWTP Class EA.

5. An on-site BAF pilot test should also be considered in order to fully detail the integrated performance of primary treatment (with/without chemical addition) and the BAF process especially with respect to TP removal and/or as a comparison of BAF supplier performance and operation.

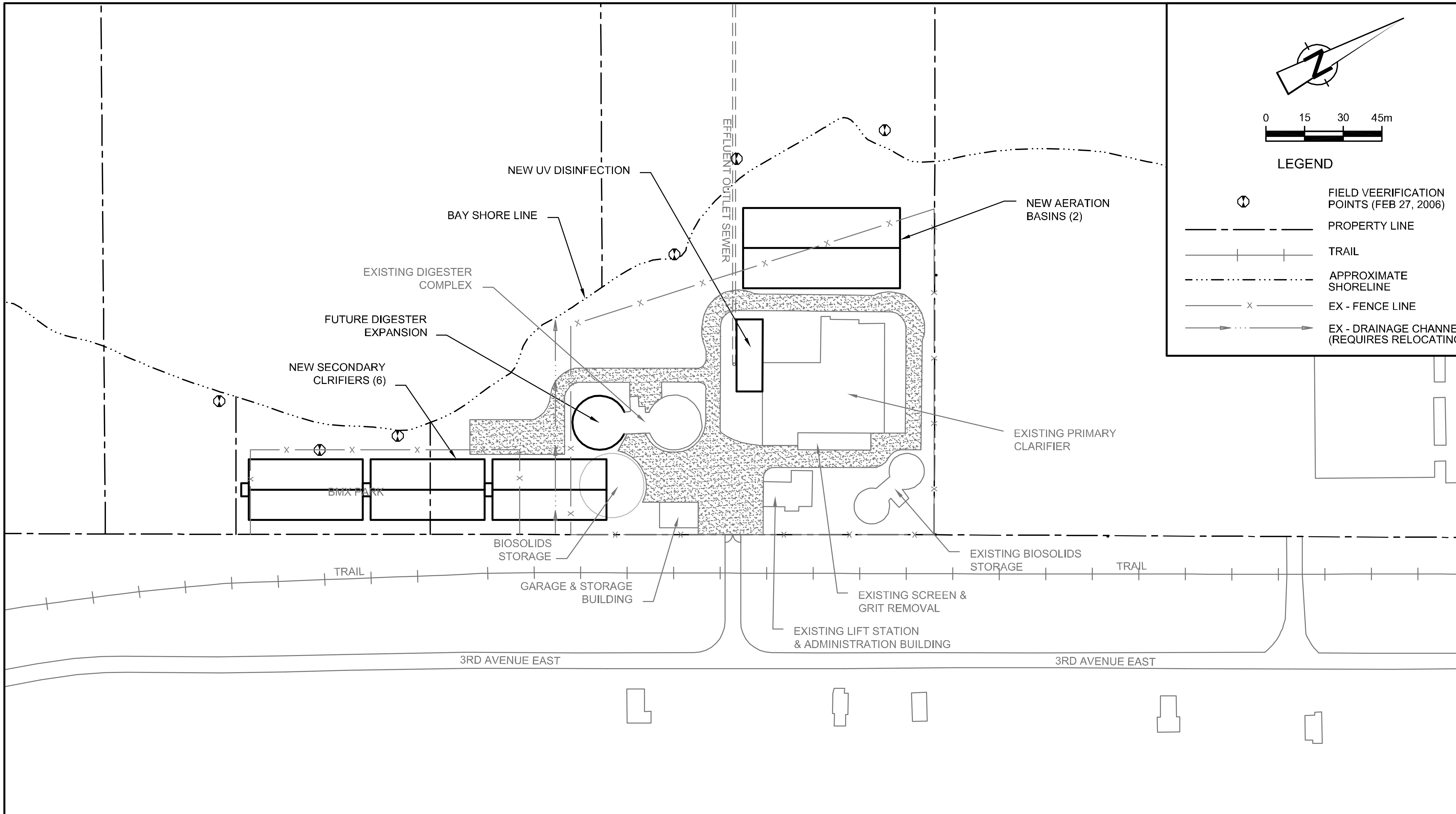

figure 4.1

WATERFRONT LOCATION
CONVENTIONAL ACTIVATED SLUDGE (CAS)
OWEN SOUND WWTP

NOTE: REMOTE BIOSOLIDS STORAGE FACILITY REQUIRED

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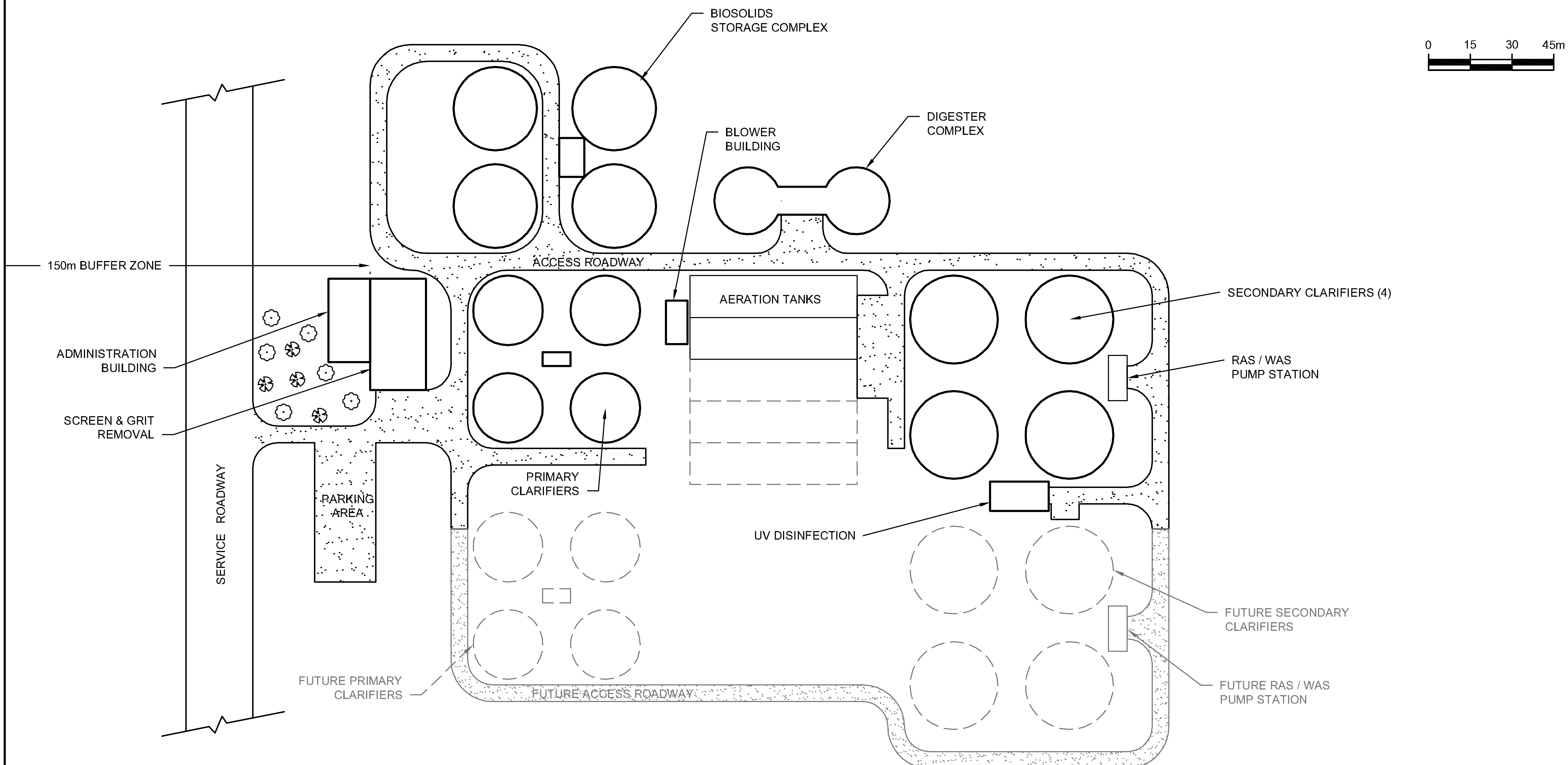

figure 4.2

REMOTE LOCATION
CONVENTIONAL ACTIVATED SLUDGE (CAS)
OWEN SOUND WWTP

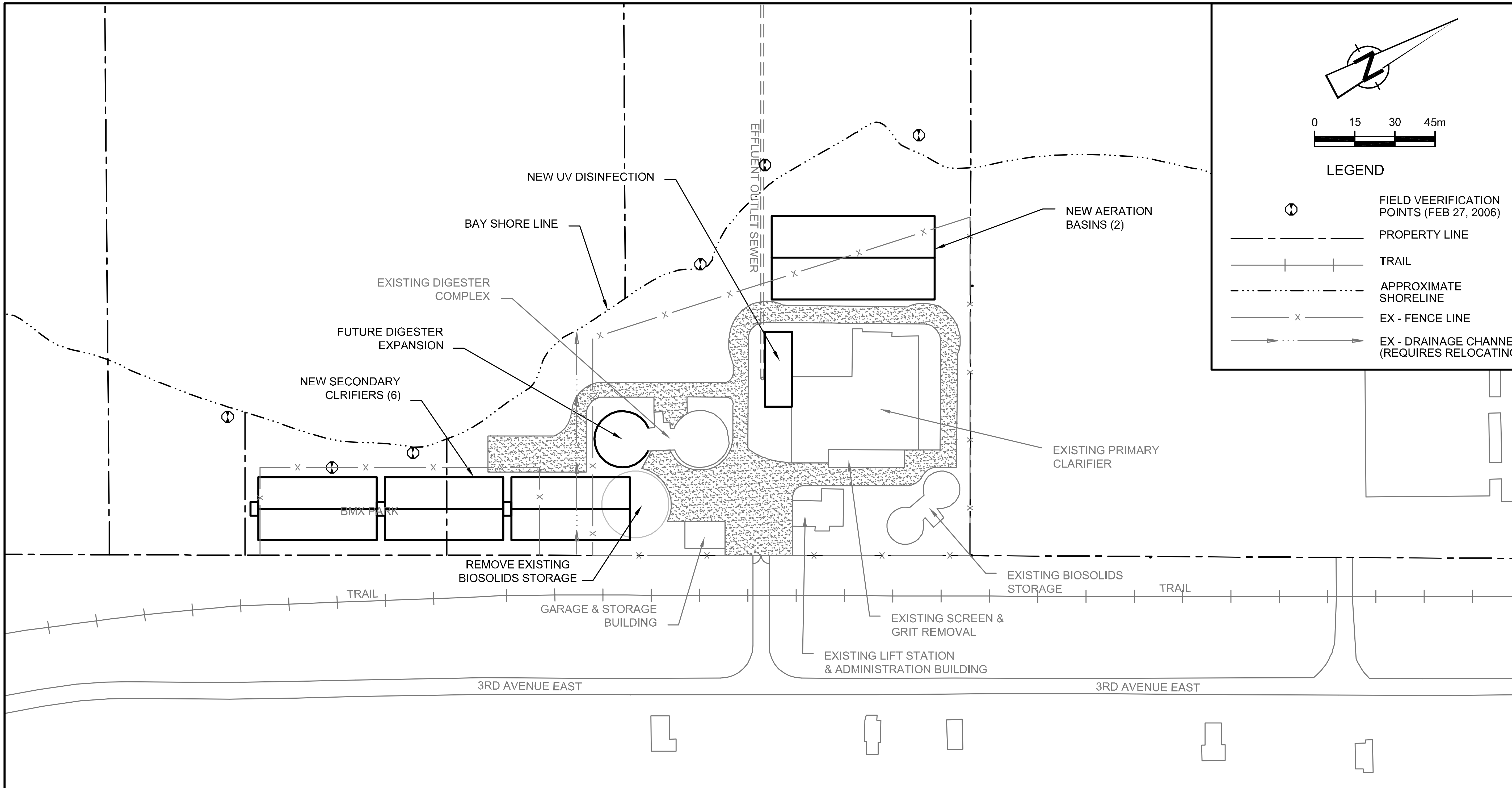

figure 5.1

WATERFRONT LOCATION
CONVENTIONAL ACTIVATED SLUDGE (CAS)
OWEN SOUND WWTP

NOTE: REMOTE BIOSOLIDS STORAGE FACILITY REQUIRED

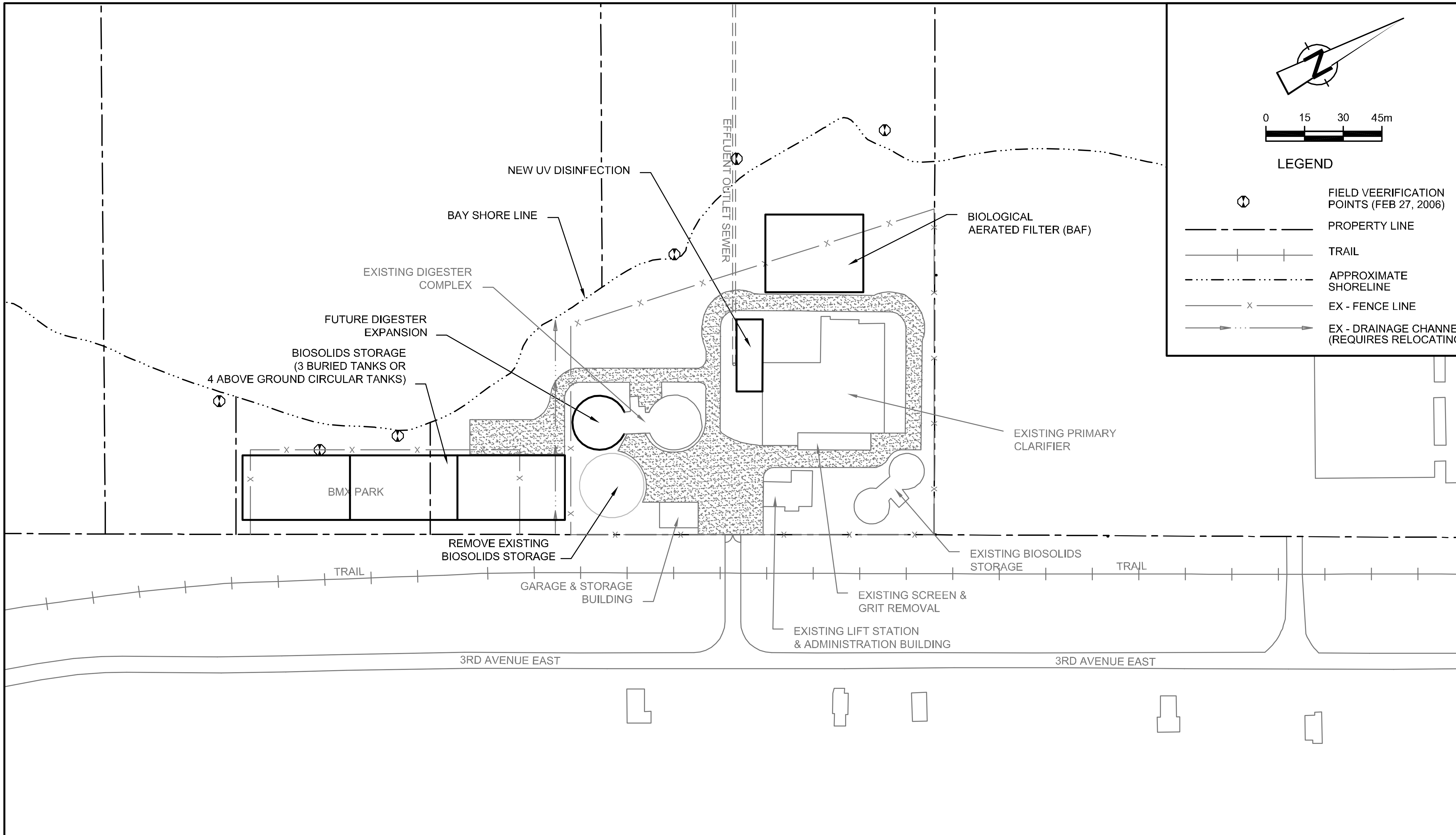

figure 5.2

WATERFRONT LOCATION
BIOLOGICAL AERATED FILTER (BAF)
OWEN SOUND WWTP

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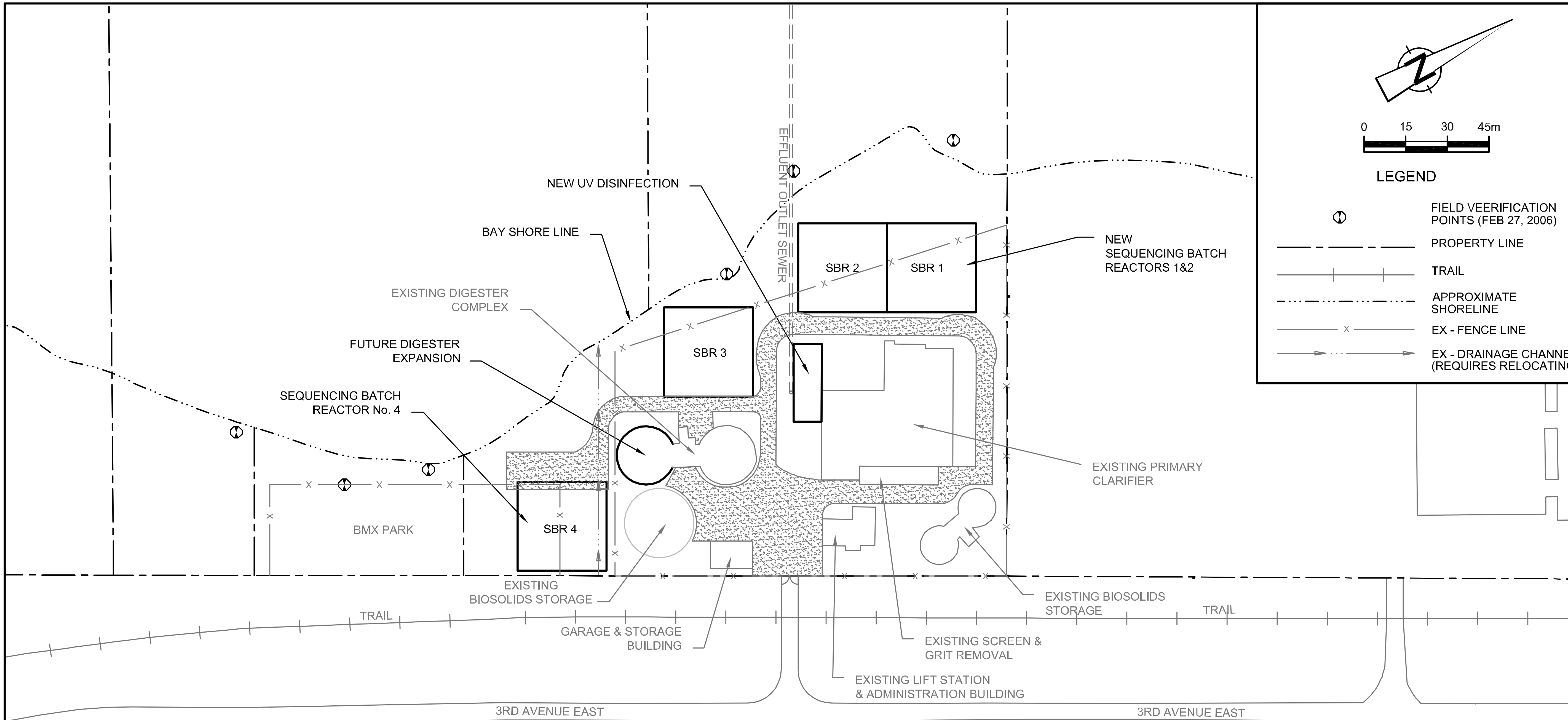

figure 5.3

WATERFRONT LOCATION - ALTERNATIVE 3
SEQUENCING BATCH REACTORS (SBR)
OWEN SOUND WWTP

NOTE: REMOTE BIOSOLIDS STORAGE FACILITY REQUIRED

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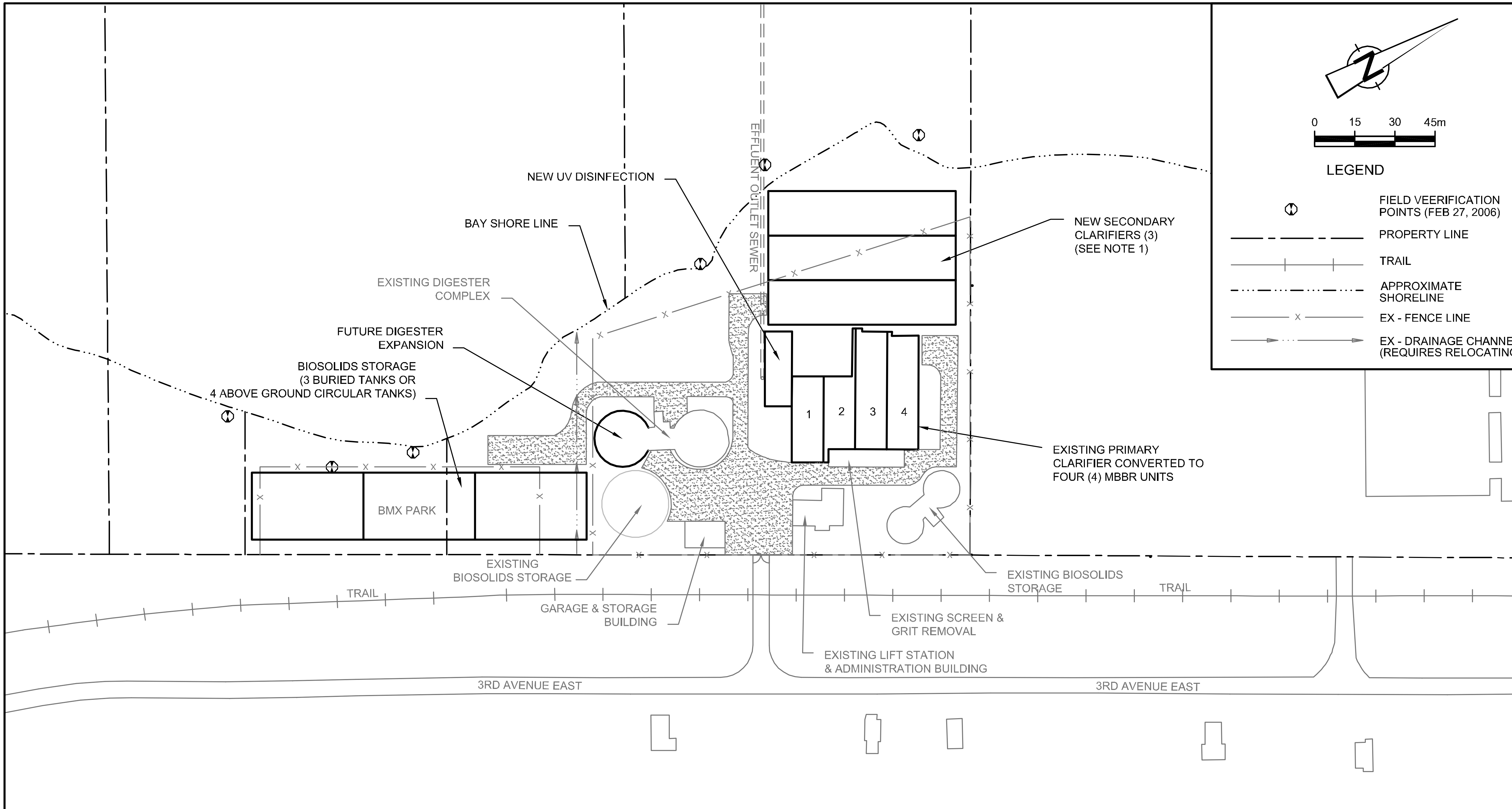

NOTES 1) CONSTRUCTION OF SECONDARY CLARIFIERS AS SHOWN REQUIRES FURTHER DETAILED GEOTECHNECAL AND STRUCTURAL DESIGN STUDY. ALTERNATIVE SECONDARY CLARIFIER LOCATION IS SOUTH OF DIGESTER COMPLEX WITH BIOSOLIDS STORAGE RELOCATED OFF-SITE.

figure 5.4

WATERFRONT LOCATION - ALTERNATIVE 4
MOVING BED BIOLOGICAL REACTOR (MBBR))
OWEN SOUND WWTP

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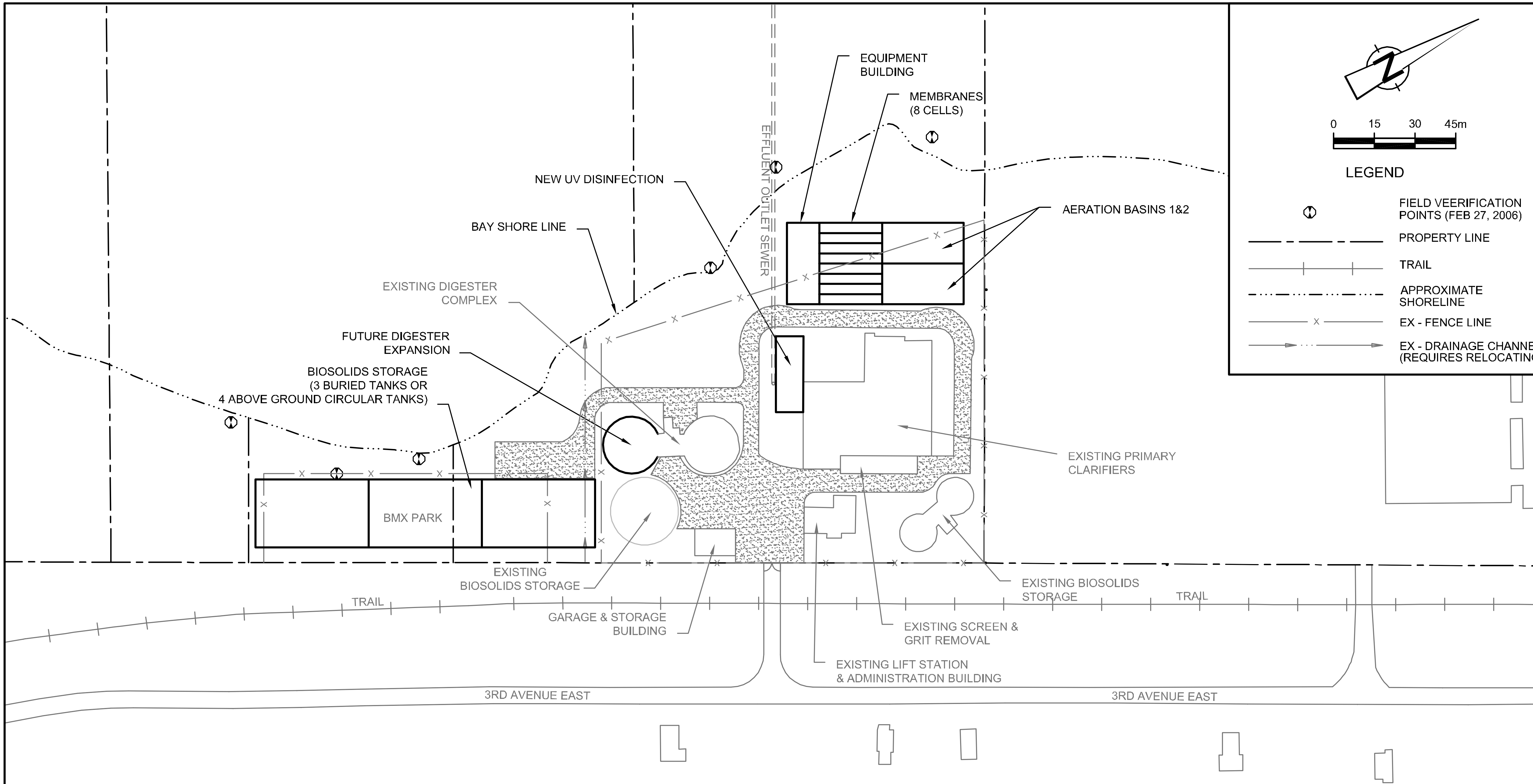

figure 5.5

WATERFRONT LOCATION - ALTERNATIVE 5
MEMBRANE BIOLOGICAL REACTOR (MBR)
OWEN SOUND WWTP

CRA

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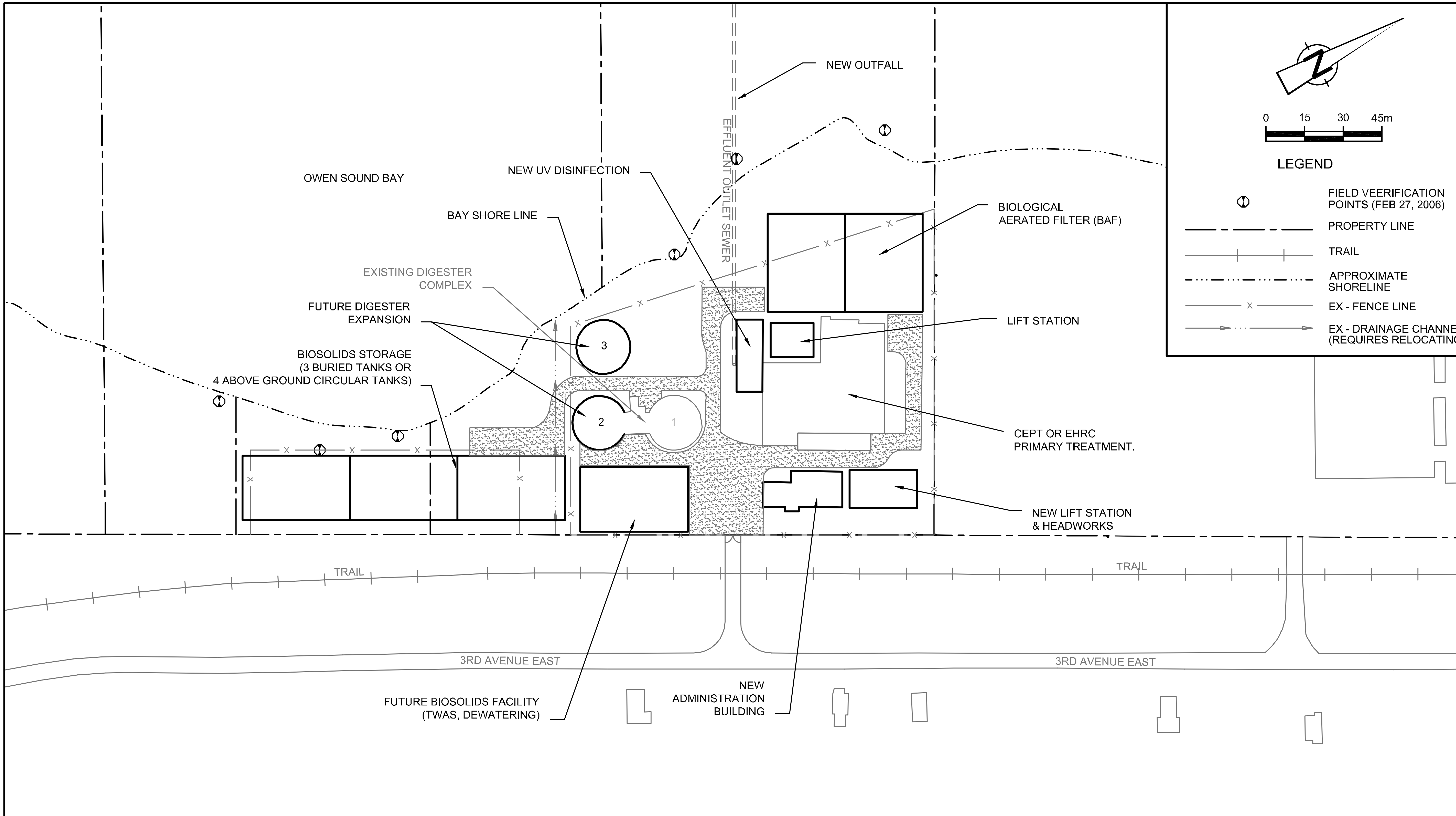

figure 6.1

WATERFRONT LOCATION
BIOLOGICAL AERATED FILTER (BAF)
ULTIMATE CAPACITY
OWEN SOUND WWTP

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