STATE OF MAINE
DEPARTMENT OF ENVIRONMENTAL PROTECTION

JOHN ELIAS BALDACCI
GOVERNOR

DAVID P. LITTELL
COMMISSIONER

May 7, 2007

Mr. Robert Berry
Director, Physical Plant
Goodwill Hinckley School
P.O. Box 159
Hinckley, Maine 04944

RE: Maine Pollutant Discharge Elimination System (MEPDES) Permit # ME0022659
Maine Waste Discharge License (WDL) Application #W001284-5C-C-R
Final Permit

Dear Mr. Berry:

Enclosed please find a copy of your **final** MEPDES permit and Maine WDL **renewal** which was approved by the Department of Environmental Protection. This permit/license replaces the National Pollutant Discharge Elimination System (NPDES) permit #ME0022659, last issued by the Environmental Protection Agency (EPA) on September 9, 1996. Please read the permit/license renewal and its attached conditions carefully. You must follow the conditions in the order to satisfy the requirements of law. Any discharge not receiving adequate treatment is in violation of State Law and is subject to enforcement action.

Any interested person aggrieved by a Department determination made pursuant to applicable regulations, may appeal the decision following the procedures described in the attached DEP FACT SHEET entitled "*Appealing a Commissioner's Licensing Decision.*"

If you have any questions regarding the matter, please feel free to call me at 287-7693.

Sincerely,

Gregg Wood
Division of Water Quality Management
Bureau of Land and Water Quality

Enc.

cc: Christopher Johnson, DEP/CMRO
Sandy Lao, USEPA

AUGUSTA
17 STATE HOUSE STATION
AUGUSTA, MAINE 04333-0017
(207) 287-7688 FAX: (207) 287-7826
RAY BLDG., HOSPITAL ST.

BANGOR
106 HOGAN ROAD
BANGOR, MAINE 04401
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PORTLAND
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PORTLAND, MAINE 04103
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PRESQUE ISLE, MAINE 04769-2094
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STATE OF MAINE
DEPARTMENT OF ENVIRONMENTAL PROTECTION
STATE HOUSE STATION 17 AUGUSTA, MAINE 04333

DEPARTMENT ORDER

IN THE MATTER OF

GOODWILL HINCKLEY SCHOOL	)	MAINE POLLUTANT DISCHARGE
FAIRFIELD, KENNEBEC COUNTY, MAINE	)	ELIMINATION SYSTEM PERMIT
OVERBOARD DISCHARGE	)	AND
#ME0022659	)	WASTE DISCHARGE LICENSE
#W001284-5C-C-R **APPROVAL**	)	**RENEWAL**

Pursuant to the provisions of the Federal Water Pollution Control Act, Title 33 USC, Section 1251, et seq. and Maine Law 38 M.R.S.A. Section 414-A, et seq., and applicable regulations, the Department of Environmental Protection (Department hereinafter) has considered the application of the GOODWILL HINCKLEY SCHOOL (GHS hereinafter), with its supportive data, agency review comments, and other related materials on file and FINDS THE FOLLOWING FACTS:

APPLICATION SUMMARY

The GHS has applied to the Department for renewal of overboard discharge (OBD) Waste Discharge License (WDL) #W001284-ZC-B-R which was issued by the Department on September 17, 1996, and expired on September 17, 2006. The WDL authorized a year-round monthly average discharge of up to 20,000 gallons per day of secondary treated waste waters to the Kennebec River, Class C in Fairfield, Maine. It is noted the U.S. Environmental Protection Agency's (EPA) records indicate National Pollutant Discharge Elimination System (NPDES) permit #ME0022659 was last issued by the EPA on September 9, 1996 and expired on September 9, 2001.

PERMIT SUMMARY

a. Regulatory - On January 12, 2001, the Department received authorization from the EPA to administer the NPDES permit program in Maine, excluding areas of special interest to Maine Indian Tribes. From that point forward, the program has been referred to as the Maine Pollutant Discharge Elimination System (MEPDES) permit program, and permit #ME0022659 (same as the NPDES permit number) will be utilized as the primary reference number for the GHS facility.

PERMIT SUMMARY

b. Terms and conditions

This permitting action is similar to the 9/17/96 licensing action in that it is:

1. Carrying forward the monthly average discharge flow limitation of 20,000 GPD of secondary treated sanitary wastewater on a year-round basis;

2. Carrying forward the monthly average and daily maximum technology-based concentration limitations for biochemical oxygen demand (BOD_5) and total suspended solids (TSS);

3. Carrying forward the daily maximum technology based limitation for total residual chlorine.

4. Carrying for the NPDES permit number of ME0022659.

This permitting action is different from the 9/17/96 licensing action in that it is:

5. Establishing a daily maximum discharge flow reporting requirement;

6. Establishing weekly average technology based concentration limits for BOD and TSS.

7. Establishing monthly average, weekly average, and daily maximum technology-based mass limitations for BOD_5 and TSS;

8. Establishing a requirement to achieve a minimum 30-day average of 85 percent removal for BOD_5 and TSS;

9. Establishing more stringent water quality based monthly average (geometric mean) and daily maximum *E. coli* bacteria limitations due to the re-classification of the Kennebec River subsequent to issuance of the 9/17/96 licensing action. The limitations apply seasonally (May 15th – September 30th) rather than year-round as was the case in the previous WDL.

10. Revising the minimum monitoring frequency requirements for BOD_5, TSS, *E. coli* bacteria, total residual chlorine and pH.

11. Establishing a requirement for the permittee to have a site evaluation performed by a licensed site evaluator with experience in designing systems for the replacement of overboard discharge systems prior to the expiration date of the permit.

12. Establishing a requirement for the permittee to pump all septic tanks at a minimum of once every three years.

13. Establishing a requirement for the permittee to develop and keep current, an Operations and Maintenance (O&M) plan for the waste treatment system and appurtenances.

CONCLUSIONS

BASED on the findings in the attached Fact Sheet dated March 21, 2007, and subject to the Conditions listed below, the Department makes the following CONCLUSIONS:

1. The discharge, either by itself or in combination with other discharges, will not lower the quality of any classified body of water below such classification.

2. The discharge, either by itself or in combination with other discharges, will not lower the quality of any unclassified body of water below the classification which the Department expects to adopt in accordance with State law.

3. The provisions of the State's antidegradation policy, 38 M.R.S.A. §464(4)(F), will be met, in that:

   (a) Existing in-stream water uses and the level of water quality necessary to protect and maintain those existing uses will be maintained and protected;

   (b) Where high quality waters of the State constitute an outstanding national resource, that water quality will be maintained and protected;

   (c) The standards of classification of the receiving water body are met or, where the standards of classification of the receiving water body are not met, the discharge will not cause or contribute to the failure of the water body to meet the standards of classification;

   (d) Where the actual quality of any classified receiving water body exceeds the minimum standards of the next highest classification that higher water quality will be maintained and protected; and

   (e) Where a discharge will result in lowering the existing water quality of any water body, the Department has made the finding, following opportunity for public participation, that this action is necessary to achieve important economic or social benefits to the State.

4. The discharges will be subject to effluent limitations that require application of best practicable treatment as defined in Maine law, 38 M.R.S.A., §414-A(1)(D).

5. The overboard discharge system was in continuing existence for the 12 months preceding June 1, 1987.

6. A subsurface wastewater disposal system can be installed in compliance with the Maine Subsurface Waste Water Disposal Rules at the time the renewal application was accepted by the Department but the Department has not offered the permittee funding to eliminate the discharge.

7. A publicly owned sewer line is not located on or abutting land owned or controlled by the permittee or is not available for the permittee's use.

8. The discharge is not located within the boundaries of a sanitary district or sewer district.

ACTION

THEREFORE, the Department APPROVES the above noted application of the GOODWILL HINCKLEY SCHOOL to discharge a monthly average flow of up to 20,000 GPD of secondary treated sanitary wastewater to the Kennebec River, Class C, in Fairfield, Maine, SUBJECT TO THE ATTACHED CONDITIONS, and all applicable standards and regulations including:

1. "*Maine Pollutant Discharge Elimination System Permit Standard Conditions Applicable to All Permits*," revised July 1, 2002, copy attached.

2. The attached Special Conditions, including any effluent limitations and monitoring requirements.

3. This permit expires five (5) years from the date of signature below.

DONE AND DATED AT AUGUSTA, MAINE, THIS 8TH DAY OF May, 2007.

DEPA RTMENT OF ENVIRONMENTAL PROTECTION

BY: _____
DAVID P. LITTELL, Commissioner

PLEASE NOTE ATTACHED SHEET FOR GUIDANCE ON APPEAL PROCEDURES

Date of initial receipt of application: January 24, 2007.

Date of application acceptance: February 7, 2007.

FILED
MAY 10 2007
BOARD OF ENVIRONMENTAL PROT.
STATE OF MAINE

Date filed with Board of Environmental Protection: _____.

This Order prepared by Gregg Wood, BUREAU OF LAND & WATER QUALITY

W12845CC 5/7/07

SPECIAL CONDITIONS

A. EFFLUENT LIMITATIONS AND MONITORING REQUIREMENTS

1. The permittee is authorized to discharge **secondary treated sanitary wastewater from Outfall #001A** to the Kennebec River. Such discharges shall be limited and monitored by the permittee as specified below[(1)]:

Effluent Characteristic	Discharge Limitations						Minimum Monitoring Requirements	
	Monthly Average	Weekly Average	Daily Maximum	Monthly Average	Weekly Average	Daily Maximum	Measurement Frequency[(5)]	Sample Type[(6)]
Flow *[50050]*	20,000 GPD *[07]*	---	Report GPD *[07]*	---	---	---	1/Week *[01/07]*	Measured *[MS]*
BOD_5 *[00310]*	5.0 lbs/day *[26]*	7.5 lbs/day *[26]*	8.3 lbs/day *[26]*	30 mg/L *[19]*	45 mg/L *[19]*	50 mg/L *[19]*	1/Month *[01/30]*	Grab *[GR]*
BOD_5 Percent Removal[(2)] *[81010]*	---	---	---	85% *[23]*	---	---	1/Month *[01/30]*	Calculate *[CA]*
TSS *[00530]*	5.0 lbs/day *[26]*	7.5 lbs/day *[26]*	8.3 lbs/day *[26]*	30 mg/L *[19]*	45 mg/L *[19]*	50 mg/L *[19]*	1/Month *[01/30]*	Grab *[GR]*
TSS Percent Removal[(2)] *[81011]*	---	---	---	85% *[23]*	---	---	1/Month *[01/30]*	Calculate *[CA]*
Settleable Solids *[00545]*	---	---	---	---	---	0.3 ml/L *[25]*	1/Month *[01/30]*	Grab *[GR]*
***E. Coli.* Bacteria**[(3)] *[31633]*	---	---	---	142/100 ml[(4)] *[13]*	---	949/100 ml *[13]*	1/Month *[01/30]*	Grab *[GR]*
Total Residual Chlorine *[50060]*	---	---	---	---	---	1.0 mg/L *[19]*	3/Week *[03/07]*	Grab *[GR]*
pH *[00400]*	---	---	---	---	---	6.0 – 9.0 SU *[12]*	---	---
The italicized numeric values bracketed in the table and in subsequent text are code numbers that Department personnel utilize to code the monthly Discharge Monitoring Reports.								

FOOTNOTES: See Page 6 of this permit for applicable footnotes.

SPECIAL CONDITIONS

A. EFFLUENT LIMITATIONS AND MONITORING REQUIREMENTS (cont'd)

FOOTNOTES:

1. **Monitoring** – All effluent monitoring shall be conducted at a location following the last treatment unit in the treatment process. Sampling and analysis must be conducted in accordance with: a) methods approved by 40 Code of Federal Regulations (CFR) Part 136; b) alternative methods approved by the Department in accordance with the procedures in 40 CFR Part 136; or c) as otherwise specified by the Department. Samples that are sent out for analysis shall be analyzed by a laboratory certified by the State of Maine's Department of Health and Human Services.

   All detectable analytical test results shall be reported to the Department including results which are detected below the respective reporting limits (RLs) specified by the Department or as specified by other approved test methods. If a non-detect analytical test result is below the respective RL, the concentration result shall be reported as <Y where Y is the detection limit achieved by the laboratory for each respective parameter. Reporting a value of <Y that is greater than an established RL is not acceptable and will be rejected by the Department. For mass, if the analytical result is reported as <Y or if a detectable result is less than a RL, report a <X lbs/day, where X is the parameter specific limitation established in the permit.

2. **Percent Removal** – The treatment facility shall maintain a minimum of 85 percent removal of both BOD_5 and TSS for all flows receiving secondary treatment. The percent removal shall be calculated based on an assumed influent value of 286 mg/L or measured effluent concentration values. Percent removal limitations are not applicable if a measured influent used to calculate the removal is <200 mg/L.

3. **Bacteria Limits** – *E. coli* bacteria limits and monitoring requirements are seasonal and apply between May 15th and September 30th of each year. The Department reserves the right to impose bacteria limits on a year-round basis to protect the health, safety, and welfare of the public.

4. **Bacteria Reporting** – The monthly average *E. coli.* bacteria limitation is a geometric mean limitation and sample results shall be reported as such.

5. **2/Months sampling** – There shall be at least 14 days between sampling events.

6. **Samples Types** – Where grab sampling is specified, the applicant may choose to obtain a composite sample instead provided the alternate sampling is noted on the DMR.

B. ANNUAL DISCHARGE FEES

Pursuant to Maine law, 38 M.R.S.A. §353-B, the permittee is required to pay an applicable annual fee for discharges authorized by this permit. Failure to pay an annual fee within 30 days of the billing date of a license/permit is sufficient grounds for revocation of the license, permit or privilege under Maine law, 38 M.R.S.A. §341-D, subsection 3.

SPECIAL CONDITIONS

C. NARRATIVE EFFLUENT LIMITATIONS

1. The effluent shall not contain a visible oil sheen, foam or floating solids at any time which would impair the usages designated by the classification of the receiving waters.
2. The effluent shall not contain materials in concentrations or combinations which are hazardous or toxic to aquatic life, or which would impair the usages designated by the classification of the receiving waters.
3. The discharges shall not cause visible discoloration or turbidity in the receiving waters which would impair the usages designated by the classification of the receiving waters.
4. Notwithstanding specific conditions of this permit, the effluent must not lower the quality of any classified body of water below such classification, or lower the existing quality of any body of water if the existing quality is higher than the classification.

D. DISINFECTION

If chlorination is used as the means of disinfection, an approved chlorine contact tank providing the proper detention time consistent with good engineering practice must be utilized followed by a dechlorination system if the imposed total residual chlorine (TRC) limit cannot be achieved by dissipation in the detention tank. The total residual chlorine in the effluent shall at no time cause any demonstrable harm to aquatic life in the receiving waters. The dose of chlorine applied shall provide a TRC concentration that will effectively reduce fecal coliform bacteria levels to or below those specified in Special Condition A, "*Effluent Limitation and Monitoring Requirements*," of this permit.

E. TREATMENT PLANT OPERATOR

The treatment facility must be operated by a person holding a minimum of a **Grade I** certificate (or Registered Maine Professional Engineer) pursuant to Title 32 M.R.S.A. §4171 *et seq*. All proposed contracts for facility operation by any person must be approved by the Department before the permittee may engage the services of the contract operator.

F. AUTHORIZED DISCHARGES

The permittee is authorized to discharge only in accordance with the terms and conditions of this permit and only from Outfall #001A. Discharges of wastewater from any other point source not identified in the 2/07 application permit renewal are not authorized under this permit, and shall be reported in accordance with Standard Condition B(5), *Bypasses*, of this permit.

SPECIAL CONDITIONS

G. NOTIFICATION REQUIREMENT

In accordance with Standard Condition D, the permittee shall notify the Department of the following.

1. Any substantial change or proposed change in the volume or character of pollutants being introduced into the wastewater collection and treatment system by a source introducing pollutants into the system at the time of permit issuance. For the purposes of this section, notice regarding substantial change shall include information on:

   (a) the quality and quantity of wastewater introduced to the wastewater collection and treatment system; and

   (b) any anticipated impact caused by the change in the quantity or quality of the wastewater to be discharged from the treatment system.

H. SITE EVALUATION FOR TRANSFERRED AND RENEWED PERMITS

Prior to permit transfer or **transfer of the property** occupying the permitted overboard discharge system **or renewal of this permit**, a site evaluation must be performed by a licensed site evaluator with experience in designing systems for the replacement of overboard discharge systems. The Department may not grant approval for permit transfer or renewal if the site evaluation concludes that a non-discharging wastewater disposal system designed in compliance with the Maine Subsurface Waste Water Disposal Rules administered by the Maine Department of Health and Human Services, Division of Health Engineering can be installed as a replacement system for the overboard discharge.

I. OPERATION & MAINTENANCE (O&M) PLAN

This facility shall have a current written comprehensive Operation & Maintenance (O&M) Plan. The plan shall provide a systematic approach by which the permittee shall at all times, properly operate and maintain all facilities and systems of treatment and control (and related appurtenances) which are installed or used by the permittee to achieve compliance with the conditions of this permit.

By December 31 of each year, or within 90 days of any process changes or minor equipment upgrades, the permittee shall evaluate and modify the O&M Plan including site plan(s) and schematic(s) for the wastewater treatment facility to ensure that it is up-to-date. The O&M Plan shall be kept on-site at all times and made available to Department and EPA personnel upon request.

Within 90 days of completion of new and or substantial upgrades of the waste water treatment facility (excepting the current yet to be completed substantial upgrade), the permittee shall submit the updated O&M Plan to their Department inspector for review and comment.

SPECIAL CONDITIONS

J. MONITORING AND REPORTING

Monitoring results obtained during the previous month shall be summarized for each month and reported on separate Discharge Monitoring Report (DMR) forms provided by the Department and **postmarked on or before the thirteenth (13th) day of the month or hand-delivered to the Department's Regional Office such that the DMR's are received by the Department on or before the fifteenth (15th) day of the month** following the completed reporting period. A signed copy of the DMR and all other reports required herein shall be submitted to the following address:

Overboard Discharge Inspector
Department of Environmental Protection
Bureau of Land and Water Quality
Division of Water Quality Management
17 State House Station
Augusta, Maine 04333-0017

K. REOPENING OF PERMIT FOR MODIFICATIONS

Upon evaluation of the tests results or monitoring requirements specified in Special Conditions of this permitting action, new site specific information, or any other pertinent test results or information obtained during the term of this permit, the Department may, at any time and with notice to the permittee, modify this permit to: (1) include effluent limits necessary to control specific pollutants or whole effluent toxicity where there is a reasonable potential that the effluent may cause water quality criteria to be exceeded; (2) require additional effluent or ambient water quality monitoring if results on file are inconclusive; or (3) change monitoring requirements or limitations based on new information.

L. SEVERABILITY

In the event that any provision or part thereof, of this permit is declared to be unlawful by a reviewing court, the remainder of the permit shall remain in full force and effect, and shall be construed and enforced in all aspects as if such unlawful provision, or part thereof, had been omitted, unless otherwise ordered by the court.

MAINE POLLUTANT DISCHARGE ELIMINATION SYSTEM PERMIT
AND
WASTE DISCHARGE LICENSE

FACT SHEET

Date: **March 21, 2007**

MEPDES PERMIT: **#ME0022659**
WASTE DISCHARGE LICENSE: **#W001284-5C-C-R**

NAME AND ADDRESS OF APPLICANT:

GOODWILL HINCKLEY SCHOOL
P.O. Box 159
Hinckley, Maine 04944

COUNTY: **Kennebec County**

NAME AND ADDRESS WHERE DISCHARGE OCCURS:

Easterly side of Route #201
Fairfield, Maine

RECEIVING WATER / CLASSIFICATION: **Kennebec River/Class C**

COGNIZANT OFFICIAL AND TELEPHONE NUMBER: **Mr. Robert Berry**
Director of Physical Plant
(207) 238-4183

1. APPLICATION SUMMARY

The GHS has applied to the Department for renewal of overboard discharge (OBD) Waste Discharge License (WDL) #W001284-ZC-B-R which was issued by the Department on September 17, 1996, and expired on September 17, 2006. The WDL authorized a year-round monthly average discharge of up to 20,000 gallons per day of secondary treated waste waters to the Kennebec River, Class C in Fairfield, Maine. See Attachment A of this Fact Sheet for a location map of the school campus. It is noted the U.S. Environmental Protection Agency's (EPA) records indicate National Pollutant Discharge Elimination System (NPDES) permit #ME0022659 was last issued by the EPA on September 9, 1996 and expired on September 9, 2001.

2. PERMIT SUMMARY

a. Regulatory - On January 12, 2001, the Department received authorization from the EPA to administer the NPDES permit program in Maine, excluding areas of special interest to Maine Indian Tribes. From that point forward, the program has been referred to as the Maine Pollutant Discharge Elimination System (MEPDES) permit program, and permit #ME0022659 (same as the NPDES permit number) will be utilized as the primary reference number for the GHS facility.

2. PERMIT SUMMARY (cont'd)

b. Terms and conditions

This permitting action is similar to the 9/17/96 licensing action in that it is:

1. Carrying forward the monthly average discharge flow limitation of 20,000 GPD of secondary treated sanitary wastewater on a year-round basis;

2. Carrying forward the monthly average and daily maximum technology-based concentration limitations for biochemical oxygen demand (BOD_5) and total suspended solids (TSS);

3. Carrying forward the daily maximum technology based limitation for total residual chlorine.

4. Carrying for the NPDES permit number of ME0022659.

This permitting action is different from the 9/17/96 licensing action in that it is:

5. Establishing a daily maximum discharge flow reporting requirement;

6. Establishing weekly average technology based concentration limits for BOD and TSS.

7. Establishing monthly average, weekly average, and daily maximum technology-based mass limitations for BOD_5 and TSS;

8. Establishing a requirement to achieve a minimum 30-day average of 85 percent removal for BOD_5 and TSS;

9. Establishing more stringent water quality based monthly average (geometric mean) and daily maximum *E. coli* bacteria limitations due to the re-classification of the Kennebec River subsequent to issuance of the 9/17/96 licensing action. The limitations apply seasonally (May 15th – September 30th) rather than year-round as was the case in the previous WDL.

10. Revising the minimum monitoring frequency requirements for BOD_5, TSS, *E. coli* bacteria, total residual chlorine and pH.

11. Establishing a requirement for the permittee have a site evaluation performed by a licensed site evaluator with experience in designing systems for the replacement of overboard discharge systems prior the expiration date of the permit.

12. Establishing a requirement for the permitte to pump all septic tanks at a minimum of once every three years.

13. Establishing a requirement for the permittee to develop and keep current, a Operations and Maintenance (O&M) plan for the waste treatment system and appurtenances

2. PERMIT SUMMARY (cont'd)

c. Facility History: This section provides a summary of the most significant regulatory actions for the GHS.

April 6, 1977 - The Department issued WDL #W1284 to the Good Will Home Association for a five-year term.

March, 1978 – The EPA issued NPDES permit #ME0022659 to the Good Will Home Association for a five-year term.

July 13, 1983 – The Department issued WDL #1284 renewal to the Good Will Home Association for a five-year term.

June 6, 1990 - The Department issued WDL renewal #W001284-58-A-R to the Good Will Home Association for a five-year term.

September 17, 1996 – The Department issued WDL renewal #W001284-ZC-B-R to the Good Will Hinckley School for a ten-year term.

January 24, 2007 – The Good Will Hinckley School submitted a complete application to the Department to renew the WDL for its waste water treatment facility.

d. Source Description: The discharge is from a year-round boarding school complex for children with approximately 80 students and 100 staff. A total of 18 buildings including two dormitories, eight cottages, three single family dwellings, visitors center, library and recreation center are connected to the waste water collection and treatment system regulated by this permitting action. See Attachment A of this fact sheet for a layout of the school campus.

e. Wastewater Treatment: Residential like waste water generated at the school receives a secondary level of treatment via a series of two tanks and a sand filter bed treatment system. The wastewater is generated by the buildings cited above. The wastewater is conveyed to a sewer collection pipe system which terminates at two larger septic tanks west side of Rt. 201. The first 9,000-gallon septic tank stops and collects all solids. The second 9,000-gallon septic tank which is in series with the first is used to skim off any remaining smaller particles that may get by the first. The remaining gray water is then gravity fed to a wet well pump station. This pump station is located on the east side of Rt. 201. The pump station consists of a wet well with a volume of 2,000 gallons and two one horsepower sewer pumps. These two pumps are rated at 50 GPM at 45' head. At last calculation one pump was pumping at 40 gpm and the other at 45 gpm. The two pumps run simultaneously to feed two 88' X 100' for a total of 17,600 square feet sand filters. One sand filter receives a little more gray water than the other does over the coarse of a year. Secondary treated effluent from the two filter beds flows by gravity to a tablet chlorinator for seasonal disinfection. Final effluent is conveyed to the Kennebec River via a 6-inch diameter outfall pipe designated as Outfall #001 in this permitting action. The outfall pipe extends out into the receiving waters approximately 50 feet with approximately two feet of water over the crown of the pipe at summer low flow condition. See Attachment B of this Fact Sheet for a layout of the collection system and the locations of the septic tanks, pump station and sans filter beds.

2. PERMIT SUMMARY (cont'd)

f. Replacement Options: The GHS has submitted documentation with the 2/07 application indicating that replacement options are feasible at this location. The replacement system(s) would consist of 12 sub-surface systems (clustered on a 5-acre area just south of the existing sandfilter) at an estimated cost of $500,000. Department rule Chapter 596, *Overboard Discharges: Licensing and Abandonment*, Section 5(A)(2) state in part "...the Department may approve an overboard discharge only if all of the following criteria are met." ".. .a subsurface wastewater disposal system can be installed on land owned or controlled by the applicant and the applicant is eligible for grant funding pursuant to 38 M.R.S.A., §411-A but no funding is available." The Department has determined no funding is available for the replacement system(s) identified in the 1/24/07 application.

3. CONDITIONS OF PERMIT

Maine law, 38 M.R.S.A. Section 414-A, requires that the effluent limitations prescribed for discharges, including, but not limited to, effluent toxicity, require application of best practicable treatment (BPT), be consistent with the U.S. Clean Water Act, and ensure that the receiving waters attain the State water quality standards as described in Maine's Surface Water Classification System. In addition, 38 M.R.S.A., Section 420 and Department rule 06-096 CMR Chapter 530, *Surface Water Toxics Control Program,* require the regulation of toxic substances not to exceed levels set forth in Department rule 06-096 CMR Chapter 584, *Surface Water Quality Criteria for Toxic Pollutants*, and that ensure safe levels for the discharge of toxic pollutants such that existing and designated uses of surface waters are maintained and protected.

4. RECEIVING WATER QUALITY STANDARDS

Maine law, 38 M.R.S.A. §467(4)(A)(10) states that the Kennebec River from the Fairfield-Skowhegan boundary to its confluence with Messalonskee Stream, including all impoundments, is classified as a Class C waterbody. Maine law 38 M.R.S.A. §465(4) contains the classification standards for Class C waterbodies.

5. RECEIVING WATER QUALITY CONDITIONS

The State of Maine 2004 Integrated Water Quality Monitoring and Assessment Report, prepared by the Department pursuant to Sections 303(d) and 305(b) of the Federal Water Pollution Control Act, lists a 14.7-mile Class C reach of the Kennebec River, main stem, from the Fairfield-Skowhegan boundary to the confluence of the Sebasticook River in Winslow (Hydrologic Unit Code #ME0103000306 / Waterbody ID #339R) as, *"Category 4-B-1: Rivers and Streams Impaired by Pollutants – Pollution Control Requirements Reasonably Expected to Result in Attainment."* Impairment in this context refers to the designated use of fishing and a fish consumption advisory due to the presence of dioxin in fish tissues. The "pollution control reasonably expected to result in attainment" refers to the change in the bleaching technology installed in the mid-1990's at S.D. Warren's kraft pulp and paper mill located less than five miles upstream of the discharge from the GHS. It is noted a document entitled, Dioxin Monitoring Program, 2005 Final Report (April 2006) contains the following statements "... Results of the Above/Below (A/B) test had indicated by 2004 that there was no longer a discharge of dioxin from the NewPage mill in Rumford, the International Paper mill in Jay, the SAPPI-Somerset mill in Skowhegan, or the Georgia Pacific mill in Old Town." "Continued compliance in 2005 was demonstrated for the NewPage mill in Rumford (formerly MeadWestvaco), International Paper mill in Jay and SAPPI Somerset mill in Skowhegan by dioxin/furan certification of bleach plant operation and bleach plant effluent data."

5. RECEIVING WATER QUALITY CONDITIONS (cont'd)

The 305b Report lists all of Maine's fresh waters as, *"Category 4-B-3: Waters Impaired by Atmospheric Deposition of Mercury. Regional or National TMDL may be Required."* Impairment in this context refers to a statewide fish consumption advisory due to elevated levels of mercury in some fish tissues. Department rule Chapter 519, *Interim Effluent Limitations and Controls for the Discharge of Mercury*, establishes controls on the discharge of mercury to the surface waters of the State through interim effluent limits and implementation of pollution prevention plans. However, Section 1(A)(1) of the Chapter 519 rule states in part:

> "This rule applies to all persons licensed or permitted pursuant to 38 MRSA §413 to discharge pollutants to the surface waters of the State except as described below. For the purposes of this rule, the term licensee also means permittee.
>
> (1) Categorical exclusions. This rule does not apply to the following categories of licensees: combined sewer overflows, snow dumps, pesticide applications, and over board discharges licensed pursuant to 38 MRSA §413.[emphasis added] Except, however, specific members of these categories may be required by the department to comply with this rule on a case by case basis..."

The Department has no information at this time that the discharge from the GHS causes or contributes to the impairment status of the receiving waterbody.

6. EFFLUENT LIMITATIONS & MONITORING REQUIREMENTS

a. Best Practicable Treatment (BPT) - Overboard discharges may be permitted only where no technologically proven alternative exists. Overboard discharge treatment systems must be capable of meeting secondary treatment standards as described in CMR Chapter 525, Section 3 and Chapter 596 section 9, unless the Department finds that alternate limits are appropriate. After accepting a renewal application as complete for processing, the Department shall approve an overboard waste discharge license only if all of the following criteria are met.

(1) A publicly owned sewer line is not located on or abutting land owned or controlled by the applicant or is not available for the applicant's use.

(2) A subsurface wastewater disposal system cannot be installed in compliance with the Subsurface Rules, 10-144 CMR 241, on land owned or controlled by the applicant. Or, a subsurface wastewater disposal system can be installed on land owned or controlled by the applicant and the applicant is eligible for grant funding pursuant to 38 M.R.S.A § 411-A but no funding is available.

(3) The discharge is not located within the boundaries of a sanitary or sewer district and the district has not agreed to service and maintain a holding tank at an annual fee that does not exceed those fees charged to other similar users of the district's services who are physically connected to the sewers of the district.

6. EFFLUENT LIMITATIONS & MONITORING REQUIREMENTS (cont'd)

(4) For a school such as the GHS facility, the volume or quantity of waste water that is discharged does not exceed;

(a) the limit imposed by the previous license

(b) the actual or estimated flow at the time of current application if a license volume increase is necessary.

(5) The receiving water is not:

(a) A Class GPA, AA, A, or SA water;

(b) A tributary to Class GPA water; or

(c) A waterbody with a drainage area of less than 10 square miles,

(6) The discharge meets the requirements of *Maine's Pollution Control Laws* 38 M.R.S.A. §414-A, and Maine's *Water Classification Laws* 38 M.R.S.A. §§ 464 to 469.

(7) The discharge receives best practicable treatment consistent with requirements in Section 9 of Department rule Chapter 596.

b. Flow: The previous licensing action established a monthly average discharge flow limitation of 20,000 gallons per day (gpd) based on the design flow for the treatment system. The design flow is calculated using a sand filter bed loading factor of 1.05 gallons per day per square foot of filter bed and a total sand filter bed area of approximately 17,600 square feet.

Department rule, 06-096 CMR Chapter 523 Section 6(b)(1), specifies, *"effluent limitations, standards, or prohibitions shall be calculated based on design flow."* A review of the monthly discharge flow data as reported on the Discharge Monitoring Reports (DMRs) submitted to the Department for the period November 2001 – October 2006 indicates the monthly average flow has ranged from 1,840 gpd to 43,470 gpd with an arithmetic mean (n=60) of 15,860 GPD. This permitting action is carrying forward the monthly average discharge flow limit of 20,000 GPD, which is considered representative of the design flow for the facility, and is establishing a daily maximum discharge flow reporting requirement to assist in compliance evaluations.

6. EFFLUENT LIMITATIONS & MONITORING REQUIREMENTS (cont'd)

c. Dilution Factors - The Department has made the determination that the dilution factors associated with the discharge shall be calculated in accordance with freshwater protocols established in Department Regulation Chapter 530, *Surface Water Toxics Control Program*, October 2005. With a permit flow limit of 20,000 gpd (0.020 MGD) and the 7Q10 and 1Q10 low flow values for the Kennebec River, the dilution factors are:

Modified Acute: 1Q10 = 487 cfs[(1)] $\Rightarrow \frac{(487 \text{ cfs})(0.6464) + (0.020 \text{ MGD})}{(0.020 \text{ MGD})} = 15{,}741{:}1$

Acute: 1Q10 = 1,947 cfs $\Rightarrow \frac{(1{,}947 \text{ cfs})(0.6464) + (0.020 \text{ MGD})}{(0.020 \text{ MGD})} = 62{,}928{:}1$

Chronic: 7Q10 = 2,388 cfs $\Rightarrow \frac{(2{,}388 \text{ cfs})(0.6464) + (0.020 \text{ MGD})}{(0.020 \text{ MGD})} = 77{,}181{:}1$

Harmonic Mean: = 4,034 cfs[(2)] $\Rightarrow \frac{(4{,}034 \text{ cfs})(0.6464) + (0.020 \text{ MGD})}{(0.020 \text{ MGD})} = 130{,}380{:}1$

Footnotes:

(1) Chapter 530 (4)(B)(1) states that analyses using numeric acute criteria for aquatic life must be based on 1/4 of the 1Q10 stream design flow to prevent substantial acute toxicity within any mixing zone. The 1Q10 is the lowest one-day flow over a ten-year recurrence interval. The regulation goes on to say that where it can be demonstrated that a discharge achieves rapid and complete mixing with the receiving water by way of an efficient diffuser or other effective method, analyses may use a greater proportion of the stream design, up to including all of it. Based on information provided by the permittee as to the configuration and location of the outfall pipe the Department has made the determination that the discharge does not receive rapid and complete mixing with the receiving water, therefore the default stream flow of ¼ of the 1Q10 is applicable in acute statistical evaluations pursuant to Chapter 530

(2) The harmonic mean flow of the Kennebec River established in this permitting action is based on a 1/9/91 statistical evaluation developed by Walter M. Grayman, a consulting engineer for the US EPA 1990 Risk Assessment for Dioxin.

6. EFFLUENT LIMITATIONS & MONITORING REQUIREMENTS (cont'd)

d. Biochemical Oxygen Demand (BOD_5) and Total Suspended Solids (TSS): The previous licensing action established, and this permitting action is carrying forward, technology-based monthly average and daily maximum BOD_5 and TSS concentration limits of 30 mg/L and 50 mg/L, respectively. The monthly average concentration limit is based on secondary treatment requirements of the Clean Water Act of 1977 §301(b)(1)(B), as defined in Department rule, 06-096 CMR Chapter 525(3)(III). The daily maximum BOD_5 and TSS concentration limits of 50 mg/L were based on a Department best professional judgment (BPJ) of best practicable treatment (BPT). This permiting action is carrying forward both technology based concentration limitations. In addition, pursuant to Department rule, 06-096 CMR Chapter 525(3)(III), this permitting action is establishing a weekly average BPT concentration limit of 45 mg/L.

The previous licensing action did not establish mass limitations for BOD_5 and TSS. Department rule Chapter 523, *Waste Discharge License Conditions*, Section 6, *Calculating NPDES permit conditions*, sub-section f(1) states that, *"all pollutants limited in permits shall have limitations, standards or prohibitions expressed in terms of mass...."* Therefore, this permitting action is establishing monthly average, weekly average and daily maximum BOD_5 and TSS mass limitations based on calculations using the design flow for the facility of 20,000 gpd (0.020 MGD) and the applicable concentration limits as follows:

Monthly Average Mass Limit: (30 mg/L)(8.34 lbs./gallon)(0.020 MGD) = 5.0 lbs/day
Weekly Average Mass Limit: (45 mg/L)(8.34 lbs./day)(0.020 MGD) = 7.5 lbs/day
Daily Maximum Mass Limit: (50 mg/L)(8.34 lbs./day)(0.020MGD) = 8.3 lbs/day

The previous licensing action established a minimum monitoring frequency requirement of once every other month for BOD_5 and TSS. This permitting action is revising the minimum monitoring frequency requirement to once per month (1/Month) for BOD_5 and TSS based on a Department best professional judgment of a sample frequency that is adequate to determine on-going compliance with this permit.

This permitting action is also establishing a new requirement for a minimum of 85% removal of BOD5 and TSS pursuant to Chapter 525(3)(III)(a)(3) and (b)(3) of the Department's rules. The GHS waste water treatment system does not have an influent sampling location that is representative of raw waste water conditions. According to the USEPA's Onsite Wastewater Treatment Systems Manual, dated February 2002, table 3-7 entitled "*Constituent Mass Loadings and Concentrations in Typical Residential Wastewater*" a reasonable influent value for BOD5 and TSS may be assumed to be 286 mg/L. Therefore, this permitting action authorizes the permittee to assume an influent BOD5 and TSS concentration value of 286 mg/L for purposes of calculating the monthly percent removal value until such time that the infrastructure is modified or replaced such that collection of a representative raw influent sample is practical.

For BOD_5, a review of the monthly average effluent concentration data as reported on the Discharge Monitoring Reports (DMRs) submitted to the Department for the period November 2001 – October 2006 indicates the monthly average BOD_5 concentration discharged has ranged from 2 mg/L to 25 mg/L with an arithmetic mean (n=27) of 4.8 mg/L. The facility has been in compliance with the monthly average limitation of 30 mg/L 100% of the time during said reporting period. For TSS, a review of the

6. EFFLUENT LIMITATIONS & MONITORING REQUIREMENTS (cont'd)

monthly average effluent concentration data as reported on the DMRs submitted to the Department for the period November 2001 – October 2006 indicates the monthly average TSS concentration discharged has ranged from 1 mg/L to 41 mg/L with an arithmetic mean (n=30) of 6.5 mg/L. The facility has been in compliance with the monthly average limitation of 30 mg/L 90% of the time during said reporting period.

e. Settleable Solids: The previous licensing action did not establish any limits for settleable solids. The Department has since reconsidered its position on the imposition for settleable solids for OBD's and to be consistent with BPT limits established for all other MEPDES permits issued for like discharges, the Department has concluded that a daily maximum concentration limit of 0.3 ml/L is an appropriate BPT limitation. Therefore, this permitting action is establishing a daily maximum limit to 0.3 ml/L and establishing a 1/Month monitoring requirement consistent with the frequency for BOD and TSS.

f. *Escherichia coli* Bacteria: The pervious licensing action established year-round monthly average and daily maximum concentration limits for *E. coli* bacteria of 142 colonies/100 ml (geometric mean) and 949 colonies/100 ml (instantaneous level), respectively, which were based on the State of Maine Water Classification Program criteria for Class C waters found at 38 M.R.S.A. §465(4)(B), and a minimum monitoring frequency requirements of once every other month. These limitations are being carried forward in this permitting action with a once per month (1/Month) based on Department best professional judgment of a sample frequency that is adequate to determine on-going compliance with this permit. The bacteria limitations established in this permitting action are being reduced from year-round to seasonal and apply between May 15 and September 30 of each year to be consistent with the time frame established in Maine law, 38 M.R.S.A., §465(C). Although *E. coli* bacteria limits are seasonal, the Department reserves the right to impose year-round bacteria limits if deemed necessary to protect the health, safety and welfare of the public.

A review of the monthly average and daily maximum data as reported on the DMRs submitted to the Department for the period November 2001 – October 2006 indicates the monthly (geometric mean) and daily maximum *E. coli* bacteria discharged has ranged from 0 colonies/100 ml to 8,100 colonies/100 ml. The DMR indicates the facility has been in compliance with the geometric mean limitation 84% of the time and in compliance with the daily maximum limitation 90% of the time during said reporting period. The data indicates violations consistently occur in the spring of the year.

6. EFFLUENT LIMITATIONS & MONITORING REQUIREMENTS (cont'd)

g. Total Residual Chlorine (TRC): The previous licensing action established a daily maximum technology based concentration limit of 1.0 mg/L for TRC. Limitations on TRC are specified to ensure that ambient water quality standards are maintained and that BPT technology is being applied to the discharge. Department permitting actions impose the more stringent of either a water quality-based or BPT-based limit. With dilution factors as determined above, end-of-pipe (EOP) water quality-based concentration thresholds for TRC may be calculated as follows:

Acute (A) Criterion	Chronic (C) Criterion	A & C Dilution Factors	Calculated Acute Threshold	Calculated Chronic Threshold
0.019 mg/L	0.011 mg/L	15,741:1 (A) 77,181 :1 (C)	299 mg/L	849 mg/L

The Department has established a daily maximum BPT limitation of 1.0 mg/L for facilities that disinfect their effluent with elemental chlorine or chlorine-based compounds. For facilities that dechlorinate the discharge in order to meet water quality based thresholds, the Department has established daily maximum and monthly average BPT limits of 0.3 mg/L and 0.1 mg/L, respectively. The GHS does not have to dechlorinate the effluent to achieve compliance with water quality-based limitations.

The daily maximum technology-based effluent TRC concentration limitation of 1.0 mg/L is more stringent than either calculated water quality-based threshold above and is therefore being carried forward in this permitting action. This permitting action is also carrying forward the monitoring frequency of 3/Week as established in the previous licensing action.

A review of the daily maximum data as reported on the DMRs submitted to the Department for the period November 2001 – October 2006 indicates the maximum TRC discharged has ranged from 0.08 mg/L to 0.7 mg/L with an arithmetic mean (n=25) of 0.35 mg/L. The DMR data indicates the facility would have been in compliance with the daily maximum limitation 100% of the time during said reporting period.

h. pH: The previous licensing action established a pH range limit of 6.0 – 8.5 standard units (SU), considered by the Department at the time, as BPT for secondary treated waste water, but did not establish any monitoring frequency requirements. Pursuant to Department rule found at Chapter 525(3)(III)(c), (promulgated subsequent to issuance of the previous licensing action) the pH range limitation is being revised to 6.0 – 9.0 SU, which is considered BPT for secondary treated wastewater. This permitting action is not establishing a regular monitoring frequency to determine compliance but the limitations are in effect and enforceable at all times.

6. EFFLUENT LIMITATIONS & MONITORING REQUIREMENTS (cont'd)

i. Whole Effluent Toxicity (WET), Priority Pollutant, and Analytical Chemistry Testing: Maine law, 38 M.R.S.A., §414-A and §420, prohibit the discharge of effluents containing substances in amounts that would cause the surface waters of the State to contain toxic substances above levels set forth in Federal Water Quality Criteria as established by the USEPA. Department rule, 06-096 CMR Chapter 530, *Surface Water Toxics Control Program* (toxics rule) sets forth effluent monitoring requirements and procedures to establish safe levels for the discharge of toxic pollutants such that existing and designated uses of surface waters are maintained and protected and narrative and numeric water quality criteria are met. Department rule 06-096 CMR Chapter 584, Surface *Water Quality Criteria for Toxic Pollutants*, sets forth ambient water quality criteria (AWQC) for toxic pollutants and procedures necessary to control levels of toxic pollutants in surface waters.

Chapter 530 Section (2)(A) specifies the dischargers subject to the rule as, *"all licensed dischargers of industrial process wastewater or domestic wastes discharging to surface waters of the State must meet the testing requirements of this section. Dischargers of other types of wastewater are subject to this subsection when and if the Department determines that toxicity of effluents may have reasonable potential to cause or contribute to exceedences of narrative or numerical water quality criteria."*

Chapter 530 Section 2.A specifies the criteria for exemption of certain discharges from toxics testing as follows:

(1) Discharges from individual discharge points licensed to discharge less than 50,000 gallons per day of solely domestic wastewater and with a chronic dilution factor of at least 50 to 1, provided no holding tank wastes containing chemicals are accepted by the facility;

(2) Discharges from residential overboard discharge systems; or

(3) Discharges from combined sewer overflow discharge points, provided the owner of the sewerage system is conducting or participating in a discharge abatement program.

The GHS facility is exempt from the Chapter 530 requirements as it permitted to discharge less than 50,000 gpd, the chronic dilution factor is greater than 50:1 and the waste water has domestic-like characteristics. However, should there be a substantial change in the characteristics of the discharge in the future, the Department may reopen this permit pursuant to Special Condition K, *Reopening of Permit for Modifications*, to incorporate the applicable whole effluent toxicity (WET), priority pollutant or analytical testing requirements cited above.

7. DISCHARGE IMPACT ON RECEIVING WATER QUALITY

As permitted, the Department has determined the existing water uses will be maintained and protected, and that the discharge as permitted will not cause or contribute to the failure of the water body to meet standards for Class C waters.

8. PUBLIC COMMENTS

Public notice of this application was made in a local newspaper on or about January 22, 2007. The Department receives public comments on an application until the date a final agency action is taken on the application. Those persons receiving copies of draft permits shall have at least 30 days in which to submit comments on the draft or to request a public hearing, pursuant to Chapter 522 of the Department's rules.

9. DEPARTMENT CONTACTS

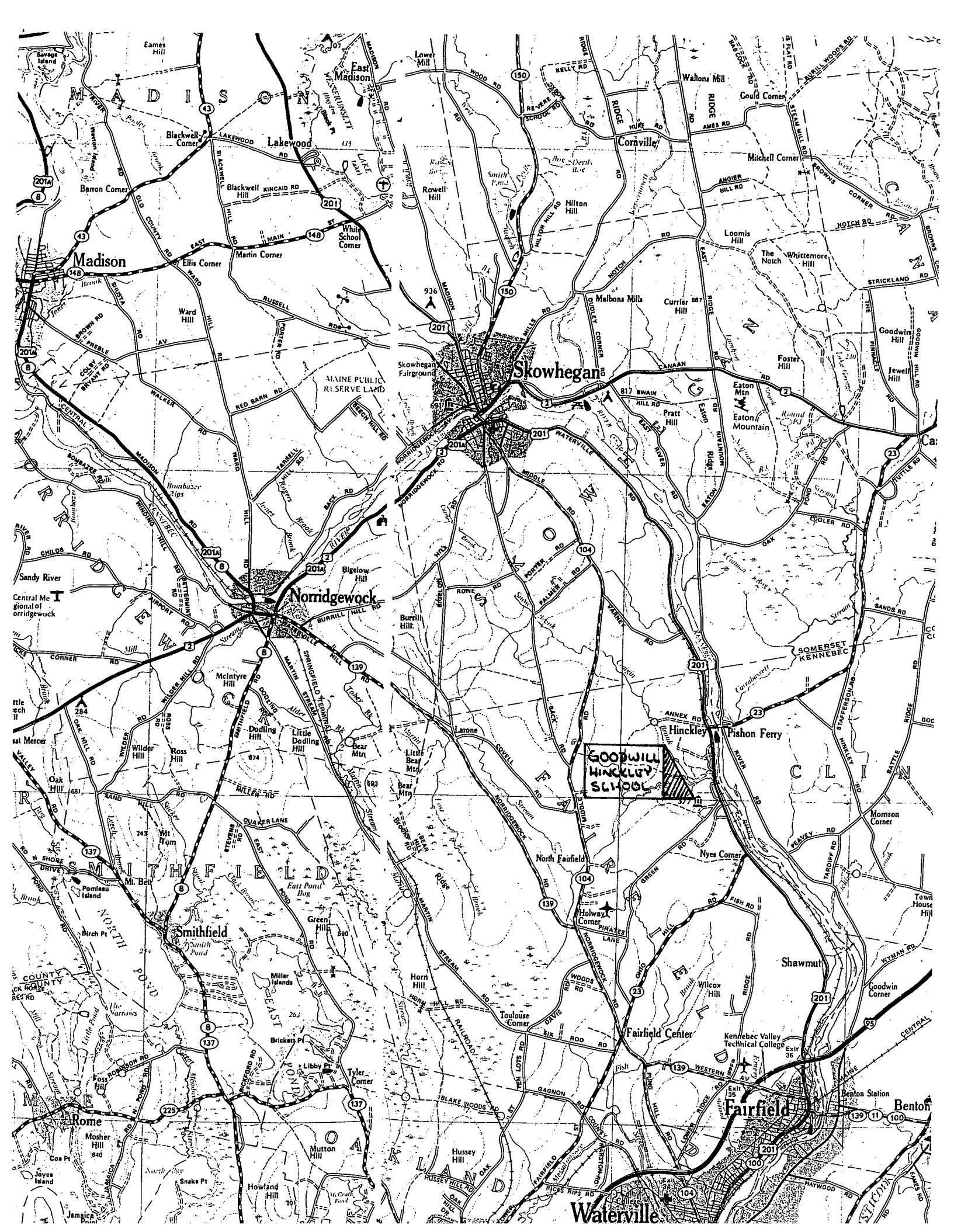
Additional information concerning this permitting action may be obtained from, and written comments sent to:

Gregg Wood
Division of Water Quality Management
Bureau of Land & Water Quality
Department of Environmental Protection
17 State House Station
Augusta, Maine 04333-0017 Telephone: (207) 287-6301
e-mail: gregg.wood@maine.gov

10. RESPONSE TO COMMENTS

During the period of March 21, 2007, through the issuance date of the permit/license, the Department solicited comments on the proposed draft permit/license to be issued for the discharge(s) from the GHS waste water treatment facility. The Department did not receive comments from the permittee, state or federal agencies or interested parties that resulted in any substantive change(s) in the terms and conditions of the permit. Therefore, the Department has not prepared a Response to Comments.

ATTACHMENT A


Madison
Skowhegan
Norridgewock
Smithfield
Fairfield
Waterville
Hinckley
Pishon Ferry
GOODWILL HINCKLEY SCHOOL
Fairfield Center
Kennebec Valley Technical College
Benton
Benton Station
Shawmut
Cornville
Mitchell Corner
Loomis Hill
Foster Hill
Eaton Mountain
Pratt Hill
Malbons Mills
Currier Hill
Goodwin Hill
Jewell Hill
Whittemore Hill
The Notch
Walton Mill
Gould Corner
Rowell Hill
Hilton Hill
Lower Mill
East Madison
Lakewood
Blackwell Corner
Barron Corner
Blackwell Hill
White School Corner
Martin Corner
Ellis Corner
Ward Hill
Eames Hill
Savage Island
Skowhegan Fairground
MAINE PUBLIC RESERVE LAND
Sandy River
Central Maine Regional of orridgewock
Bigelow Hill
Burrill Hill
McIntyre Hill
Dodling Hill
Little Dodling Hill
Bear Mtn
Wilder Hill
Ross Hill
Oak Hill
Mt. Bell
Pomeau Island
Green Hill
Miller Islands
Brickett Pt
Libby Pt
Tyler Corner
Rome
Mosher Hill
Mutton Hill
Howland Hill
Hussey Hill
Joyce Island
Jamaica Pond
Snake Pt
Cox Pt
Larone
Little Bear Mtn
North Fairfield
Holway Corner
Horn Hill
Toulouse Corner
Wilcox Hill
Goodwin Corner
Nyes Corner
Morrison Corner
Town House Hill
Eaton Mtn
Ridge
Mountain
Somerset
Kennebec
Canaan
Waterville
Fairfield
Benton
Madison
Norridgewock
Smithfield
Skowhegan
Lakewood
Lake
Pond
River
Stream
Brook
Hill
Ridge
Corner
Mills
Falls
Rapids
Bridge
Valley
Mountain
Creek
Run
Swamp
Meadow
Woods
Road
Drive
Lane
Avenue
Street
Turnpike
Railroad
Airport
Cemetery
Church
School
Library
Post Office
Town Hall
Fire Station
Police Station
Hospital
Golf Course
Campground
Picnic Area
Boat Launch
Dam
Bridge
Tunnel
Overpass
Underpass
Interchange
Exit
Entrance
Toll Booth
Weigh Station
Rest Area
Scenic Overlook
Historic Site
Monument
Memorial
Park
Forest
Wilderness
Wildlife Management Area
Conservation Area
Recreation Area
Trail
Path
Boardwalk
Footbridge
Causeway
Levee
Dike
Jetty
Breakwater
Seawall
Pier
Wharf
Dock
Marina
Boathouse
Lighthouse
Beacon
Buoy
Channel
Harbor
Bay
Cove
Inlet
Outlet
Estuary
Delta
Island
Peninsula
Isthmus
Cape
Point
Ledge
Reef
Shoal
Sandbar
Beach
Dune
Cliff
Bluff
Gorge
Canyon
Ravine
Valley
Basin
Plateau
Mesa
Butte
Volcano
Crater
Lava Flow
Geyser
Hot Spring
Cave
Sinkhole
Karst
Aquifer
Groundwater
Surface Water
Watershed
Drainage Basin
Divide
Continental Divide
Great Divide
Basin
Range
Mountain Range
Foothills
Alpine
Tundra
Glacier
Moraine
Kame
Esker
Drumlin
Erratic
Cirque
Arete
Horn
Col
Saddle
Pass
Notch
Gap
Summit
Peak
Mountain
Hill
Knoll
Mound
Butte
Mesa
Plateau
Escarpment
Cuesta
Hogback
Flatiron
Inselberg
Tor
Monadnock
Kopje
Volcano
Caldera
Crater
Lava Dome
Lava Tube
Pahoehoe
Aa
Pillow Lava
Obsidian
Pumice
Ash
Tuff
Breccia
Conglomerate
Sandstone
Shale
Limestone
Dolomite
Chalk
Coal
Oil
Gas
Petroleum
Natural Gas
Fossil Fuel
Renewable Energy
Solar
Wind
Hydroelectric
Geothermal
Biomass
Nuclear
Coal-fired
Oil-fired
Gas-fired
Power Plant
Transmission Line
Substation
Transformer
Generator
Turbine
Boiler
Condenser
Cooling Tower
Reactor
Fuel Rod
Control Rod
Containment
Spent Fuel
Waste
Radioactive
Decay
Half-life
Isotope
Element
Atom
Nucleus
Proton
Neutron
Electron
Quark
Lepton
Boson
Fermion
Antimatter
Dark Matter
Dark Energy
Universe
Galaxy
Milky Way
Andromeda
Triangulum
Whirlpool
Sombrero
Centaurus A
Messier
NGC
IC
Caldwell
Herschel
Star
Sun
Solar System
Mercury
Venus
Earth
Mars
Jupiter
Saturn
Uranus
Neptune
Pluto
Moon
Asteroid
Comet
Meteor
Meteorite
Meteoroid
Kuiper Belt
Oort Cloud
Heliosphere
Magnetosphere
Ionosphere
Troposphere
Stratosphere
Mesosphere
Thermosphere
Exosphere
Atmosphere
Weather
Climate
Temperature
Pressure
Humidity
Precipitation
Rain
Snow
Sleet
Hail
Fog
Mist
Dew
Frost
Cloud
Cumulus
Stratus
Cirrus
Nimbus
Thunderstorm
Lightning
Tornado
Hurricane
Typhoon
Cyclone
Anticyclone
Front
Cold Front
Warm Front
Occluded Front
Stationary Front
Jet Stream
Trade Winds
Westerlies
Polar Easterlies
Monsoon
El Niño
La Niña
Greenhouse Effect
Global Warming
Climate Change
Ozone Layer
Ozone Hole
Pollution
Smog
Acid Rain
Deforestation
Desertification
Erosion
Sedimentation
Soil
Topsoil
Subsoil
Bedrock
Fault
Earthquake
Seismic
Epicenter
Focus
Richter Scale
Mercalli Scale
Tsunami
Volcano
Eruption
Lava
Magma
Ash
Pyroclastic Flow
Lahar
Caldera
Crater
Fumarole
Hot Spring
Geyser
Mud Pot
Steam Vent
Geothermal
Plate Tectonics
Continental Drift
Pangaea
Gondwana
Laurasia
Rodinia
Supercontinent
Ocean Floor
Mid-Ocean Ridge
Trench
Subduction
Convergent
Divergent
Transform
Hotspot
Island Arc
Back-arc Basin
Forearc
Accretionary Wedge
Ophiolite
Mantle
Core
Crust
Lithosphere
Asthenosphere
Mesosphere
Outer Core
Inner Core
Seismic Wave
P-wave
S-wave
Surface Wave
Love Wave
Rayleigh Wave
Seismograph
Seismometer
Accelerometer
Tiltmeter
GPS
Satellite
Orbit
Geostationary
Polar Orbit
Sun-synchronous
Remote Sensing
Lidar
Radar
Sonar
Echo Sounder
Bathymetry
Topography
Contour
Elevation
Datum
Projection
Mercator
Transverse Mercator
Lambert Conformal Conic
Albers Equal Area
Universal Transverse Mercator
State Plane
Geographic Coordinate System
Latitude
Longitude
Prime Meridian
Equator
Tropic of Cancer
Tropic of Capricorn
Arctic Circle
Antarctic Circle
Time Zone
Daylight Saving Time
Standard Time
Coordinated Universal Time
Greenwich Mean Time
International Date Line
Nautical Mile
Knot
Fathom
Chart
Nautical Chart
Aeronautical Chart
Sectional Chart
Terminal Area Chart
Instrument Approach
Visual Approach
Runway
Taxiway
Apron
Hangar
Control Tower
Air Traffic Control
Navigation
Compass
Gyroscope
Inertial Navigation
Autopilot
Flight Plan
Flight Level
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Airspeed
Ground Speed
Mach
Lift
Drag
Thrust
Weight
Aerodynamics
Airfoil
Wing
Fuselage
Tail
Rudder
Elevator
Aileron
Flap
Slat
Spoiler
Landing Gear
Propeller
Jet Engine
Turbofan
Turbojet
Turboprop
Ramjet
Scramjet
Rocket
Spacecraft
Launch Vehicle
Payload
Fairing
Stage
Booster
Upper Stage
Orbital Insertion
Reentry
Heat Shield
Parachute
Capsule
Module
Space Station
International Space Station
Mir
Skylab
Tiangong
Spacesuit
Extravehicular Activity
Microgravity
Zero Gravity
Life Support
Environmental Control
Thermal Control
Radiation Shielding
Micrometeoroid
Orbital Debris
Kessler Syndrome
Space Weather
Solar Flare
Coronal Mass Ejection
Solar Wind
Van Allen Belt
Magnetic Field
Aurora
Auroral Oval
Geomagnetic Storm
Kp Index
Dst Index
Ap Index
F10.7
Sunspot
Solar Cycle
Maunder Minimum
Dalton Minimum
Little Ice Age
Medieval Warm Period
Holocene
Pleistocene
Pliocene
Miocene
Oligocene
Eocene
Paleocene
Cretaceous
Jurassic
Triassic
Permian
Carboniferous
Devonian
Silurian
Ordovician
Cambrian
Precambrian
Proterozoic
Archean
Hadean
Geologic Time Scale
Era
Period
Epoch
Age
Eon
Fossil
Trilobite
Ammonite
Dinosaur
Mammal
Bird
Reptile
Amphibian
Fish
Invertebrate
Vertebrate
Plant
Tree
Flower
Fern
Moss
Algae
Bacteria
Virus
Archaea
Eukaryote
Prokaryote
Cell
Nucleus
Mitochondria
Chloroplast
Ribosome
DNA
RNA
Protein
Gene
Chromosome
Genome
Mutation
Evolution
Natural Selection
Adaptation
Speciation
Extinction
Biodiversity
Ecosystem
Biome
Habitat
Niche
Food Web
Food Chain
Trophic Level
Producer
Consumer
Decomposer
Predator
Prey
Symbiosis
Mutualism
Commensalism
Parasitism
Competition
Carrying Capacity
Population
Community
Ecology
Conservation
Endangered Species
Threatened Species
Extinct
Habitat Loss
Fragmentation
Invasive Species
Overexploitation
Pollution
Climate Change
Sustainability
Resource
Renewable
Nonrenewable
Recycling
Waste Management
Landfill
Incinerator
Composting
Wastewater Treatment
Drinking Water
Groundwater
Surface Water
Watershed
Aquifer
Well
Reservoir
Dam
Levee
Flood
Drought
Water Cycle
Evaporation
Transpiration
Condensation
Precipitation
Infiltration
Runoff
Groundwater Recharge
Groundwater Discharge
Water Table
Porosity
Permeability
Hydraulic Conductivity
Darcy's Law
Groundwater Flow
Contaminant Transport
Remediation
Superfund
Brownfield
Hazardous Waste
Toxic
Carcinogen
Mutagen
Teratogen
Endocrine Disruptor
Persistent Organic Pollutant
Heavy Metal
Lead
Mercury
Arsenic
Cadmium
Chromium
Asbestos
Radon
Pesticide
Herbicide
Insecticide
Fungicide
Rodenticide
Fertilizer
Nitrogen
Phosphorus
Potassium
Eutrophication
Algal Bloom
Dead Zone
Hypoxia
Anoxia
Oxygen
Carbon Dioxide
Methane
Nitrous Oxide
Greenhouse Gas
Carbon Cycle
Nitrogen Cycle
Phosphorus Cycle
Sulfur Cycle
Biogeochemical Cycle
Primary Production
Photosynthesis
Respiration
Fermentation
Decomposition
Nutrient
Limiting Factor
Liebig's Law
Shelford's Law
Succession
Primary Succession
Secondary Succession
Climax Community
Disturbance
Fire
Wildfire
Prescribed Burn
Logging
Clear-cut
Selective Cut
Reforestation
Afforestation
Agroforestry
Silviculture
Forestry
Timber
Pulpwood
Lumber
Sawmill
Paper Mill
Pulp
Cellulose
Lignin
Wood
Bark
Leaf
Root
Stem
Trunk
Branch
Twig
Bud
Flower
Fruit
Seed
Pollen
Pollination
Fertilization
Germination
Seedling
Sapling
Mature Tree
Old Growth
Canopy
Understory
Forest Floor
Litter
Humus
Soil Horizon
O Horizon
A Horizon
B Horizon
C Horizon
Parent Material
Soil Profile
Soil Texture
Sand
Silt
Clay
Loam
Soil Structure
Soil Color
Soil pH
Soil Organic Matter
Soil Fauna
Earthworm
Nematode
Arthropod
Insect
Spider
Mite
Collembola
Protozoa
Fungi
Mycorrhiza
Lichen
Moss
Liverwort
Hornwort
Vascular Plant
Gymnosperm
Angiosperm
Monocot
Dicot
Conifer
Deciduous
Evergreen
Broadleaf
Needleleaf
Shrub
Herb
Grass
Sedge
Rush
Wetland
Marsh
Swamp
Bog
Fen
Peatland
Peat
Tundra
Permafrost
Taiga
Boreal Forest
Temperate Forest
Temperate Rainforest
Tropical Rainforest
Tropical Dry Forest
Savanna
Grassland
Prairie
Steppe
Desert
Hot Desert
Cold Desert
Semi-arid
Arid
Mediterranean
Chaparral
Scrub
Thicket
Hedgerow
Riparian
Floodplain
Delta
Estuary
Salt Marsh
Mangrove
Seagrass
Kelp Forest
Coral Reef
Coral
Polyp
Zooxanthellae
Bleaching
Ocean Acidification
Ocean Warming
Sea Level Rise
Coastal Erosion
Beach Nourishment
Seawall
Groin
Jetty
Breakwater
Revetment
Gabion
Riprap
Levee
Dike
Floodwall
Storm Surge
Tide
Spring Tide
Neap Tide
Tidal Range
Tidal Flat
Tidal Marsh
Tidal Creek
Tidal Inlet
Barrier Island
Barrier Beach
Spit
Tombolo
Lagoon
Salt Pond
Salt Pan
Evaporite
Halite
Gypsum
Anhydrite
Potash
Trona
Borax
Sulfur
Phosphate
Nitrate
Guano
Coprolite
Fossil Fuel
Coal
Oil
Natural Gas
Oil Shale
Tar Sands
Heavy Oil
Light Oil
Crude Oil
Refinery
Petrochemical
Plastic
Polymer
Monomer
Ethylene
Propylene
Benzene
Toluene
Xylene
Styrene
Vinyl Chloride
Polyethylene
Polypropylene
Polystyrene
PVC
PET
Nylon
Rayon
Cotton
Wool
Silk
Linen
Hemp
Jute
Flax
Textile
Fiber
Yarn
Thread
Fabric
Weave
Knit
Dye
Pigment
Ink
Paint
Varnish
Lacquer
Solvent
Adhesive
Glue
Resin
Epoxy
Polyurethane
Silicone
Rubber
Latex
Synthetic Rubber
Tire
Tread
Sidewall
Inner Tube
Valve
Rim
Wheel
Axle
Bearing
Gear
Transmission
Clutch
Brake
Suspension
Shock Absorber
Spring
Leaf Spring
Coil Spring
Torsion Bar
Air Suspension
Steering
Steering Wheel
Steering Column
Rack and Pinion
Power Steering
Alignment
Camber
Caster
Toe
Wheel Balancing
Tire Pressure
Tire Rotation
Tire Replacement
Tire Repair
Tire Recycling
Tire Disposal
Tire Fire
Tire Derived Fuel
Tire Shred
Tire Crumb
Rubber Mulch
Rubber Asphalt
Rubberized Asphalt
Asphalt
Bitumen
Tar
Pitch
Creosote
Coal Tar
Coal Tar Pitch
Coke
Coal Gasification
Coal Liquefaction
Fischer-Tropsch
Synthetic Fuel
Biofuel
Ethanol
Biodiesel
Methanol
Butanol
Hydrogen
Fuel Cell
Battery
Lithium-ion
Lead-acid
Nickel-metal Hydride
Supercapacitor
Flywheel
Compressed Air
Pumped Storage
Hydroelectric
Tidal Power
Wave Power
Ocean Thermal Energy Conversion
Osmotic Power
Salinity Gradient
Geothermal
Hot Dry Rock
Enhanced Geothermal System
Binary Cycle
Flash Steam
Dry Steam
Heat Pump
Ground Source Heat Pump
Air Source Heat Pump
Water Source Heat Pump
Absorption Chiller
Cogeneration
Combined Heat and Power
District Heating
District Cooling
Microgrid
Smart Grid
Demand Response
Load Shedding
Peak Shaving
Base Load
Intermittent
Capacity Factor
Net Metering
Feed-in Tariff
Renewable Portfolio Standard
Carbon Tax
Cap and Trade
Carbon Offset
Carbon Footprint
Life Cycle Assessment
Environmental Impact Assessment
Environmental Impact Statement
Environmental Audit
Environmental Management System
ISO 14001
Green Building
LEED
BREEAM
Passive House
Net Zero Energy
Net Zero Water
Living Building
Biophilic Design
Daylighting
Natural Ventilation
Thermal Mass
Insulation
R-value
U-value
Vapor Barrier
Air Barrier
Weatherization
Energy Audit
Blower Door Test
Infrared Thermography
Energy Star
Appliance Efficiency
Lighting Efficiency
LED
Compact Fluorescent
Incandescent
Halogen
Fluorescent
High-intensity Discharge
Sodium Vapor
Metal Halide
Mercury Vapor
Ballast
Dimmer
Occupancy Sensor
Daylight Sensor
Smart Thermostat
Programmable Thermostat
Setback
Setpoint
Deadband
Hysteresis
Proportional-Integral-Derivative
Control System
Building Automation System
Energy Management System
Supervisory Control and Data Acquisition
Programmable Logic Controller
Human-Machine Interface
Sensor
Actuator
Transducer
Thermocouple
Thermistor
Resistance Temperature Detector
Pressure Transducer
Flow Meter
Level Sensor
Gas Detector
Smoke Detector
Carbon Monoxide Detector
Fire Alarm
Sprinkler System
Fire Suppression
Clean Agent
Halon
FM-200
Novec 1230
Inergen
Carbon Dioxide Suppression
Water Mist
Foam
Dry Chemical
Wet Chemical
Class A Fire
Class B Fire
Class C Fire
Class D Fire
Class K Fire
Fire Extinguisher
Fire Hose
Fire Hydrant
Standpipe
Fire Department Connection
Emergency Lighting
Exit Sign
Egress
Evacuation
Assembly Point
Muster Point
Fire Drill
Emergency Plan
Incident Command System
Hazmat
Hazardous Material
Material Safety Data Sheet
Globally Harmonized System
Personal Protective Equipment
Respirator
Self-contained Breathing Apparatus
Air-purifying Respirator
Powered Air-purifying Respirator
Supplied-air Respirator
Escape Respirator
Filter
Cartridge
Canister
Particulate Filter
Gas Filter
Combination Filter
Fit Test
Qualitative Fit Test
Quantitative Fit Test
Seal Check
Facepiece
Half Mask
Full Face
Hood
Helmet
Eye Protection
Safety Glasses
Goggles
Face Shield
Hearing Protection
Earplug
Earmuff
Hard Hat
Safety Shoes
Steel Toe
Protective Clothing
Coverall
Apron
Gloves
Nitrile
Latex
Neoprene
Butyl
Viton
Chemical Resistance
Permeation
Degradation
Breakthrough Time
Glove Thickness
Glove Size
Glove Donning
Glove Doffing
Contamination
Decontamination
Shower
Eyewash
Emergency Shower
Emergency Eyewash
First Aid
CPR
Automated External Defibrillator
Trauma
Bleeding Control
Tourniquet
Hemostatic Agent
Wound Dressing
Splint
Spinal Immobilization
Shock
Hypothermia
Hyperthermia
Heat Stroke
Heat Exhaustion
Heat Cramps
Dehydration
Electrolyte
Sodium
Potassium
Chloride
Calcium
Magnesium
Bicarbonate
Phosphate
Glucose
Insulin
Diabetes
Hypoglycemia
Hyperglycemia
Seizure
Epilepsy
Stroke
Heart Attack
Myocardial Infarction
Angina
Arrhythmia
Atrial Fibrillation
Ventricular Fibrillation
Asystole
Pulseless Electrical Activity
Blood Pressure
Hypertension
Hypotension
Blood
Red Blood Cell
White Blood Cell
Platelet
Plasma
Hemoglobin
Hematocrit
Anemia
Leukemia
Lymphoma
Cancer
Tumor
Benign
Malignant
Metastasis
Chemotherapy
Radiation Therapy
Surgery
Biopsy
Diagnosis
Prognosis
Epidemiology
Incidence
Prevalence
Mortality
Morbidity
Risk Factor
Cohort Study
Case-control Study
Randomized Controlled Trial
Meta-analysis
Systematic Review
Evidence-based Medicine
Public Health
Vaccination
Immunization
Herd Immunity
Outbreak
Epidemic
Pandemic
Endemic
Quarantine
Isolation
Contact Tracing
Surveillance
Reportable Disease
Notifiable Disease
Infectious Disease
Bacterial Infection
Viral Infection
Fungal Infection
Parasitic Infection
Antibiotic
Antiviral
Antifungal
Antiparasitic
Antimicrobial Resistance
Sepsis
Septic Shock
Inflammation
Immune System
Innate Immunity
Adaptive Immunity
Antibody
Antigen
T Cell
B Cell
Natural Killer Cell
Macrophage
Neutrophil
Eosinophil
Basophil
Monocyte
Dendritic Cell
Cytokine
Interferon
Interleukin
Tumor Necrosis Factor
Complement System
Autoimmune Disease
Allergy
Anaphylaxis
Asthma
Eczema
Dermatitis
Hives
Urticaria
Angioedema
Histamine
Antihistamine
Epinephrine
Corticosteroid
Immunosuppressant
Transplant
Organ Donation
Tissue Donation
Blood Donation
Blood Type
ABO System
Rh Factor
Crossmatch
Graft Rejection
Graft-versus-host Disease
Stem Cell
Bone Marrow
Umbilical Cord Blood
Gene Therapy
Genetic Engineering
Recombinant DNA
Plasmid
Vector
Restriction Enzyme
Polymerase Chain Reaction
Gel Electrophoresis
Southern Blot
Northern Blot
Western Blot
ELISA
Flow Cytometry
Microscopy
Light Microscope
Electron Microscope
Scanning Electron Microscope
Transmission Electron Microscope
Confocal Microscope
Fluorescence Microscope
Phase Contrast Microscope
Differential Interference Contrast Microscope
Dark Field Microscope
Bright Field Microscope
Staining
Gram Stain
Acid-fast Stain
Hematoxylin and Eosin Stain
Immunohistochemistry
In Situ Hybridization
Karyotype
Chromosome Analysis
Genetic Counseling
Genetic Disorder
Chromosomal Disorder
Down Syndrome
Turner Syndrome
Klinefelter Syndrome
Trisomy
Monosomy
Translocation
Deletion
Duplication
Inversion
Point Mutation
Frameshift Mutation
Silent Mutation
Missense Mutation
Nonsense Mutation
Single Nucleotide Polymorphism
Copy Number Variation
Epigenetics
DNA Methylation
Histone Modification
Chromatin
Heterochromatin
Euchromatin
Transcription
Translation
Codon
Anticodon
Amino Acid
Peptide
Polypeptide
Protein Folding
Chaperone
Enzyme
Substrate
Active Site
Allosteric Site
Inhibitor
Competitive Inhibition
Noncompetitive Inhibition
Uncompetitive Inhibition
Michaelis-Menten Kinetics
Lineweaver-Burk Plot
Catalase
Peroxidase
Oxidase
Dehydrogenase
Kinase
Phosphatase
Protease
Nuclease
Ligase
Polymerase
Helicase
Topoisomerase
Restriction Endonuclease
Reverse Transcriptase
Telomerase
Telomere
Centromere
Kinetochore
Spindle
Mitosis
Meiosis
Cell Cycle
Interphase
Prophase
Metaphase
Anaphase
Telophase
Cytokinesis
Cell Division
Cell Death
Apoptosis
Necrosis
Autophagy
Senescence
Cancer Cell
Oncogene
Tumor Suppressor Gene
p53
Retinoblastoma Protein
Cyclin
Cyclin-dependent Kinase
Checkpoint
DNA Damage
DNA Repair
Base Excision Repair
Nucleotide Excision Repair
Mismatch Repair
Double-strand Break Repair
Homologous Recombination
Non-homologous End Joining
Transposon
Retrotransposon
Viral Genome
Prion
Viroid
Satellite Virus
Bacteriophage
Lysogenic Cycle
Lytic Cycle
Capsid
Envelope
Spike Protein
Receptor
Host Cell
Viral Replication
Viral Assembly
Viral Release
Antiviral Drug
Vaccine
Live Attenuated Vaccine
Inactivated Vaccine
Subunit Vaccine
Conjugate Vaccine
Toxoid Vaccine
mRNA Vaccine
Viral Vector Vaccine
DNA Vaccine
Adjuvant
Booster
Immunization Schedule
Cold Chain
Vaccine Hesitancy
Herd Immunity Threshold
Basic Reproduction Number
Effective Reproduction Number
Case Fatality Rate
Infection Fatality Rate
Attack Rate
Secondary Attack Rate
Serial Interval
Generation Time
Incubation Period
Latent Period
Infectious Period
Symptomatic
Asymptomatic
Presymptomatic
Fomite
Droplet
Aerosol
Airborne
Droplet Precautions
Contact Precautions
Airborne Precautions
Standard Precautions
Personal Protective Equipment
Hand Hygiene
Alcohol-based Hand Rub
Soap and Water
Surface Disinfection
Sterilization
Autoclave
Steam Sterilization
Ethylene Oxide Sterilization
Hydrogen Peroxide Sterilization
Plasma Sterilization
Dry Heat Sterilization
Chemical Sterilization
Disinfection
High-level Disinfection
Intermediate-level Disinfection
Low-level Disinfection
Sporicidal
Tuberculocidal
Virucidal
Fungicidal
Bactericidal
Bacteriostatic
Minimum Inhibitory Concentration
Minimum Bactericidal Concentration
Antibiotic Susceptibility Testing
Disk Diffusion
Broth Dilution
Agar Dilution
Etest
Antibiotic Resistance Gene
Beta-lactamase
Extended-spectrum Beta-lactamase
Carbapenemase
Methicillin-resistant Staphylococcus aureus
Vancomycin-resistant Enterococcus
Multidrug-resistant Organism
Extensively Drug-resistant
Pandrug-resistant
Horizontal Gene Transfer
Conjugation
Transformation
Transduction
Plasmid
Integron
Biofilm
Quorum Sensing
Efflux Pump
Porin
Cell Wall
Peptidoglycan
Lipopolysaccharide
Teichoic Acid
Capsule
Flagellum
Pilus
Fimbria
Spore
Endospore
Vegetative Cell
Gram-positive
Gram-negative
Acid-fast
Mycobacterium
Tuberculosis
Leprosy
Nontuberculous Mycobacteria
Actinomycete
Streptomycete
Nocardia
Rickettsia
Chlamydia
Mycoplasma
Ureaplasma
Spirochete
Treponema
Borrelia
Leptospira
Campylobacter
Helicobacter
Vibrio
Cholera
Escherichia coli
Shiga Toxin
Salmonella
Shigella
Yersinia
Plague
Pseudomonas
Burkholderia
Legionella
Neisseria
Meningococcus
Gonococcus
Haemophilus
Bordetella
Pertussis
Staphylococcus
Streptococcus
Group A Streptococcus
Group B Streptococcus
Pneumococcus
Enterococcus
Clostridium
Botulism
Tetanus
Gas Gangrene
Clostridioides difficile
Bacillus
Anthrax
Listeria
Corynebacterium
Diphtheria
Actinomyces
Nocardia
Mycobacterium
Tuberculosis
Leprosy
Nontuberculous Mycobacteria
Fungus
Yeast
Mold
Dimorphic Fungus
Candida
Aspergillus
Cryptococcus
Pneumocystis
Histoplasma
Blastomyces
Coccidioides
Sporothrix
Mucormycosis
Dermatophyte
Tinea
Ringworm
Athlete's Foot
Jock Itch
Onychomycosis
Thrush
Vaginal Candidiasis
Invasive Candidiasis
Aspergillosis
Cryptococcosis
Pneumocystis Pneumonia
Histoplasmosis
Blastomycosis
Coccidioidomycosis
Sporotrichosis
Mucormycosis
Parasite
Protozoa
Helminth
Ectoparasite
Endoparasite
Malaria
Plasmodium
Anopheles
Mosquito
Vector
Reservoir
Host
Definitive Host
Intermediate Host
Paratenic Host
Life Cycle
Sporozoite
Merozoite
Gametocyte
Oocyst
Schizont
Trophozoite
Cyst
Amoeba
Entamoeba histolytica
Amebiasis
Giardia
Giardiasis
Cryptosporidium
Cryptosporidiosis
Toxoplasma
Toxoplasmosis
Trypanosoma
Chagas Disease
Triatomine
Kissing Bug
Leishmania
Leishmaniasis
Sandfly
Trypanosoma brucei
African Trypanosomiasis
Tsetse Fly
Sleeping Sickness
Trichomonas
Trichomoniasis
Babesia
Babesiosis
Tick
Ixodes
Lyme Disease
Borrelia burgdorferi
Anaplasmosis
Ehrlichiosis
Rocky Mountain Spotted Fever
Tularemia
Relapsing Fever
Tick-borne Encephalitis
Powassan Virus
Colorado Tick Fever
Babesiosis
Flea
Plague
Yersinia pestis
Typhus
Rickettsia typhi
Rickettsia prowazekii
Louse
Louse-borne Relapsing Fever
Trench Fever
Bartonella quintana
Mite
Scabies
Sarcoptes scabiei
Chigger
Trombiculidae
Scrub Typhus
Orientia tsutsugamushi
Fly
Blackfly
Onchocerca volvulus
Onchocerciasis
River Blindness
Loiasis
Loa loa
Mansonella
Filariasis
Lymphatic Filariasis
Wuchereria bancrofti
Brugia malayi
Elephantiasis
Dracunculiasis
Guinea Worm
Schistosomiasis
Schistosoma
Snail
Intermediate Host
Cercaria
Miracidium
Schistosomiasis japonica
Schistosomiasis mansoni
Schistosomiasis haematobium
Clonorchiasis
Clonorchis sinensis
Opisthorchiasis
Opisthorchis viverrini
Fasciolopsiasis
Fasciolopsis buski
Fascioliasis
Fasciola hepatica
Paragonimiasis
Paragonimus
Crab
Crayfish
Intestinal Flukes
Trematode
Cestode
Taeniasis
Taenia saginata
Taenia solium
Cysticercosis
Neurocysticercosis
Echinococcosis
Echinococcus granulosus
Hydatid Cyst
Alveolar Echinococcosis
Echinococcus multilocularis
Diphyllobothriasis
Diphyllobothrium latum
Hymenolepiasis
Hymenolepis nana
Dipylidium caninum
Flea-borne Tapeworm
Intestinal Tapeworm
Nematode
Ascariasis
Ascaris lumbricoides
Trichuriasis
Trichuris trichiura
Whipworm
Enterobiasis
Enterobius vermicularis
Pinworm
Hookworm
Ancylostoma duodenale
Necator americanus
Strongyloidiasis
Strongyloides stercoralis
Trichinosis
Trichinella spiralis
Trichinella britovi
Trichinella nativa
Trichinella nelsoni
Trichinella pseudospiralis
Trichinella murrelli
Trichinella zimbabwensis
Trichinella papuae
Trichinella chanchalensis
Trichinella sp. T6
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